

External influences on complementary feeding practices of caregivers of Native Hawaiian, Other  
Pacific Islander and/or Filipino infants residing on O‘ahu, Hawai‘i.

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## **Abstract**

The overall goal of this dissertation was to examine the complementary feeding practices and behaviors of caregivers of Native Hawaiian, Other Pacific Islander and Filipino infants residing on the island of O‘ahu. This knowledge is important in addressing childhood health and infant nutrition particularly in the Native Hawaiian, Other Pacific Islander and Filipino populations as they are under-researched and under-represented in the public health literature despite their health disparities. Prior to the “Exploring First Foods of Keiki on O‘ahu, Hawai‘i” pilot project which collected data from 2018 – 2019, the last publication on complementary feeding practices in Hawai‘i was published in 1995, in which a large proportion of mothers in Hawai‘i were observed to not meet the timing recommendation for the introduction of complementary foods. In the decades between the 1995 publication and the data collected in 2018 – 2019 for the pilot project, childhood obesity has increased in the Native Hawaiian, Other Pacific Islander and Filipino populations in Hawai‘i. Thus, the aim of this dissertation was to fill the knowledge gap by investigating the influences shaping the complementary feeding practices of caregivers of these infants.

Chapter one provides background on childhood obesity, infant diet and influences on complementary feeding. Chapter two presents findings from a review of the literature on health behavior theories used to explore reasons why caregiver complementary feed the way they choose too. Studies reviewed included nine observational epidemiological studies that included cohort and cross-sectional study designs; and three intervention studies. Health behavior theories from the individual (Theory of Planned Behavior, Stages of Change), interpersonal (Social Cognitive Theory, Culture Care Theory) and community (Social Ecological) suggest multiple constructs shape behavior, presenting potentially modifiable behavioral factors that influence complementary feeding decisions. A secondary analysis of data from a community-oriented pilot project was conducted for chapters three and four. Chapter three presents findings from interviews with caregivers of Native Hawaiian, Other Pacific Islander and Filipino infants, exploring the support caregivers perceive from their family, friends and within their community for their complementary feeding practices. This study found caregivers perceive support regardless of their feeding decisions. Chapter four presents findings from the same database to explore the association between caregiver’s cultural identity, the infant’s household membership, and diet quality; this study found no significant relationships among these variables.

Results from these three studies suggest caregiver complementary feeding practices and behaviors are influenced by many factors including the caregivers' social relationships, cultural and physical environments, socio-economic and nutritional status of the caregivers. However, measuring the effects of these is complicated by the inconsistent health messaging caregivers received. This provides an opportunity for future research and health promotion efforts to increase the nutritional health of infants. Prevention is a recommended strategy for addressing adverse health conditions. Improving complementary feeding practices is one strategy to promote the nutrition and well-being of an individual in the first 1000 days of life.

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## Chapter 1: Introduction

### **Infant nutrition**

Infant nutrition refers to providing infants with the essential nutrients to assure their proper and optimal growth, development and functioning. Nutrition during the first 1,000 days of life begins with the initial mode of feeding through to nearly the complete weaning of the infant.<sup>1</sup> Sound nutritional practices during these initial periods are paramount to establishing healthy nutritional behaviors leading to healthy outcomes later in life.<sup>2</sup> In a similar but opposing manner, unhealthy feeding/eating practices established during infancy and childhood may lead to increased risk for adverse health conditions including obesity. Thus, nutrition early in the lifespan assists in setting the health trajectory of an individual.<sup>3</sup>

### **Complementary feeding practices**

Complementary feeding is the stage in infant feeding when infants are transitioning from consuming only human milk and/or infant formula to consuming other foods and beverages in addition.<sup>4</sup> Complementary (i.e. first) foods complement the infant's diet of human milk and/or infant formula to meet the nutritional needs of the growing infant. Complementary feeding practices include the timing, type and diversity of complementary foods.<sup>5</sup> The Centers for Disease Control and Prevention (CDC) and the American Academy of Pediatrics (AAP) recommends solid foods be introduced at approximately 6 months.<sup>6,7</sup> Prior to this age, the recommendation is to exclusively feed the infant human milk with reasons for this including concerns of exposing infants to water and foodborne illnesses with the introduction of solid foods.<sup>8,9</sup>

Complementary feeding is an important health event and contributes to shaping long-term eating behaviors. Thus if unhealthy behaviors take hold, the likelihood of adverse health conditions are significant.<sup>2</sup> According to the Centers for Disease Control and Prevention (CDC), early introduction to food prevents infants from being exclusively breastfed during the first 6 months of life.<sup>10</sup> Effects of this include, among others, increased likelihood of gastrointestinal infections for the infant and slower maternal weight loss after birth for the mother.<sup>11</sup> Moreover, early introduction to complementary foods (e.g. <4 months) increases the risk for overweight and obesity later in life.<sup>11</sup> How parents decide to meet the nutritional needs of their infants starting at

birth and continuing for the first 1,000 days postpartum profoundly impacts the infants nutrition and long-term health.<sup>12-16</sup> This is highlighted by data showing the most commonly consumed first food of infants in the US is a sugar sweetened beverage.<sup>17</sup> Literature suggests when complementary foods are introduced reflects the culture, environment, and socio-economic and nutritional status of caregiver.<sup>18</sup> Complementary feeding practices present a significant disease prevention and health promotion stage especially for populations who suffer disproportionately from chronic disease and obesity in comparison to other ethnic groups.<sup>5,19</sup>

### **The importance of infant nutrition**

The importance of nutrition is seen in its influence on an individual's health. The CDC reports nearly 14% of children, ages 2 – 5 years old, are obese.<sup>20</sup> Childhood obesity highlights the importance of nutrition. Nutrition deals with the intakes of energy and nutrients and their bioavailability, along with the metabolism and growth of an individual. The first few months after birth are a critical time of rapid growth of the infant, with much of the growth directed by the nutrition of the infant. Research suggests a “growth acceleration” event occurs during this timeframe, which sets in place the metabolic programming of the individual, which could ultimately shape his or hers susceptibility to obesity later in life.<sup>13,19,21</sup> Children, predominantly of Native Hawaiian and Other Pacific Islander (NHPI) and Filipino descent, who had experienced rapid growth between 12 – 23 months were at the highest risk for child obesity at 4–5 years old compared to children who did not experience rapid growth during the same interval.<sup>22</sup> The nutrient intakes of infants and children largely influences their rapid weight gain (i.e. energy-dense foods and high caloric intakes increase weight gain). Thus, how and why caregivers decide to feed their infants complementary food is critical in combating childhood obesity. Childhood obesity is a public health concern, especially given its association with problems later in life such as overweight, obesity, and comorbidities such as high blood pressure and diabetes. In the Pacific region, the prevalence of obesity and type 2 diabetes in adults is among the highest in the world.<sup>23</sup> NHPI were found to be 3.32 times more likely to die from diabetes compared to the general population in Hawai‘i.<sup>24</sup>

Obesity prevention is a multifaceted strategy beginning with the early stages of nutrient consumption. Given the influence of complementary feeding practices on forming life-long

eating habits, infant nutrition is important as it plays a role in preventing nutrition-related diseases. Infants are limited in their dietary options. The lack of autonomy in infants choosing their diets shifts the focus to their caregivers, as those determining food selection and feeding. This places caregivers in positions of influence over their infant's nutrition.<sup>25</sup>

### **Factors that influence infant nutrition: nutrition transition**

A key factor in obesogenic environments is nutrition transition. Nutritional transition is the shift in dietary consumption and energy expenditure as it relates to the broader world and its events during a specified timeframe.<sup>26</sup> Diets across the world have become increasingly energy-dense (e.g. higher intakes of animal fat) and processed (e.g. replacement of higher-fiber foods with processed versions of them) in light of changes to the socioeconomic and demographic profiles of populations.<sup>25</sup> In higher-income countries (e.g. US, United Kingdom, Australia) portion sizes, eating out/away-from-home, snacking and drinking sweetened beverages have increased. Moreover, the increase use of modern technologies in the workplace, at home and in the community (i.e. transportation, shopping areas) have fostered major shifts in physical activity.<sup>24</sup> These dietary and physical shifts have affected people's health.<sup>25,26</sup> Primary prevention strategies stand to benefit from taking into consideration nutrition transition and its effect on health.<sup>27</sup>

Nutrition transition has been observed in the First Nations of Northern Ontario. This people group traditionally harvested and prepared local foods that provided health benefits and strengthened their cultural identity and lifeways.<sup>28</sup> As Western food types and eating habits became more prominent, traditional foods and their role in the culture, identity and lives of its people, were undermined.<sup>28</sup> This was also observed among other indigenous people groups in North America who have come to view their traditional foods and food systems as heavily influenced by colonization.<sup>29</sup> It is important to recognize nutrition transition among ethnic groups undergoing environmental changes as they adapt to new living conditions and cultures.<sup>30</sup> When tailoring nutritional interventions and preventative strategies to such populations, there needs to be incorporation, in an appropriate and respectful way, of cultural factors into the design and execution of such activities, to strengthen efforts.<sup>29,31</sup>

### **Factors that influence infant nutrition: caregiver cultural identity and traditional foods**

The reliance of infants on their caregivers underpins the need to understand caregiver behaviors and practices.<sup>32-34</sup> Cultural identity and lifeways guide dietary behaviors.<sup>35</sup> Indigenous peoples primarily consumed a broad range of plant and animal species from their local and natural environment through their traditional food systems.<sup>36</sup> However, these traditional systems have changed with the colonization of ancestral lands of indigenous people. A variety of eating behaviors and food availabilities have become normalized.<sup>26</sup>

There are many attributes of traditional foods. They serve as a physical anchor for people to maintain their cultural norms and expectations, and as a spiritual anchor connecting people to their ancestors and their land.<sup>28</sup> The traditional Native Hawaiian food poi (mashed taro root), for example, is a nutrient dense food with prebiotic and probiotic properties.<sup>37</sup> A caregiver's decision to feed a traditional food (e.g., poi) to an infant may be influenced by the culture of the caregiver.<sup>5,35</sup> Critical to the efforts to improve dietary practices and health outcomes, is understanding the culture of the caregiver who shape an infant's nutrition.

In Hawai'i, numerous cultures have gathered over time allowing studies to investigate ethnicity as it relates to childhood health. Research found the body size of NHPI children was larger compared to children from other race or ethnic groups.<sup>38,39</sup> Other research found the timing of complementary feeding practices differed among infants identified as White, Japanese, Filipino and Native Hawaiian, with Native Hawaiian infants being fed complementary foods near to 4 months.<sup>40</sup> Literature suggests cultural aspects contribute to disparities in childhood obesity since infant feeding practices are influenced by culture, and culture differs by race or ethnic groups.<sup>34,41</sup> However, research by Kim and colleagues in Hawai'i observed ethnicity was not the strongest influence on dietary patterns which was partially explained by the unique multicultural environment Hawai'i and the diverse mixed ancestry background of the research participants. Kim et al. further suggest genetic susceptibility and socioeconomic and lifestyle factors hold strong influence on dietary patterns.<sup>42</sup> Dietary behaviors are affected by the complex interactions of a large number of factors at different levels.

Literature on the traditional Native Hawaiian practices of complementary feeding gives context to the cultural feeding practices among Native Hawaiians. These early traditions may still exert an influence on modern day practices and might explain observed complementary feeding behaviors of this population. Writings by the late Native Hawaiian authority Mary Kawena Pukui (1895 – 1986), who was taught medicinal and midwifery traditions, revealed traditional Native Hawaiian infant feeding practices included feeding solid foods near 4 months.<sup>43</sup> In Pukui's book, *The Polynesian Family System in Ka-ʻu, Hawaiʻi* published in 1958, she wrote infants were usually orally fed soft foods such as mashed cooked sweet potato thinned with water at 4 months of age. Thicker foods such as poi was fed near 6 months.<sup>43</sup>

Similar to Pukui, the first edition of the *Pediatric Nutrition Handbook* published in 1980 stated that typically at or around 4 months of age, the infant will display indicators for its readiness to consume solid foods. Indicators such as neuromuscular development and activity level will dictate the consistency of the food.<sup>44</sup> Pukui's account of infant feeding behaviors of early Native Hawaiians, nearly 20 years prior, attests to the intuitive knowledge this culture possessed, evidenced by their belief that infant development was associated with nutrition and health.<sup>43</sup> Moreover, the similarity between Native Hawaiian feeding traditions and modern-day feeding recommendations, reveals a similar understanding about infant development and appropriate infant nutrition. Pukui describes the early Native Hawaiians as observant, “natural scientists in their knowledge of the natural history and the human species of their land and race.”<sup>43</sup> This is evident in the logical nature of their indigenous traditional therapies.

Traditional infant feeding practices of Native Hawaiians, Other Pacific Islanders and Filipino are important given the current risk these populations are at for obesity, diabetes and other metabolic diseases, many of which can be avoided through prevention.<sup>5,35,45,46</sup> Prevention of childhood obesity begins with understanding the factors contributing to the behaviors of caregivers. Studies done in Hawaiʻi revealed the social and physical environments surrounding infants yields a comprehensive view of the complementary feeding practices in play.<sup>22</sup> Higgins research on the culture care theory among Puerto Rican families with infants emphasized the significance of social norms much of which are perpetuated by older generations of family members like grandmothers, aunts and older sisters.<sup>34</sup> The traditional Native Hawaiian feeding practice of

introducing food beginning at approximately 4 months of age when the infant displays developmental readiness cues, yields insight to why this feeding behavior is common among modern-day Native Hawaiians.<sup>5,35,40</sup> Feeding semi-solid and solid foods near 4 months of age is seen elsewhere among the people groups in the Pacific. In the country of Samoa, Hawley and colleagues observed infants were commonly fed complementary foods by 4 months.<sup>23</sup> In the metropolitan area of Cebu in the Philippines, data collected in 2011 showed 82% of infants in this area were fed complementary foods before 6 months, with the average age being 4 months.<sup>47</sup> In the Marshall Islands, complementary food introduction were seen as early as 2 months.<sup>48</sup> Similar to Higgins' suggestion, what these findings imply is new approaches and programmatic efforts need to include extended family. Family and the social environments they create are critical in understanding the cultural ideology underlying complementary infant feeding practices. Furthermore, caregivers recognize and honor their ancestral knowledge and traditions through their feeding behaviors.<sup>34</sup>

### **Measures of cultural identity**

Nutrient intake, nutritional knowledge, and language are lifestyle factors associated with nutrition, and are influenced by the exposure to and exchanges and practices of cultures.<sup>49-51</sup> Changes in behaviors are evident in the adoptions of dietary habits and physical activity.<sup>52</sup> What this leads to is the importance of an individual's (e.g. caregiver) cultural environment, and the attitudes and beliefs surrounding the cultural identify. Understanding this will result in a comprehensive understanding of health behaviors and reasons for them (e.g. how do people eat and why they eat like that).

The Kohala Health Research Project (KHRP) designed an 8-item cultural identity and affiliation scale to assess the acculturation modes of Native Hawaiians.<sup>53</sup> Modes of acculturation were determined by the combined score of two subscales: a 4-item ethnic cultural identity subscale and a 4-item US cultural identity subscale. Each subscale asked the caregivers about their degree of identity with involvement in, feelings toward, and knowledge about each cultural group, and the impact each cultural group has on their lifestyle. Responses to each item were reversed scored, so that 1 corresponded to very knowledgeable, very positive, or very involved and 5 corresponded to not knowledgeable at all, very negative, or disinterested. The range of a total

possible scores was from 5 to 25, with lower scores indicating a stronger identity.<sup>50,53</sup> These scales were validated in studies examining the degree of Native Hawaiian cultural and US, Mainland mainstream cultural identification.<sup>50,53</sup>

These scales also help explain the cultural environment people are experiencing, which in turn can help achieve a comprehensive understanding of health behaviors and reasons for them.<sup>35</sup> This is critical for understanding how people eat and why. With good nutrition during the first years of life being vital for healthy growth and development, it is important to study influences shaping an individual's eating habits. Investigating caregiver's cultural identity and their relationship with infant nutrient intakes will clarify the health and lifestyle behaviors and decisions taking place in during this period of the lifespan.

### **Factors that influence infant nutrition: household environment**

To understand the complementary infant feeding practices taking place, there is a need to understand the caregivers and the environment that surrounds them and their infants.<sup>54-56</sup> Possible determinants of eating behaviors include social environments such as household environments. The US Census Bureau found that 8% of households with a multiracial householder were multi-generational.<sup>57</sup> These households consisted of three or more generations.<sup>58</sup> Nearly 30% of Filipino households, and 20% of Native Hawaiian and Other Pacific Islander households consisted of two or more adult generations in contrast to 3.7% of non-Hispanic White households and 9% of Black and Asian households.<sup>57,58</sup>

The Consumer Expenditure Survey found multigenerational households spend less on childcare as older generations provide this service.<sup>59</sup> Grandparents provide an adaptive strategy for low-income or single parent households by offsetting living costs, which allows more resources to be invested in the children.<sup>60</sup> The practice and perpetuation of culture (e.g. securing and preparing cultural foods) are supported in a living arrangement where multiple persons with knowledge of cultural traditions and who practice these customs, reside nearby.<sup>25</sup>

Grandparents provide a protective measure against adverse health conditions in grandchildren.<sup>61</sup> Among Pacific Islanders, the family is central in providing support and advice regarding infant

care.<sup>62-64</sup> Grandmothers have been found to hold great influence in childcare decisions including infant feeding.<sup>65</sup> However, maternal grandmothers of low-income African-American adolescent mothers were found to facilitate early complementary food introductions, as early as 1 – 2 weeks old.<sup>33,41</sup> Also in the African-American community, non-maternal caregivers such as grandmothers, fathers and licensed childcare providers had a negative effect on appropriate feeding practices.<sup>66</sup>

The definition of family according to Bengtson's encompasses relationships across generations.<sup>67</sup> Bengtson writes intergenerational relationships are diverse in structure and functions, with certain relationships being valuable resources for families.<sup>67</sup> One such valuable intergenerational relationship is with grandparents. Grandparents may potentially have an important part in family life by providing financial, emotional and practical care as well as support to their children and grandchildren.<sup>68</sup> Diaries and in-depth interviews from people living in multigenerational households in the cities of Sydney and Brisbane revealed the benefits of such a living arrangements were companionship, support and increased likelihood of daily conversations supporting the exchange of knowledge and perspectives.<sup>25,60</sup>

Although there are clear advantages for multigenerational family housing where the grandparents provide support rather than are in need of support, these types of living arrangements are also associated with socio-economic disadvantage and lack of personal privacy and control.<sup>33</sup> A cross-sectional study of Aboriginal infants and children from remote communities in northern Australia observed children living in households with 3 – 5 people were more likely to meet the World Health Organization(WHO)/ United Nations Children's Fund (UNICEF) minimum meal frequency criteria compared to children living in households with 6 – 31 people.<sup>69</sup> However, this study did not investigate the relationship between children and household members.<sup>69</sup> The tethering of housing and family into a single cohesive unit hides that family is comprised of individuals with different roles and degrees of control, who are interacting with one another on different levels and within different contexts.<sup>70</sup> Furthermore, literature makes it clear there are inherent differences between multigenerational households and skipped-generational households where a grandchild lives with a grandparent(s) without the biological parent(s) present.<sup>71</sup>



Complementary feeding practices often reflect the sociocultural settings, socioeconomic factors, social pressures, and availability of convenient alternatives.<sup>18</sup> The degree to which caregivers' complementary feeding behaviors can be influenced, emphasizes the impact of additional supports (e.g. support from others and places).<sup>12,72-74</sup> For example, the internet provides support by giving parents information and access to educational resources on complementary feeding.<sup>75</sup> Family provides support by giving tangible resources such as financial assistance.<sup>75</sup> This can be seen in the support grandparents give when they informally care for their grandchildren from which they influence the food and eating environments of these children.<sup>25</sup>

Complementary feeding practices are also influenced by non-maternal caregivers such the infant's father and grandparents, babysitters, nannies and licensed childcare providers.<sup>33,66,76</sup> Typically, these non-maternal caregivers care for the infant in place of the mother thus contributing to the infant's exposure to foods and beverages. Through the identifying of supports for and influences on complementary feeding practices, crucial information can be revealed to help improve childhood nutrition, especially in unique populations like NHPI and Filipinos who are underrepresented in research.

Prevention of childhood obesity begins with knowing what contributes to the feeding behaviors of caregivers.<sup>76</sup> Thus, prevention must aim to improve complementary feeding practices to be healthier and culturally appropriate, so it may resonate with caregivers. These efforts will enhance public health efforts to reduce the health disparities experienced by populations burdened with poor social determinants (e.g. NHPI and Filipino).<sup>5,35</sup>

### **Dietary quality and guidelines**

Diet quality is crucial in relating complementary infant feeding practices to infant health and nutritional status.<sup>77,78</sup> The quality of the diet and the quantity of foods consumed are nutritional contributors to diet-related illnesses, such as obesity and diabetes.<sup>79</sup> Diet quality contributing to the risk of becoming obese among older individuals can be seen in the associations between low intakes of nutrient-dense foods, high intakes of energy-dense foods, and indicators of body size.<sup>15</sup> Among infants, dietary diversity is an indicator of the quality of the diet. Diet diversity is a proxy measure of the nutrient density of the foods and liquids consumed.<sup>80</sup> A diverse diet is

associated with a better quality diet and can predict the micronutrient density among infants.<sup>9</sup> In need of mentioning is the relationship between infant age and diet diversity. When following complementary feeding guidelines, diet diversity is positively associated with infant age after 4 months. Before 4 months, diet diversity is negatively associated as complementary feeding is not recommended at this age.<sup>8,9</sup> Therefore, diet diversity should be adjusted for age (in days, weeks or months) as diet diversity is recommended to increase from 4 – 6 months of age. Observations of infant diets in the United States (US) found from 4 – 12 months of age diversity is low, with sugar-sweetened beverages commonly consumed as the first food, and there being a low consumption of fruits and vegetables.<sup>5,17</sup>

The 2020-2025 US Dietary Guidelines Advisory Committee created guidelines for infants, age 0 to 23 months, as well as for pregnant and lactating women.<sup>81</sup> The World Health Organization (WHO) also has guidelines to measure dietary healthfulness of the infant.<sup>9,82</sup> In 2008, the WHO published simple, valid and reliable indicators for assessing infant and young child feeding practices that can be used in population-based surveys.<sup>9</sup> The WHO dietary diversity indicator categorizes all foods consumed into seven food groups. Consuming at least four food groups in a day means the infant has a high likelihood of consuming at least one animal-source food and at least one fruit or vegetable food that day, as well as a staple food such as grains or tubers.<sup>24</sup> The 2008 WHO dietary diversity indicator did not categorize human milk into one of the seven food groups. This indicator is intended to reflect the quality of the complementary food diet in a human milk fed population. The WHO acknowledged the consequence of this exclusion in the indicator, in that it may show more diverse diets of infants not fed human milk compared to those that are fed human milk, in populations where formula and/or milk are commonly given to non-human milk fed children. In 2017, WHO revised their IYCFP guidelines.<sup>82</sup> The dietary diversity indicator now uses eight food groups, with the eighth group being human milk. Consuming five or more of the food groups indicates the infant has a better quality diet and is likely receiving adequate nutrients. The WHO indicators can be used when there is no available dietary nutrient analyses and/or appropriate nutrient database.<sup>9,82</sup>

## **“Exploring First Foods of Keiki on O‘ahu, Hawai‘i” pilot project: data source for dissertation**

Unhealthy long-term eating patterns, resulting in a multitude of negative consequences and sequelae, often originate during childhood with unhealthy feeding practices.<sup>21,83,84</sup> Important characteristics of such infant feeding practices include the timing and type of complementary food introduction, both of which effect the foundations of nutritional status and health.<sup>4</sup> By identifying influences on dietary behaviors, public health programs can address infant nutrition and the prevalence of childhood obesity.

In 1995, Goldberg and colleagues suggested the rationales that govern Pacific Islander caregiver practices might not be apparent solely from quantifiable infant dietary data, thus sounding the call for the inclusion of qualitative inquiry.<sup>40</sup> From 2018 – 2019, the “Exploring First Foods of Keiki on O‘ahu, Hawai‘i” pilot project collected data aimed at addressing the gap in research by exploring the reasons for the observed infant feeding practices in Hawai‘i among indigenous and minority ethnic groups. Prior to 2018, when the “Exploring First Foods of Keiki on O‘ahu, Hawai‘i” pilot project started collecting data, the last comprehensive assessment of complementary food for infants in Hawai‘i was published by Goldberg and colleagues in 1995.<sup>54</sup> Since then the prevalence of childhood obesity has increased, specifically among the NHPI and Filipino populations.<sup>22,38,39,46</sup> The gap in literature indicates the need for data on complementary feeding practices and caregiver behaviors.

This pilot project aimed to assess then-current caregiver complementary feeding practices and infant dietary data in Hawai‘i from data collected from 2018 – 2019.<sup>5</sup> This pilot project also aimed to collect data on the social-ecological environments of caregivers and infants with the intent to inform programmatic efforts desiring to be culturally relevant to improve their efficacy. The data collected from 2018 – 2019 by the “Exploring First Foods of Keiki on O‘ahu, Hawai‘i” pilot project was used in this dissertation. Jessie Kai, author of this dissertation, was the graduate student research assistant for the pilot project tasked with collecting both the quantitative and qualitative data analyzed in this dissertation.

The “Exploring First Foods of Keiki on O‘ahu, Hawai‘i” pilot project was an observational, cross-sectional study conducted from March 2018 to February 2019. Eligible infants had to be between the ages of 3 – 12 months, consuming complementary foods in addition to human milk and/or infant formula at time of enrollment, residing on O‘ahu, and identified with at least one of the following races or ethnic groups--Native Hawaiian, Other Pacific Islander and/or Filipino--were included.<sup>5,40</sup> The aforementioned eligibility criteria of the pilot project were informed by previous research.<sup>5,40</sup> Caregiver eligibility criteria included being  $\geq 18$  years of age, an owner of an iOS mobile device, primarily responsible for caring for the participant, willing to participant for the entirety of the four-day dietary collection period, and physically able to attend the follow-up visit. A convenience sampling approach recruited participants throughout O‘ahu. Equal representation of initial mode of feeding (i.e. “only ever fed human milk” and “not only fed human milk”) was set only for the qualitative portion of the study. The project received exemption from the University of Hawai‘i Institutional Review Board (2017-00845).

The Technology Assisted Dietary Assessment (TADA) system is a mobile food record smartphone application.<sup>85</sup> The TADA system is an innovative approach for collecting dietary intake data among individuals across the lifespan.<sup>86,87</sup> Caregivers recorded all infant eating occasions over four consecutive days (Thursday – Sunday). Immediately following the 4-day data collection period, researchers reviewed the records submitted and clarified any questions with participants.

In-depth, qualitative interviews with consenting caregivers were collected following the dietary data collection period. The guiding questions for these interviews were adapted from the Nā Mo‘olelo o Ko Kākou Kupuna study.<sup>45</sup> Interview questions asked to the caregivers included: Where did you grow up? What did you eat growing up? What foods are healthy for babies? Who do you go to for advice about feeding your baby? What are your earliest recollections about how babies were fed in your family? All interviews were audio recorded with permission from the caregivers and transcribed into text for thematic analysis.

### **Purpose of the dissertation**

The purpose of this dissertation is to examine the relationships among external influences on the complementary feeding practices and diet healthfulness of NHPI and/or Filipino infants 3 - 12

months of age residing on O‘ahu. This dissertation is a secondary analysis of data collected in the “Exploring First Foods of Keiki on O‘ahu, Hawai‘i” pilot project. The following chapters of this dissertation focused on the health behavior theories surrounding caregivers’ complementary feeding behaviors; caregivers’ perception of support from their family, friends and within the community for their infant complementary feeding practices; and the association between caregivers’ cultural identity, infants’ household membership, and infant dietary healthfulness.

The three research questions addressed by this dissertation were:

1. What health behavior theories explain the complementary feeding behaviors of caregivers?

Hypothesis: Health behavior theories of the different socioecological levels will help to explain caregiver complementary feeding behaviors, and the various constructs of the theories will help to further understand the influences on behavior.

2. How does the perception of support from family, friends, and within the community for complementary feeding practices differ between caregivers of NHPIF infants who engaged in different complementary feeding practices?

Hypothesis: Caregiver perception of support will differ between caregivers engaged in different complementary feeding practices.

3. What is the association between the cultural identity of the caregiver, the infant’s household membership categories (parent(s) only or with sibling(s) vs. extended family members), and the dietary quality of the infant?

Hypothesis: The strength of the caregiver’s cultural identity, and the households comprised of extended family members (e.g. maternal and paternal grandparents, aunts, uncles, cousins), will be associated with better quality diets of the infants.

Similarly to the “Exploring First Foods of Keiki” pilot project, which provided the data examined in this dissertation, a mixed methods approach was applied to study the nutrition of NHPI and Filipino infants. This dissertation presents a qualitative exploration of caregivers’ perception of support for how they decide to feed their infants. It will also examine the

relationship between caregiver cultural identity and infant household membership categories and the healthfulness of the infant's diet.

An important contribution of this dissertation to the literature on complementary feeding practices is the inclusion of NHPI and Filipino infants, which are under-represented and researched in public health.<sup>24,88</sup> Moreover, the focus of this dissertation on Hawai'i and its unique cultural environment provides further information for community specific recommendations.

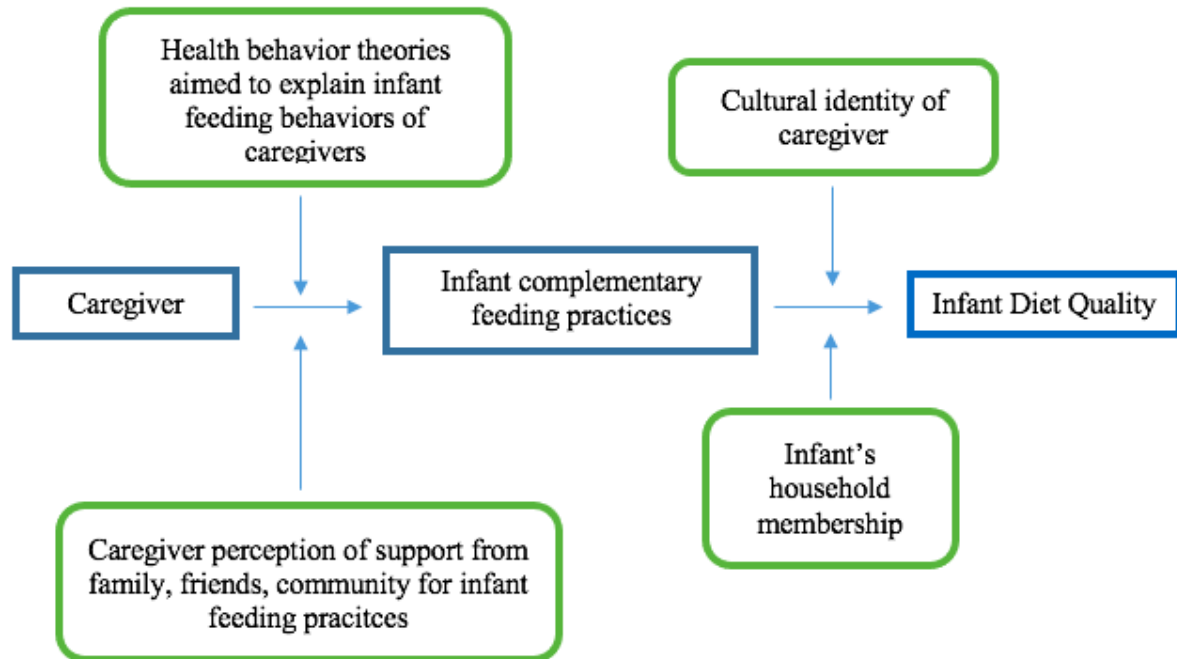
### **Dissertation conceptual framework**

The conceptual framework guiding this dissertation is in Figure 1. This dissertation investigates the effect of potential moderators of the feeding relationship between the caregiver and infant. The cultural identity and household membership moderators are hypothesized to exert their influence on the diet quality of the infant. Caregivers perceived support moderates the relationship between the caregiver and their chosen complementary feeding practices. The health behavior theories are hypothesized to moderate caregivers feeding behaviors.

The literature review of this dissertation gathers the research done on health behavior theories to illustrate their ability to comprehensively explain caregivers complementary feeding behavior. The qualitative research study of this dissertation explores the support from family, friends and the community as perceived by a caregiver for his/her infant complementary feeding practices providing a deeper understanding of the role support systems have on the caregiver's infant feeding practices. The quantitative research study of this dissertation investigates the association between cultural identity of the caregiver and the household membership of the infant's home, and infant dietary quality.

### **Figure 1: Dissertation Conceptual Framework**

Conceptual framework of the dissertation research aims as they relate caregiver complementary feeding practices to infant diet quality.



## References

1. Cusick S, Georgieff MK. The First 1,000 Days of Life: The Brain's Window of Opportunity. UNICEF; 2013. <https://www.unicef-irc.org/article/958-the-first-1000-days-of-life-the-brains-window-of-opportunity.html>
2. Pietrobelli A, Agosti M, the MeNu Group. Nutrition in the First 1000 Days: Ten Practices to Minimize Obesity Emerging from Published Science. IJERPH. 2017;14(12):1491. doi:10.3390/ijerph14121491
3. Taveras EM, Perkins ME, Boudreau AA, et al. Twelve-Month Outcomes of the First 1000 Days Program on Infant Weight Status. Pediatrics. 2021;148(2):e2020046706. doi:10.1542/peds.2020-046706
4. Fewtrell M, Bronsky J, Campoy C, et al. Complementary Feeding: A Position Paper by the European Society for Paediatric Gastroenterology, Hepatology, and Nutrition (ESPGHAN) Committee on Nutrition. Journal of Pediatric Gastroenterology & Nutrition. 2017;64(1):119-132. doi:10.1097/MPG.0000000000001454
5. Fialkowski MK, Ng-Osorio J, Kai J, et al. Type, Timing, and Diversity of Complementary Foods Among Native Hawaiian, Pacific Islander, and Filipino Infants. Hawaii J Health Soc Welf. 2020;79(5 Suppl 1):127-134.
6. Infant Food and Feeding. Published online 2021. <https://www.aap.org/en-us/advocacy-and-policy/aap-health-initiatives/HALF-Implementation-Guide/Age-Specific-Content/Pages/Infant-Food-and-Feeding.aspx>

7. Breastfeeding: Frequently Asked Questions (FAQ). Centers for Disease Control and Prevention; 2021. Accessed February 24, 2022. <https://www.cdc.gov/breastfeeding/faq/index.htm#howlong>
8. World Health Organization. Global Nutrition Monitoring Framework: Operational Guidance for Tracking Progress in Meeting Targets for 2025. World Health Organization; 2017. Accessed November 4, 2021. <https://apps.who.int/iris/handle/10665/259904>
9. World Health Organization (WHO). Indicators for Assessing Infant and Young Child Feeding Practices: Conclusions of a Consensus Meeting Held 6-8 November 2007 in Washington D.C., USA. World Health Organization (WHO); 2008.
10. Childhood Obesity Causes & Consequences. Centers for Disease Control and Prevention; 2021. <https://www.cdc.gov/obesity/childhood/causes.html>
11. Chiang KV, Hamner HC, Li R, Perrine CG. Timing of Introduction of Complementary Foods — United States, 2016–2018. *MMWR Morb Mortal Wkly Rep.* 2020;69(47):1787-1791. doi:10.15585/mmwr.mm6947a4
12. Blair A, MacGregor E, Lee N. Childhood Obesity and Breastfeeding Rates in Pennsylvania Counties—Spatial Analysis of the Lactation Support Landscape. *Front Public Health.* 2020;8:123. doi:10.3389/fpubh.2020.00123
13. Young BE, Johnson SL, Krebs NF. Biological Determinants Linking Infant Weight Gain and Child Obesity: Current Knowledge and Future Directions. *Advances in Nutrition.* 2012;3(5):675-686. doi:10.3945/an.112.002238
14. Baird J, Fisher D, Lucas P, Kleijnen J, Roberts H, Law C. Being big or growing fast: systematic review of size and growth in infancy and later obesity. *BMJ.* 2005;331(7522):929. doi:10.1136/bmj.38586.411273.E0
15. Gillman MW. Early infancy – a critical period for development of obesity. *J Devel Orig Health Dis.* 2010;1(05):292-299. doi:10.1017/S2040174410000358
16. Thompson AL, Bentley ME. The critical period of infant feeding for the development of early disparities in obesity. *Social Science & Medicine.* 2013;97:288-296. doi:10.1016/j.socscimed.2012.12.007
17. Miles G, Siega-Riz AM. Trends in Food and Beverage Consumption Among Infants and Toddlers: 2005–2012. *Pediatrics.* 2017;139(6):e20163290. doi:10.1542/peds.2016-3290
18. Underwood BA, Hofvander Y. Appropriate timing for complementary feeding of the breast-fed infant. A review. *Acta Paediatr Scand Suppl.* 1982;294:1-32. doi:10.1111/j.1651-2227.1982.tb09578.x
19. Singhal A, Lanigan J. Breastfeeding, early growth and later obesity. *Obesity Reviews.* 2007;8(s1):51-54. doi:10.1111/j.1467-789X.2007.00318.x



20. Prevalence of Childhood Obesity in the United States. Centers for Disease Control and Prevention; 2021. <https://www.cdc.gov/obesity/data/childhood.html>
21. Singhal A, Lucas A. Early origins of cardiovascular disease: is there a unifying hypothesis? *The Lancet*. 2004;363(9421):1642-1645. doi:10.1016/S0140-6736(04)16210-7
22. Okihiro M, Davis J, White L, Derauf C. Rapid Growth from 12 to 23 Months of Life Predicts Obesity in a Population of Pacific Island Children. Published online 2013:11.
23. Hawley NL, McGarvey ST. Obesity and Diabetes in Pacific Islanders: the Current Burden and the Need for Urgent Action. *Curr Diab Rep*. 2015;15(5):29. doi:10.1007/s11892-015-0594-5
24. M A Look, S Soong, J K Kaholokula. Assessment and Priorities for Health and Well-Being in Native Hawaiians and Pacific Islanders. Published online 2020. doi:10.13140/RG.2.2.22162.89286
25. Aubel J. The role and influence of grandmothers on child nutrition: culturally designated advisors and caregivers: Grandmothers: nutrition advisors and caregivers. *Maternal & Child Nutrition*. 2012;8(1):19-35. doi:10.1111/j.1740-8709.2011.00333.x
26. Popkin BM. The Nutrition Transition and Obesity in the Developing World. *The Journal of Nutrition*. 2001;131(3):871S-873S. doi:10.1093/jn/131.3.871S
27. de Hoog ML, Kleinman KP, Gillman MW, Vrijkotte TG, van Eijsden M, Taveras EM. Racial/ethnic and immigrant differences in early childhood diet quality. *Public Health Nutr*. 2014;17(6):1308-1317. doi:10.1017/S1368980013001183
28. Haman F, Fontaine-Bisson B, Batal M, Imbeault P, Blais JM, Robidoux MA. Obesity and type 2 diabetes in Northern Canada's remote First Nations communities: the dietary dilemma. *Int J Obes*. 2010;34(S2):S24-S31. doi:10.1038/ijo.2010.236
29. Skinner K, Pratley E, Burnett K. Eating in the City: A Review of the Literature on Food Insecurity and Indigenous People Living in Urban Spaces. *Societies*. 2016;6(2):7. doi:10.3390/soc6020007
30. Popkin BM. Global nutrition dynamics: the world is shifting rapidly toward a diet linked with noncommunicable diseases1–3. Published online 2018:10.
31. Ho-Lastimososa I, Chung-Do JJ, Hwang PW, et al. Integrating Native Hawaiian tradition with the modern technology of aquaponics. *Glob Health Promot*. 2019;26(3\_suppl):87-92. doi:10.1177/1757975919831241
32. Hamilton K, Daniels L, White KM, Murray N, Walsh A. Predicting mothers' decisions to introduce complementary feeding at 6 months. An investigation using an extended theory of planned behaviour. *Appetite*. 2011;56(3):674-681. doi:10.1016/j.appet.2011.02.002

33. Bentley M, Gavin L, Black MM, Teti L. Infant feeding practices of low-income, African-American, adolescent mothers: an ecological, multigenerational perspective. *Social Science & Medicine*. 1999;49(8):1085-1100. doi:10.1016/S0277-9536(99)00198-7
34. Higgins B. Puerto Rican Cultural Beliefs: Influence on Infant Feeding Practices in Western New York. *J Transcult Nurs*. 2000;11(1):19-30. doi:10.1177/104365960001100105
35. Kai J, Chen JJ, Braun KL, et al. Associations between Cultural Identity, Household Membership and Diet Quality among Native Hawaiian, Pacific Islander, and Filipino Infants in Hawai'i. *Children*. 2022;9(1):48. doi:10.3390/children9010048
36. Kuhnlein HV, Receveur O. Dietary Change and Traditional Food Systems of Indigenous Peoples. *Annu Rev Nutr*. 1996;16(1):417-442. doi:10.1146/annurev.nu.16.070196.002221
37. Ibrahim SA, Song D. Poi History, Uses, and Role in Health. In: *Bioactive Foods in Promoting Health*. Elsevier; 2010:265-271. doi:10.1016/B978-0-12-374628-3.00018-9
38. Oshiro CES, Novotny R, Grove JS, Hurwitz EL. Race/Ethnic Differences in Birth Size, Infant Growth, and Body Mass Index at Age Five Years in Children in Hawaii. *Childhood Obesity*. 2015;11(6):683-690. doi:10.1089/chi.2015.0027
39. Teranishi K, Hayes DK, Iwaishi LK, Fuddy LJ. Poorer general health status in children is associated with being overweight or obese in Hawai'i: findings from the 2007 National Survey of Children's Health. *Hawaii Med J*. 2011;70(7 Suppl 1):16-20.
40. Goldberg DL, Novotny R, Kieffer E, Mor J, Thiele M. Complementary Feeding and Ethnicity of Infants in Hawaii. *Journal of the American Dietetic Association*. 1995;95(9):1029-1031. doi:10.1016/S0002-8223(95)00280-4
41. Black MM, Siegel EH, Abel Y, Bentley ME. Home and Videotape Intervention Delays Early Complementary Feeding Among Adolescent Mothers. *PEDIATRICS*. 2001;107(5):e67-e67. doi:10.1542/peds.107.5.e67
42. Kim HS, Park SY, Grandinetti A, Holck PS, Waslien C. Major dietary patterns, ethnicity, and prevalence of type 2 diabetes in rural Hawaii. *Nutrition*. 2008;24(11-12):1065-1072. doi:10.1016/j.nut.2008.05.008
43. Craighill Handy e, Pukui M. *The Polynesian Family System in Ka-'U, Hawai'i*. Tuttle Pub.; 1989. Accessed July 16, 2021. <https://public.ebookcentral.proquest.com/choice/publicfullrecord.aspx?p=868741>
44. Kleinman RE, Coletta FA. Historical Overview of Transitional Feeding Recommendations and Vegetable Feeding Practices for Infants and Young Children. *Nutrition Today*. 2016;51(1):7-13. doi:10.1097/NT.0000000000000137
45. Fialkowski MK, Fonseca-Smith T, Pinto P o EK, Ng-Osorio J. Native Hawaiian Complementary Feeding Practices as Told by Grandparents: A Transgenerational

- Experience. *Current Developments in Nutrition*. 2021;5(Supplement\_4):40-53.  
doi:10.1093/cdn/nzaa086
46. Novotny R, Li F, Fialkowski MK, et al. Prevalence of obesity and acanthosis nigricans among young children in the children's healthy living program in the United States Affiliated Pacific. *Medicine*. 2016;95(37):e4711. doi:10.1097/MD.0000000000004711
  47. Borja, Judith. The Impact of Early Nutrition on Health: Key Findings from the Cebu Longitudinal Health and Nutrition Survey (CLHNS). *Mal J Nutr*. 2013;19(1):1-8.
  48. Johnson KV, Scott AL, Shreve M, Ayers BL, Seaton VS, McElfish PA. Marshallese Beliefs, Perceptions, and Practices Related to Child Feeding Among Marshallese in the United States: Implications for Childhood Obesity. *Nutr Metab Insights*. 2019;12:1178638819827609. doi:10.1177/1178638819827609
  49. Novotny R, Chen C, Williams AE, et al. US Acculturation Is Associated with Health Behaviors and Obesity, but not Their Change, with a Hotel-Based Intervention among Asian-Pacific Islanders. *Journal of the Academy of Nutrition and Dietetics*. 2012;112(5):649-656. doi:10.1016/j.jand.2012.02.002
  50. Kaholokula JK, Nacapoy AH, Grandinetti A, Chang HK. Association Between Acculturation Modes and Type 2 Diabetes Among Native Hawaiians. *Diabetes Care*. 2008;31(4):698-700. doi:10.2337/dc07-1560
  51. Chun KM, Balls Organista P, Marín G, eds. *Acculturation: Advances in Theory, Measurement, and Applied Research*. American Psychological Association; 2003. doi:10.1037/10472-000
  52. Arandia G, Sotres-Alvarez D, Siega-Riz AM, et al. Associations between acculturation, ethnic identity, and diet quality among U.S. Hispanic/Latino Youth: Findings from the HCHS/SOL Youth Study. *Appetite*. 2018;129:25-36. doi:10.1016/j.appet.2018.06.017
  53. Kaholokula JK, Iwane MK, Nacapoy AH. Effects of perceived racism and acculturation on hypertension in Native Hawaiians. *Hawaii Med J*. 2010;69(5 Suppl 2):11-15.
  54. Boak R, Virgo-Milton M, Hoare A, et al. Choosing foods for infants: a qualitative study of the factors that influence mothers. *Child: Care, Health and Development*. 2016;42(3):359-369. doi:10.1111/cch.12323
  55. Lakhanpaul M, Benton L, Lloyd-Houldey O, et al. Nurture Early for Optimal Nutrition (NEON) programme: qualitative study of drivers of infant feeding and care practices in a British-Bangladeshi population. *BMJ Open*. 2020;10(6):e035347. doi:10.1136/bmjopen-2019-035347
  56. Taylor NJ, Sahota P, Sargent J, et al. Using intervention mapping to develop a culturally appropriate intervention to prevent childhood obesity: the HAPPY (Healthy and Active Parenting Programme for Early Years) study. *Int J Behav Nutr Phys Act*. 2013;10(1):142. doi:10.1186/1479-5868-10-142

57. Historical Living Arrangements of Children - United States Census Bureau.; 2020.  
<https://www.census.gov/data/tables/time-series/demo/families/children.html>
58. American Community Survey - United State Census Bureau.  
<https://www.census.gov/acs/www/data/data-tables-and-tools/geographic-comparison-tables/>
59. Multigenerational Household. U.S. Bureau of Labor Statistics  
<https://beta.bls.gov/dataQuery/find?q=household&q=household>
60. Amorim M. Are grandparents a blessing or a burden? Multigenerational coresidence and child-related spending. *Social Science Research*. Published online 2019:13.
61. Chambers SA, Rowa-Dewar N, Radley A, Dobbie F. A systematic review of grandparents' influence on grandchildren's cancer risk factors. van Wouwe JP, ed. *PLoS ONE*. 2017;12(11):e0185420. doi:10.1371/journal.pone.0185420
62. Borrows J, Williams M, Schluter P, Paterson J, Langitoto Helu S. Pacific Islands Families Study: The Association of Infant Health Risk Indicators and Acculturation of Pacific Island Mothers Living in New Zealand. *Journal of Cross-Cultural Psychology*. 2011;42(5):699-724. doi:10.1177/0022022110362750
63. Tseng M, Taylor S, Tautolo ES, Savila F, Paterson J, Rush E. Maternal Cultural Orientation and Child Growth in New Zealand Pacific Families. *Childhood Obesity*. 2015;11(4):430-438. doi:10.1089/chi.2014.0127
64. Abel S, Park J, Tipene-Leach D, Finau S, Lennan M. Infant care practices in New Zealand: a cross-cultural qualitative study. *Social Science & Medicine*. 2001;53(9):1135-1148. doi:10.1016/S0277-9536(00)00408-1
65. Kerr RB, Berti PR, Chirwa M. Breastfeeding and Mixed Feeding Practices in Malawi: Timing, Reasons, Decision Makers, and Child Health Consequences. *Food Nutr Bull*. 2007;28(1):90-99. doi:10.1177/156482650702800110
66. Reeves EA, Woods-Giscombé CL. Infant-Feeding Practices Among African American Women: Social-Ecological Analysis and Implications for Practice. *J Transcult Nurs*. 2015;26(3):219-226. doi:10.1177/1043659614526244
67. Bengtson VL. Beyond the Nuclear Family: The Increasing Importance of Multigenerational Bonds. THE BURGESS AWARD LECTURE\*. *J Marriage and Family*. 2001;63(1):1-16. doi:10.1111/j.1741-3737.2001.00001.x
68. Glaser K, Stuchbury R, Price D, Di Gessa G, Ribe E, Tinker A. Trends in the prevalence of grandparents living with grandchild(ren) in selected European countries and the United States. *Eur J Ageing*. 2018;15(3):237-250. doi:10.1007/s10433-018-0474-3
69. Leonard D, Aquino D, Hadgraft N, Thompson F, Marley JV. Poor nutrition from first foods: A cross-sectional study of complementary feeding of infants and young children in six

- remote Aboriginal communities across northern Australia: Poor nutrition from first foods in remote northern Australia. *Nutr Diet*. 2017;74(5):436-445. doi:10.1111/1747-0080.12386
70. Easthope H, Liu E, Judd B, Burnley I. Feeling at Home in a Multigenerational Household: The Importance of Control. *Housing, Theory and Society*. 2015;32(2):151-170. doi:10.1080/14036096.2015.1031275
71. Goodman CC. Intergenerational Triads in Skipped-Generation Grandfamilies. *Int J Aging Hum Dev*. 2007;65(3):231-258. doi:10.2190/AG.65.3.c
72. House JS. *Work Stress and Social Support*. 2. print. Addison-Wesley; 1983.
73. Leahy Warren P. First-time mothers: social support and confidence in infant care. *J Adv Nurs*. 2005;50(5):479-488. doi:10.1111/j.1365-2648.2005.03425.x
74. Nickerson LE, Sykes AC, Fung TT. Mothers' experience of fathers' support for breast-feeding. *Public Health Nutr*. 2012;15(9):1780-1787. doi:10.1017/S1368980011003636
75. Wright ME. *Sources of Infant Care Informational Social Support for Mothers of Infants in the Appalachian Region*. Florida Atlantic University; 2015. <http://eres.library.manoa.hawaii.edu/login?url=https://www.proquest.com/dissertations-theses/sources-infant-care-informational-social-support/docview/1780295044/se-2?accountid=27140>
76. Wasser HM, Thompson AL, Maria Siega-Riz A, Adair LS, Hodges EA, Bentley ME. Who's feeding baby? Non-maternal involvement in feeding and its association with dietary intakes among infants and toddlers. *Appetite*. 2013;71:7-15. doi:10.1016/j.appet.2013.06.096
77. Laving AR, Hussain SR, Atieno DO. Overnutrition: Does Complementary Feeding Play a Role? *Ann Nutr Metab*. 2018;73(1):15-18. doi:10.1159/000490088
78. Au LE, Gurzo K, Paolicelli C, Whaley SE, Weinfield NS, Ritchie LD. Diet Quality of US Infants and Toddlers 7–24 Months Old in the WIC Infant and Toddler Feeding Practices Study-2. *The Journal of Nutrition*. 2018;148(11):1786-1793. doi:10.1093/jn/nxy192
79. Grote V, Theurich M, Koletzko B. Do complementary feeding practices predict the later risk of obesity?: Current Opinion in Clinical Nutrition and Metabolic Care. 2012;15(3):293-297. doi:10.1097/MCO.0b013e328351baba
80. Azadbakht L, Esmailzadeh A. Dietary diversity score is related to obesity and abdominal adiposity among Iranian female youth. *Public Health Nutr*. 2011;14(1):62-69. doi:10.1017/S1368980010000522
81. *Dietary Guidelines for Americans, 2020-2025*. Dietary Guidelines for Americans <https://www.dietaryguidelines.gov/resources/2020-2025-dietary-guidelines-online-materials>
82. World Health Organization. *Developing and Validating an Iron and Folic Acid Supplementation Indicator for Tracking Progress towards Global Nutrition Monitoring*

Framework Targets: Final Report June 2018. World Health Organization; 2018. Accessed November 4, 2021. <https://apps.who.int/iris/handle/10665/274372>

83. Bingham S, Riboli E. Diet and cancer — the European Prospective Investigation into Cancer and Nutrition. *Nature Reviews Cancer*. 2004;4(3):206-215. doi:10.1038/nrc1298
84. Cameron N, Demerath EW. Critical periods in human growth and their relationship to diseases of aging. *Am J Phys Anthropol*. 2002;119(S35):159-184. doi:10.1002/ajpa.10183
85. Boushey CJ, Spoden M, Zhu FM, Delp EJ, Kerr DA. New mobile methods for dietary assessment: review of image-assisted and image-based dietary assessment methods. *Proc Nutr Soc*. 2017;76(3):283-294. doi:10.1017/S0029665116002913
86. Boushey C, Spoden M, Delp E, et al. Reported Energy Intake Accuracy Compared to Doubly Labeled Water and Usability of the Mobile Food Record among Community Dwelling Adults. *Nutrients*. 2017;9(3):312. doi:10.3390/nu9030312
87. Aflague T, Boushey C, Guerrero R, Ahmad Z, Kerr D, Delp E. Feasibility and Use of the Mobile Food Record for Capturing Eating Occasions among Children Ages 3–10 Years in Guam. *Nutrients*. 2015;7(6):4403-4415. doi:10.3390/nu7064403
88. Baruffi G, Hardy CJ, Waslien CI, Uyehara SJ, Krupitsky D. Ethnic differences in the prevalence of overweight among young children in Hawaii. *Journal of the American Dietetic Association*. 2004;104(11):1701-1707. doi:10.1016/j.jada.2004.08.027

Chapter 2: Why do caregivers' feed their babies the way they do? A literature review of the health behavior theories surrounding complementary infant feeding practices.

### **Abstract**

Healthy complementary feeding practices, ones that observe timing and type recommendations, can improve infant nutrition and childhood health; however much of this is decided upon by caregivers, thus raising the question of what guides the feeding behaviors of caregivers? This literature review identified twelve studies reporting on health behavior theories aiming to explain caregiver complementary feeding behaviors. Of the twelve studies, nine were non-experimental, observational studies where researchers observed participant behavior using cohort or cross-sectional study designs. Three of the twelve studies were experimental studies using intervention activities to produce a behavior change and beneficial health outcome. All three intervention studies based their intervention on health behavior theories and had a positive net effect.

However, only one intervention study met both the duration and positive net effect criteria to be effective using the Brennan method of assessing intervention quality. The review of these twelve studies showed caregivers were influenced by the constructs of social norms, cultural norms, environments, and individual preferences regarding their complementary feeding practices. The theory of planned behavior was used in seven studies. The effective intervention study used both the theoretical domains framework and intervention mapping to decrease weight gain in infants. Findings from this literature review illustrate the complexity of the influences on caregiver complementary feeding behavior and how health behavior theories can explain the constructs shaping their behavior and infant nutritional health. This can guide future research by developing research approaches (i.e. survey questions, focus group questions, intervention activities) and also support programmatic efforts to improve infant health. This literature review on health behavior theories contributed to this dissertation by increasing the knowledge of infant nutrition by better understanding caregivers and their complementary feeding behaviors. Furthermore, the health behavior literature helped explain observations in the qualitative and quantitative data.

### **Introduction**

Complementary infant feeding is the stage in infant nutrition when infants are transitioning from consuming only human milk and/or infant formula to consuming other foods and beverages.<sup>1,2</sup>

Complementary (i.e. first) foods supplement the infant's diet of human milk and/or infant formula to meet the nutritional needs of the growing infant.<sup>3</sup> Complementary feeding practices include the timing, type and diversity of complementary foods. The Centers for Disease Control and Prevention (CDC) and the American Academy of Pediatrics (AAP) recommends solid foods be introduced at approximately 6 months.<sup>4,5</sup> Prior to this age, the recommendation is to exclusively feed the infant human milk with a reason being to lessen exposure to water and foodborne illnesses.<sup>6</sup>

Nutrition during the first 1,000 days of life begins with the initial mode of feeding through to nearly the complete weaning of the infant.<sup>7</sup> Complementary feeding practices are important milestones shaping the health and nutrition status of infants. This is seen in the role nutrition has in appetite, metabolism, energy intakes and weight-for-length measurements.<sup>8</sup> Research suggests there is a “growth acceleration” that takes effect during this time period and oversees metabolic programming that may lead to increased susceptibility to obesity later in life.<sup>9-11</sup> Evidence of this was observed in a sample of children, predominantly of Native Hawaiian and Other Pacific Islander (NHPI) and Filipino ethnicities, that had experienced rapid growth between 12 – 23 months who were at the highest risk for child obesity at 4–5 years old compared to children who did not experience rapid growth during the same interval.<sup>12</sup> Childhood obesity is a public health concern, especially given its association with problems later in life such as overweight, obesity, and comorbidities such as high blood pressure and diabetes.<sup>13-16</sup>

The lack of autonomy infants have in their first 1,000 days of life highlights the importance of caregivers. The focus on caregivers points to the need to understand these individuals and their behaviors and practices. Several psychological models or theories have been used to help explain human behaviors, such as dietary practices.<sup>17</sup> These theories identify theoretical determinants significant in predicting and explaining behaviors. Moreover, theories help to systematically understand an event, providing a road map for studying problems, developing appropriate tools and interventions, and evaluating their successes.<sup>18</sup> A theory is defined by its concepts and key constructs which help to clarify a behavior by illustrating the relationships between the constructs. For example, a health behavior theory may involve the constructs of social and environmental factors shaping eating behaviors (e.g. Socioecological Theory).<sup>19</sup> Another



example of a health behavior theory is the theory of planned behavior (TPB) which is focused on intrapersonal factors occurring within the individual.<sup>18</sup>

This literature review examines the health behavior theories surrounding complementary infant feeding practices. The question guiding this review was: What health behavior theories are used to explain complementary feeding behaviors of caregivers? This question will inform the literature review process including the participant and methodical approach eligibility criteria. The intention of this literature review is to facilitate discussions on health behavior theories, their capability to explain behavior, and how they can be used by research focused on infant complementary feeding practices.

## **Methods**

A literature review was done to identify original studies adopting health behavior theories to investigate the nutritional phenomena of infant complementary feeding practices.

Complementary infant feeding practices were defined as the consumption of nutrients from sources other than infant formula and human milk. Health behavior theories were defined as a systematic way of understanding behaviors, and explaining or predicting events or situations by illustrating relationships between variables.<sup>17 18</sup>

Studies were identified through a Boolean search strategy done in May 2020 and again in April 2022. The databases searched were PubMed, Web of Science, Academic Search Complete, Agricola, CINAHL, ERIC, Open Dissertations, Psychology and Behavioral Sciences, Social Work Abstracts, and Medline. Terms and their combinations used in the Boolean search strategy included “complementary feeding or weaning NOT breastfeeding” AND “community or neighborhood or society or group or support system” AND “culture or cultural or ethnicity or identity or values or religious or belief” AND “family or families or relatives or parents or siblings or caregivers” AND theory.” Results were refined by article type to include only peer-reviewed articles published in scholarly journals between the years 2000 and 2022 in the English language.

Articles were included if they reported on the application of health behavior theory(s) to identify

and explore variables of infant complementary feeding practice, and the relationships among the variables. The titles and abstracts of the articles were examined and excluded based on the following criteria: wrong population (the study participants were not human infants, 12 months or less of age), wrong topic (the article did not relate to infant complementary feeding), wrong language (the article was not written in English, the primary language of the reviewer), absence of health theory (the article did not include a health behavior theory in its framework), and no results discussed (the article was published as a proposal or progress update). The remaining articles were read and reexamined, with the exclusion criteria being reapplied.

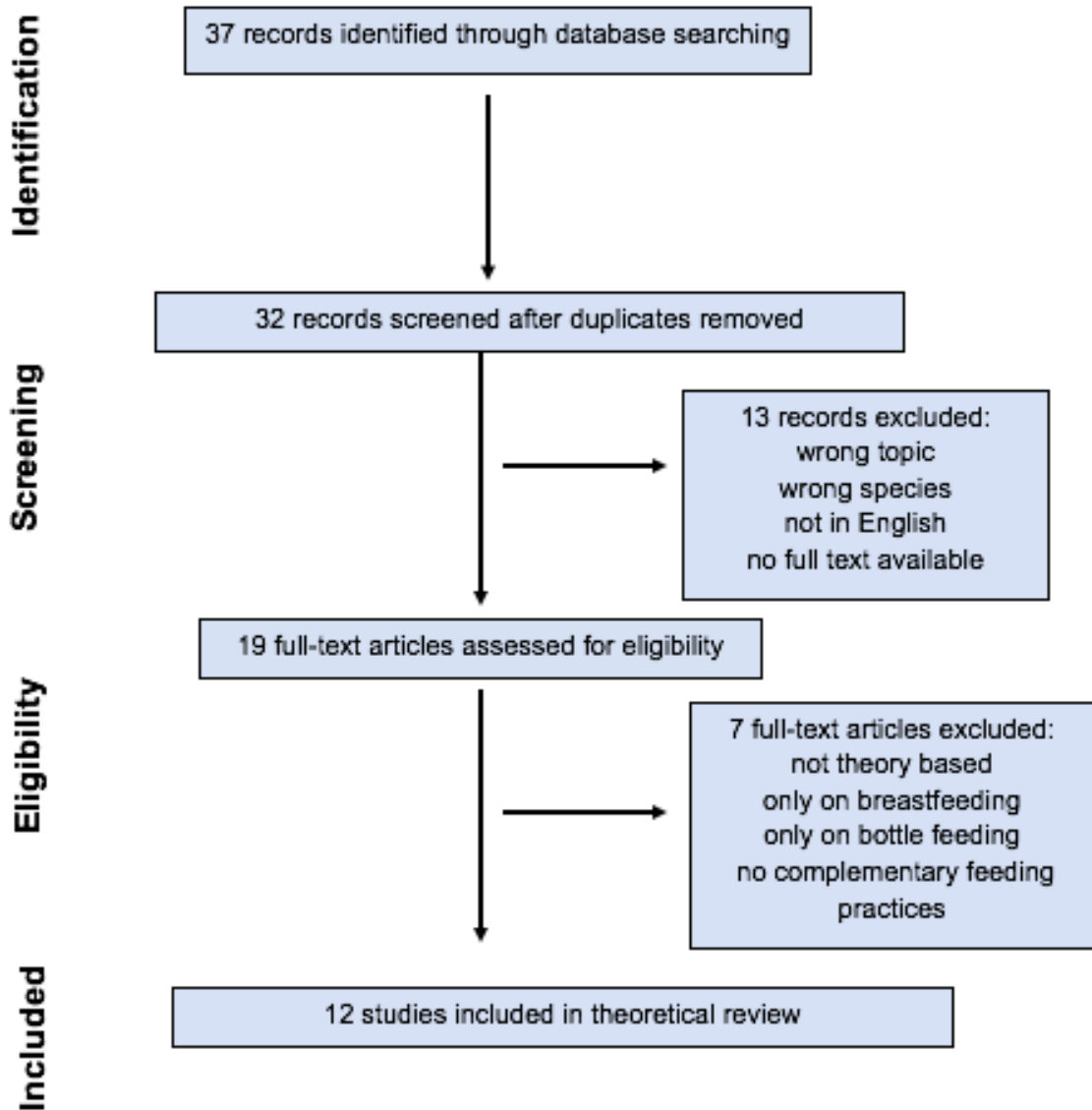
The information abstracted from the literature included the location of the study, the population of focus, and the health behavior theory or model cited in the article. Articles were categorized by study design. For intervention studies, the intervention activities, the health measures and the results were also abstracted. The rating system by Brennan and colleagues was used to measure the quality of the intervention studies.<sup>20</sup> An effective study had an intervention duration no less than 6 months and a net positive percent change reported in the results.<sup>20</sup>

## **Results**

A total of 37 articles were identified through database searching using the Boolean terms and citation chasing. After removing duplicates, 32 pieces of literature were screened. A total of thirteen records were excluded based on the aforementioned criteria. The remaining 19 articles were read in full and the exclusion criteria were reapplied. This resulted in seven additional articles being removed. A total of twelve original articles on infant complementary feeding practices and health behavior theories were included in this review. Of these twelve articles, nine were non-experimental observational studies and three were intervention studies. The nine observational studies were descriptive epidemiology studies. The three intervention studies had researchers interceding as part of the study design to determine the effectiveness of the intervention. Specifically, the three experimental intervention studies used health behavior theories to create activities and measures that would illicit a behavioral change. The flow diagram of the inclusion stages to retrieve relevant and appropriate studies on health behavior theories as they explore complementary infant feeding, is presented in Figure 2.

**Figure 2: Flow Diagram of the Literature Review Process of Health Behavior Theories.**

Flow diagram of the search for health behavior theory literature on complementary feeding practices of caregivers, and the inclusion of literature at the different stages of the review process.



Abstracted information from the nine observational studies (e.g. cohort, cross-sectional studies) are presented in Table 1 and include the study’s author(s), location(s), and focus population. Majority of the articles focused on a population at risk for health disparities. Three studies focused on low-income mothers and/or mothers eligible for Medicaid and/or the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC). Three studies focused

on ethnic minority groups (e.g. Puerto Rican, Bangladeshi, and African Americans). Three studies focused on first-time mothers and one study focused on pregnant women classified as overweight/obese. All the observational epidemiologic studies reported the health behavioral theory(s) used to guide the study's approaches (Table 1).

**Table 1: Information of the Observational Studies on Health Behavior Theories.**

Abstracted information from the nine observational studies guided by a health behavior theory reviewed in this literature review on complementary infant feeding practices.

Study Design: Observational (n=9)					
Author(s)	Location	Focus Population	Number of Participants	Health Behavior Theory or Model and its constructs	Study's results discussed within the theory's constructs
Higgins, 2000	Western New York, USA	Puerto Rican families	15	<p>Theory of Culture Care:</p> <ul style="list-style-type: none"> <li>- Preservation of culture</li> <li>- Accommodation of culture</li> <li>- Restructuring according to culture</li> </ul>	<p>Influences on caregiver complementary feeding behaviors:</p> <ul style="list-style-type: none"> <li>- Kinship and social factors</li> <li>- Cultural values and lifeways</li> <li>- Religious and philosophical views</li> </ul> <p>Preservation of culture:</p> <ul style="list-style-type: none"> <li>- Kinship and social factors                             <ul style="list-style-type: none"> <li>o How: recognize the love and respect they have for family members</li> </ul> </li> <li>- Cultural values and lifeways                             <ul style="list-style-type: none"> <li>o How: family-centered care</li> </ul> </li> <li>- Religious and philosophical views                             <ul style="list-style-type: none"> <li>o How: respect for cultural and religious symbols</li> </ul> </li> </ul> <p>Accommodation of culture:</p> <ul style="list-style-type: none"> <li>- Kinship and social factors</li> </ul>

					<ul style="list-style-type: none"> <li>○ How: respect older female family members</li> <li>- Cultural values and lifeways <ul style="list-style-type: none"> <li>○ How: recognize the cultural way of life</li> <li>○ How: negotiate with the cultural value of bigger the heathier</li> </ul> </li> <li>- Religious and philosophical views <ul style="list-style-type: none"> <li>○ How: incorporate religious views</li> </ul> </li> </ul> <p>Restructure around culture:</p> <ul style="list-style-type: none"> <li>- Kinship and social factors <ul style="list-style-type: none"> <li>○ How: involve mothers in planning and implementing nutrition and health classes</li> </ul> </li> <li>- Cultural values and lifeways <ul style="list-style-type: none"> <li>○ How: use indigenous language</li> </ul> </li> <li>- Religious and philosophical views <ul style="list-style-type: none"> <li>○ How: verbalize cultural personality</li> </ul> </li> </ul>
Boak et al., 2016	Barwon South Western Victoria	Mother of infants from the Splash! Cohort	32	Social-Ecological Model <ul style="list-style-type: none"> <li>- Individual</li> <li>- Relationships</li> <li>- Community</li> <li>- Societal</li> </ul>	Influences on caregiver complementary feeding behaviors: <ul style="list-style-type: none"> <li>- Individual: <ul style="list-style-type: none"> <li>○ Caregiver’s awareness of healthy food</li> </ul> </li> </ul>

	region, Australia				<ul style="list-style-type: none"> <li>○ Infant preference for sweet flavors</li> <li>- Relationships: <ul style="list-style-type: none"> <li>○ Older siblings</li> <li>○ Grandparents</li> <li>○ Friends</li> </ul> </li> <li>- Community: <ul style="list-style-type: none"> <li>○ Food availability</li> <li>○ Daycare</li> </ul> </li> <li>- Societal: <ul style="list-style-type: none"> <li>○ Marketing and food labeling</li> <li>○ Cultural norms and values</li> <li>○ Economy</li> </ul> </li> </ul>
Lakhanpaul et al., 2020	Tower Hamlets, London	British-Bangladeshi caregivers	141	Socioecological framework <ul style="list-style-type: none"> <li>- Individual</li> <li>- Relationships</li> <li>- Community</li> <li>- Societal</li> </ul>	Influences on caregiver complementary feeding behaviors: <ul style="list-style-type: none"> <li>- Individual: <ul style="list-style-type: none"> <li>○ Caregiver's information, knowledge and awareness</li> <li>○ Caregiver's view of self-efficacy</li> </ul> </li> <li>- Community <ul style="list-style-type: none"> <li>○ Physical and local environment</li> <li>○ Fast food outlets, advertising</li> </ul> </li> <li>- Societal <ul style="list-style-type: none"> <li>○ Society and culture values</li> </ul> </li> </ul>

					<ul style="list-style-type: none"> <li>○ Equating chubby baby to healthy baby</li> </ul>
Heinig et al., 2006	Northern California, USA	Mothers participating in WIC <sup>a</sup>	65	<p>Theory of Planned Behavior</p> <ul style="list-style-type: none"> <li>- Intention</li> <li>- Attitude</li> <li>- Subjective norms</li> <li>- Perceived behavioral control</li> </ul>	<p>Influences on caregiver complementary feeding behaviors:</p> <ul style="list-style-type: none"> <li>- Intention <ul style="list-style-type: none"> <li>○ Prenatal plans for complementary feeding practices</li> </ul> </li> <li>- Attitude <ul style="list-style-type: none"> <li>○ Beliefs about the developmental importance of complementary feeding practices</li> <li>○ Signs of health such as the size of the infant and hunger cues</li> </ul> </li> <li>- Subjective norms <ul style="list-style-type: none"> <li>○ Concern from family about infant's fullness</li> <li>○ Pressure by family, friends, and health care providers to make certain decisions</li> <li>○ Information sharing from social networks</li> </ul> </li> <li>- Perceived behavioral control <ul style="list-style-type: none"> <li>○ Forced to make decisions based on circumstances</li> <li>○ Complying with guidelines</li> </ul> </li> </ul>



					<ul style="list-style-type: none"> <li>○ Dictated by infant's behavior</li> </ul>
Horodynski et al., 2007	Michigan, USA	Low income, Medicaid eligible mothers	23	<p>Theory of Planned Behavior</p> <ul style="list-style-type: none"> <li>- Intention</li> <li>- Attitude</li> <li>- Subjective norms</li> <li>- Perceived behavioral control</li> </ul>	<p>Influences on caregiver complementary feeding behaviors:</p> <ul style="list-style-type: none"> <li>- Attitude <ul style="list-style-type: none"> <li>○ Positive but skeptical view of feeding recommendation</li> <li>○ Belief complementary feeding is an important indicator of development and a sign of a healthy, growing baby</li> <li>○ Maternal knowledge about infant feeding</li> </ul> </li> <li>- Subjective norms <ul style="list-style-type: none"> <li>○ Reliance on others for advice and support</li> <li>○ Perceived social pressure felt from relatives to complementary feed early</li> </ul> </li> <li>- Perceived behavioral control <ul style="list-style-type: none"> <li>○ Infant feeding decisions affected by factors out of their control</li> </ul> </li> </ul>
Walsh et al., 2015	Brisbane, Australia	First-time mothers	21	<p>Theory of Planned Behavior</p> <ul style="list-style-type: none"> <li>- Intention</li> <li>- Attitude</li> <li>- Subjective norms</li> </ul>	<p>Influences on caregiver complementary feeding behaviors:</p> <ul style="list-style-type: none"> <li>- Attitude <ul style="list-style-type: none"> <li>○ Salient belief of the advantages and</li> </ul> </li> </ul>

				<ul style="list-style-type: none"> <li>- Perceived behavioral control</li> </ul>	<ul style="list-style-type: none"> <li>disadvantages of introducing at 6mo. <ul style="list-style-type: none"> <li>○ Attitude about complementary foods assisting with infant weight gain, sleeping patterns and mealtime enjoyment</li> </ul> </li> <li>- Subjective norms <ul style="list-style-type: none"> <li>○ Opinions of important others</li> <li>○ Valued feeding information came from peers recently experienced with infant feeding</li> </ul> </li> <li>- Perceived behavioral control <ul style="list-style-type: none"> <li>○ Mother's control controlled by infant and infant's developmental progression</li> </ul> </li> </ul>
Hamilton et al., 2011	Brisbane and Adelaide, Australia	First-time mothers	375	Theory of Planned Behavior <ul style="list-style-type: none"> <li>- Intention</li> <li>- Attitude</li> <li>- Subjective norms</li> <li>- Perceived behavioral control</li> </ul>	Influences on caregiver complementary feeding behaviors: <ul style="list-style-type: none"> <li>- Attitude <ul style="list-style-type: none"> <li>○ Attitude towards feeding solids at 6mo.</li> <li>○ Belief of perceived weight status</li> </ul> </li> <li>- Subjective norms <ul style="list-style-type: none"> <li>○ Perceived pressure from important others to feed solids at 6mo.</li> </ul> </li> </ul>

					<ul style="list-style-type: none"> <li>- Perceived behavioral control <ul style="list-style-type: none"> <li>o Was not predictive of intention</li> </ul> </li> </ul>
Mutiso et al., 2018	Homa Bay County, Western Kenya	Mothers of children who received nutrition education from the SUSTAIN project	665	Theory of Planned Behavior <ul style="list-style-type: none"> <li>- Intention</li> <li>- Attitude</li> <li>- Subjective norms</li> <li>- Perceived behavioral control</li> </ul>	Influences on caregiver complementary feeding behaviors: <ul style="list-style-type: none"> <li>- Attitude <ul style="list-style-type: none"> <li>o Knowledge of feeding practices</li> </ul> </li> <li>- Subjective norms <ul style="list-style-type: none"> <li>o Social pressure to practice feeding recommendations</li> </ul> </li> <li>- Perceived behavioral control <ul style="list-style-type: none"> <li>o Personal control over practicing feeding recommendations</li> </ul> </li> </ul>
Newby et al., 2014	Queensland, Australia	First-time mothers	277	Theory of Planned Behavior <ul style="list-style-type: none"> <li>- Intention</li> <li>- Attitude</li> <li>- Subjective norms</li> <li>- Perceived behavioral control</li> </ul>	Influence on caregiver complementary feeding behaviors: <ul style="list-style-type: none"> <li>- Attitude <ul style="list-style-type: none"> <li>o Beliefs and knowledge of recommended feeding practices</li> </ul> </li> </ul>

<sup>a</sup> The Special Supplemental Nutrition Program for Women, Infants, and Children (WIC)

The socioecological theory guided the perspective of two qualitative studies. Boak and colleagues examined the multiple influences on food choices of 32 Australian mothers of infants aged 4 – 15 months old.<sup>21</sup> Researchers observed maternal decision-making was influenced by personal factors (e.g. caregiver's awareness, infant preferences); social networks (e.g. grandparents, friends); physical settings (e.g. food supply and childcare); and macro-level environments (e.g. cultural norms, values, marketing, governance, economy). Drivers of these influences are socio-political, socio-economic, socio-environmental and socio-cultural circumstances experienced by the decision makers and their communities.<sup>21</sup>

Similarly, Lakhanpaul and colleagues observed socioecological factors impacted infant nutrition in the British-Bangladeshi population.<sup>22</sup> From 12 focus groups and 45 semi structured interviews, researchers observed society and culture (e.g. physical characteristics representing health), physical and local environments (e.g. household, advertising, fast food outlets), and individual's information and awareness (e.g. traditional culture, health services, communication) were determinants in infant feeding.<sup>22</sup>

The theory of culture care guided the study by Higgins.<sup>23</sup> Theory of culture care focuses on culturally consistent care at the interpersonal, relationship level. This theory was designed for nursing care and believes patients who experience care congruent with their cultural beliefs and ways of life will comply with treatment, thus increasing the overall effectiveness of the care. Higgins focused on Puerto Rican families and explored their cultural beliefs and practices that influence their complementary feeding practices. Cultural values of family cohesiveness, respect, philosophical beliefs, and the culture care ideology were observed to influence infant feeding in this population. Moreover, family held a critical role in reinforcing the cultural ideology underlying infant feeding practices.<sup>23</sup>

Of the six observational studies using the theory of planned behavior to understand the intention driving feeding behavior, half examined the behavior quantitatively through questionnaires and half examined it through focus groups and interviews. All studies observed caregivers' intentions were predicted by the constructs of behavioral beliefs and subjective norms. Behavior beliefs

observed to be impactful were the attitudes and feelings about the importance and feasibility of recommended complementary feeding practices (e.g. timing of complementary feeding). The influential subjective norms were the opinions and the acceptance of people important to the participants about recommended complementary feeding practices and the social pressure to get approval from these important people. In their sample of 375 first-time mothers, Hamilton and colleagues found 65% of the variance in intentions was explained by attitude and subjective norms and, additionally, group norms (the mothers' perception that other mothers perform the same feeding behavior).<sup>24</sup> Mutiso and colleagues found the perceived behavior control of mothers was associated with their deployment of recommended practices.<sup>25</sup> Specifically, the likelihood of mothers practicing feeding recommendations had a significantly positive effect on the number of recommendations used by the mothers. However, contrary to Mutiso, the other studies saw mothers' salient belief of their perceived control was actually controlled by their infant, including its behavior (e.g. hunger), developmental cues (e.g. readiness), and what mothers identified as the infant's interest in the family's food.<sup>24,26-28</sup>

The activity(s) and the theory(s) used to formulate the interventions are in table 2. The method of assessing the quality and effectiveness of the intervention and study was based on the rating system put forth by Brennan and colleagues. Brennan et al.'s effectiveness rating was created to capture study design, intervention duration, and outcomes affected and their corresponding effect size or percent change. For example, the intervention duration is a rating of the length of time for implementation. The effect size or percent change is a rating of the net effect of the intervention on the outcomes. According to Brennan et al. an "effective" study is operationalized as Intervention Evaluation x Duration (high/medium) x Effect Size (net positive), in addition it also produces a significant positive health or behavioral outcome. High duration is greater than or equal to 12 months and medium duration is 6–12 months. Net positive is where majority of effects (key effects such as obesity, BMI; size of the effects) suggest positive change.

**Table 2: Information of the Interventional Studies on Health Behavior Theories.**

Abstracted information from the three intervention studies guided by a health behavior theory reviewed in this literature review on complementary infant feeding practices.

Study Design: Intervention (n=3)							
Author(s)	Location	Focus Population	Number of Participants	Health Behavior Theory or Model and its constructs	Intervention activity(s) and duration	Effective Rating <sup>a</sup>	Study's results discussed within the theory's constructs
Black et al., 2000	Baltimore, Maryland, USA	Black, adolescent mothers	121	Social cognitive theory <ul style="list-style-type: none"> <li>- Reciprocal determinism</li> <li>- Behavioral capability</li> <li>- Expectations</li> <li>- Self-efficacy</li> <li>- Observational learning</li> <li>- Reinforcements</li> </ul>	1. Home visitation 2. Videotape showing 3. Mentorship with home visitor  Duration: 3 months	Not effective based on activity duration being less than 6 months	Intervention activities were guided by the constructs of observational learning, familiar contexts, and skill-oriented strategies.  Mothers in intervention group nearly 4 times more likely to adhere to AAP <sup>a</sup> guidelines, compared to mothers in the control group

Silk et al., 2010	Michigan, USA	Low income mothers	28	<p>Theory of Planned Behavior</p> <ul style="list-style-type: none"> <li>- Intention</li> <li>- Attitude</li> <li>- Subjective norms</li> <li>- Perceived behavioral control</li> </ul> <p>Transtheoretical Model/Stages of Change</p> <ul style="list-style-type: none"> <li>- Precontemplation</li> <li>- Contemplation</li> <li>- Preparation</li> <li>- Action</li> <li>- Maintenance</li> </ul>	<p>1. Home visitation</p> <p>2. 6 lesson curriculum</p> <p>Duration: 6 weeks</p>	Not effective based on activity duration being less than 6 months	<p>Intervention activities were guided by the constructs of TPB and stages of change</p> <p>24 mothers who underwent the intervention activities delayed complementary feeding beyond 4 months</p>
Taylor et al., 2013	Bradford, England	Overweight/Obese pregnant women	120	<p>Intervention Mapping</p> <ul style="list-style-type: none"> <li>- Process for intervention development, implementation and evaluation</li> </ul> <p>Theoretical Domains Framework:</p> <ul style="list-style-type: none"> <li>- Emotion</li> <li>- Social influences</li> <li>- Skills</li> <li>- Beliefs about consequences</li> <li>- Action planning</li> </ul>	<p>1. 6 antenatal lessons</p> <p>2. 6 postnatal group sessions</p> <p>Duration: 12 months</p>	Effective based on activity duration being 6+ months	<p>Overall high acceptability of the intervention activities</p> <p>Less overweight infants (23%) in the intervention group compared to overweight infants (45%) in the control group</p>

				<ul style="list-style-type: none"> <li>- Memory, attention and decision processes</li> <li>- Social and professional role and identity</li> <li>- Knowledge</li> <li>- Environmental context and resources</li> <li>- Motivation and goals</li> <li>- Beliefs about capabilities</li> </ul>			
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<sup>a</sup> Brennan L, Castro S, Brownson RC, Claus J, Orleans CT. Accelerating evidence reviews and broadening evidence standards to identify effective, promising, and emerging policy and environmental strategies for prevention of childhood obesity. *Annu Rev Public Health*. 2011;32:199-223. doi:10.1146/annurev-publhealth-031210-101206

<sup>b</sup>American Academy of Pediatrics



All three intervention studies reported a positive net effect of the activity on the outcomes. However, only the study by Taylor and colleagues met the duration criteria in addition to the effect size.<sup>20,29</sup> Taylor et al. applied a yearlong intervention to examine anthropometric and nutrient intake patterns of infants whose mothers were overweight or obese during their pregnancy. The activity was a series of group health educational sessions during both the antenatal and postnatal stages targeted at the group-level. Taylor et al. used intervention mapping and theoretical domains frameworks. The intervention mapping framework incorporates theory into the development of the intervention, and its implementation and evaluation. Theoretical domains identifies and addresses 11 theoretical determinants of behavior change which include knowledge, skills, beliefs, self-efficacy, intentions, social influence, and environmental resources.<sup>29</sup> The researchers found fewer overweight infants (23%) in the intervention group compared to overweight infants (45%) in the control group.<sup>30</sup> The theory-based intervention was effective and accepted by the participants.

Using the ecological theory and social cognitive theory, Black and colleagues developed a home-based intervention using videotape messaging about strategies to avoid conflict in the infant's household and promote timely infant feeding practices.<sup>31</sup> Additionally, a mentorship model was implemented through the home visits between participants and researchers. The intervention activity was applied for three months. Participants were low-income, first-time, adolescent black mothers. The intervention was targeted at the individual level. Researchers chose the social cognitive theory to guide the intervention activity believing the mothers' personal factors, environment and infant feeding behavior all interact to influence each other. Results indicated participants in the intervention group were more likely to adhere to timely complementary feeding practices.<sup>31</sup>

Silk and colleagues developed infant feeding curriculum integrating two health behavior theories at the individual level.<sup>32</sup> The intervention activity was applied for six weeks. The TPB and the transtheoretical model of change helped explain influences and how change could occur. The transtheoretical model of change believes individuals are at different stages of readiness when it comes to changing their behavior, thus the desired behavioral changes are framed in five different stages. The model's 10 processes of change essential to motivating individuals to

engage in the recommended behavior was instrumental in designing the lessons' content. Low-income mothers and pregnant women who completed the six lesson curriculum via one-on-one home delivery had higher self-efficacy adhering to timely complementary feeding practices.<sup>32</sup>

Based on this review of literature, a summary of the health behavior theories and their constructs are presented in Table 3. Organized by construct level, this table provides a structure to view the influences shaping caregivers and their complementary feeding behaviors.

**Table 3: Health Behavior Theories and their Key Constructs.**

Summary of the health behavioral theories and their constructs to understand caregiver’s complementary feeding behavior.

	Health Behavior Theory	Relationship to Caregiver Behavior	Key Constructs of the Theory
Individual Level	Stages of Change Model	Caregivers motivation and readiness to change their feeding behavior	Precontemplation Contemplation Decision Action Maintenance
	Theory of Planned Behavior	Caregivers’ attitudes toward their feeding behavior, perceptions of norms, and beliefs about the easy or difficulty of changing their feeding behavior	Behavioral Intention Attitude Subjective Norm Perceived Behavioral Control
Interpersonal Level	Social Cognitive Theory	Caregivers’ personal factors, their environment and behavior exert influence on each other	Reciprocal Determinism Behavioral Capability Expectations Self-efficacy Observational Learning Reinforcements
	Theory of Culture Care	Caregivers’ culture influences their feeding practices	Culture Care Preservation Modality Culture Care Accommodation Modality Culture Care Restructuring Modality

Community Level	Social-Ecological Model	Range of factors that influence other factors at the individual, relationship, community, and societal levels to show the complex interplay between these factors	Cultural Values Cultural Norms Environment Ethos Social Network Knowledge Attitudes Skills
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## **Discussion**

This literature review identified seven studies (six observational studies, one intervention study) that used theories at the intrapersonal level (theory of planned behavior, transtheoretical stages of change); two studies (one observational study, one intervention study) that used interpersonal level theories (social cognitive theory; culture care theory); and three studies that used community level theories (theoretical domains, socioecological model) to explain caregiver complementary feeding behavior, and the potential to change this behavior. What can be illustrated by this review is the complexity surrounding caregivers' decisions to complementary feed the way they choose to. This suggests there are multilevel constructs shaping behavior, and these constructs are potentially modifiable behavioral factors that influence caregivers' complementary feeding behavior.

This insight into the dynamics of infant feeding helps to identify and explain key theoretical constructs and their presumed relationships to this health behavior. By congregating the literature on health behavior theories to explain the nature of complementary feeding, this review helps to identify crucial factors essential to assuring the success of innovative, tailored activities in their attempt to improve caregiver feeding behaviors. This provides guidance for future research in their development of survey questionnaires, interview and focus group questions, and pre-testing intervention activities.

In examining the theories of planned behavior, stages of change, theoretical domains, and the socioecological theory, the caregiver emerged not only as a key construct but one that each theory recognized as crucial in behavior development.<sup>22,24,29,32</sup> Worth mentioning however is the infant as its own individual. The infant was observed to be integral in the feeding behaviors. The construct of perceived behavioral control of the caregiver was found to be

controlled by the infant.<sup>24,26-28</sup> Other shared constructs between theories were social influences, relationships with others, and the physical environment of the caregiver. This suggests a range of theories might be useful in understanding complementary infant feeding practices. This is somewhat similar to the intent of the theoretical domains framework.<sup>29,30</sup> This framework aims to integrate theories surrounding behavior change into 11 domains in an ecological perspective. The framework's list of constructs that may shape caregivers' feeding behaviors gives insight into the cognitive, emotional, social and environmental factors of feeding behaviors.

For their intervention activity, Black and colleagues used the construct of observational learning in the social cognitive theory to get caregivers to see and learn recommended complementary feeding behaviors.<sup>6</sup> In their cohort study, Boak and colleagues used the social-ecological theory to observe the constructs of social norms and food environment in describing caregivers' food choices.<sup>18</sup> The multi-level constructs of these theories help to show the many influences shaping caregiver feeding behavior. Much like the socio-ecological perspective and theoretical domains framework, each level and its theories and their constructs, are critical in building up the framework in which to view health behaviors.<sup>2</sup>

The fact that behavioral change is not straightforward highlights the profoundness of the success of the intervention studies, and attest to the importance of grounding activities in health behavioral theories.<sup>29,31,32</sup> Intervention activities concerning the multiple constructs of the different social ecological levels (individual, group, and community) were found to be effective due to the recognition of the many factors influencing caregivers' feeding behaviors.<sup>19</sup> Both the observational and experimental studies showed the ability of a theory to

explain behavior and be a guide in creating appropriate and efficient approaches to influence and change behavior.<sup>17</sup> The summary of the literature on health behavior theories may be useful to future studies attempting to integrate key constructs into their measurements and evaluations, and when they are discussing the application of findings.

The findings of this literature review contributed to this dissertation by giving a comprehensive understanding of the influences on complementary feeding behaviors (e.g. what and who shapes decisions) and ultimately the nutritional health of infants. This knowledge can be used to identify opportunities to establish healthy dietary patterns in childhood, thus contributing to the efforts to reduce health disparities early on. Health behavior theories have the ability to serve as a roadmap when examining and/or intervening on a given health behavior.<sup>22</sup> This review helped to better understand the observations seen in the qualitative and quantitative data used in this dissertation.

A limitation of this literature review is the Boolean search terms used. For example, complementary feeding practices may be called differently elsewhere. However, the use of other known terms such as weaning and “NOT breastfeeding” in the Boolean search helped to offset this likelihood. Not including weaning and supplementation in the Boolean search excluded earlier studies when these terms were commonly used in place of complementary feeding. Moreover, the search phrase of “weaning NOT breastfeeding” which might have added not breastfeeding to weaning, may have eliminated relevant studies since weaning also involves concurrent food and milk feeding but with an opposite trajectory, that being the human milk or infant formula is being taken away and more food is being added.

Furthermore, this literature review was also not a systematic review exploring research on complementary feeding practices. This may have left out studies that examined this feeding behavior using components of a health behavior theory without explicitly naming the theory. An example could be studies that looked at the society and cultural construct of the socioecological theory but did not mention the theory by name. This literature review only included literature on health behavior theories. Absent from this review are literature on cultural adaptations and culturally responsive and grounded approaches and models for health.

The strength of this review is its contribution to improving complementary feeding practices through the examination of the literature on health behavior theories and models aimed at understanding why caregivers behave the way they do. Health behavior theories help guide future research and programmatic efforts to be more successful, and help inform the design of effective intervention strategies.<sup>18</sup> Public health efforts to reduce health disparities among vulnerable populations stand to benefit from research and programs employing relevant and meaningful activities intended to make the behaviors of caregivers healthier.

## **Conclusion**

Health behavior theories equip researchers with tools to create systematic, scientific approaches. Theories also serve to prevent the likelihood of researchers acting on instinct or unintentionally repeating earlier solutions. The National Cancer Institute's guide "Theory at a Glance" quotes this Winston Churchill saying, "I pass with relief from the tossing sea of Cause and Theory to the firm ground of Result and Fact" to summarize the effect of health behavior theories.<sup>18</sup>



Grounding complementary feeding studies in such theories greatly strengthens the efficacy of efforts to reduce health disparities in at risk populations. This review highlighted the profound ability health behavior theories have in explaining reasons for behaviors. It also points to the need for additional research so there will be a more comprehensive understanding of why caregivers choose to complementarily feed their infants in the ways they do. In light of the prevalence of childhood obesity, it is important to have synergy among the different ecological levels influencing the establishment of a child's healthy dietary foundation.

## References

1. Thompson AL, Bentley ME. The critical period of infant feeding for the development of early disparities in obesity. *Social Science & Medicine*. 2013;97:288-296. doi:10.1016/j.socscimed.2012.12.007
2. World Health Organization (WHO). Indicators for Assessing Infant and Young Child Feeding Practices: Conclusions of a Consensus Meeting Held 6-8 November 2007 in Washington D.C., USA. World Health Organization (WHO); 2008.
3. Fialkowski MK, Ng-Osorio J, Kai J, et al. Type, Timing, and Diversity of Complementary Foods Among Native Hawaiian, Pacific Islander, and Filipino Infants. *Hawaii J Health Soc Welf*. 2020;79(5 Suppl 1):127-134.
4. Infant Food and Feeding. Published online 2021. <https://www.aap.org/en-us/advocacy-and-policy/aap-health-initiatives/HALF-Implementation-Guide/Age-Specific-Content/Pages/Infant-Food-and-Feeding.aspx>
5. Childhood Obesity Causes & Consequences. Centers for Disease Control and Prevention; 2021. <https://www.cdc.gov/obesity/childhood/causes.html>

6. Breastfeeding: Frequently Asked Questions (FAQ). Centers for Disease Control and Prevention; 2021. Accessed February 24, 2022.  
<https://www.cdc.gov/breastfeeding/faq/index.htm#howlong>
7. Cusick S, Georgieff MK. The First 1,000 Days of Life: The Brain's Window of Opportunity. UNICEF; 2013. <https://www.unicef-irc.org/article/958-the-first-1000-days-of-life-the-brains-window-of-opportunity.html>
8. Pietrobelli A, Agosti M, the MeNu Group. Nutrition in the First 1000 Days: Ten Practices to Minimize Obesity Emerging from Published Science. *IJERPH*. 2017;14(12):1491. doi:10.3390/ijerph14121491
9. Singhal A, Lanigan J. Breastfeeding, early growth and later obesity. *Obesity Reviews*. 2007;8(s1):51-54. doi:10.1111/j.1467-789X.2007.00318.x
10. Singhal A, Lucas A. Early origins of cardiovascular disease: is there a unifying hypothesis? *The Lancet*. 2004;363(9421):1642-1645. doi:10.1016/S0140-6736(04)16210-7
11. Young BE, Johnson SL, Krebs NF. Biological Determinants Linking Infant Weight Gain and Child Obesity: Current Knowledge and Future Directions. *Advances in Nutrition*. 2012;3(5):675-686. doi:10.3945/an.112.002238
12. Okihiro M, Davis J, White L, Derauf C. Rapid Growth from 12 to 23 Months of Life Predicts Obesity in a Population of Pacific Island Children. Published online 2013:11.
13. Monteiro POA, Victora CG. Rapid growth in infancy and childhood and obesity in later life - a systematic review. *Obesity Reviews*. 2005;6(2):143-154. doi:10.1111/j.1467-789X.2005.00183.x
14. Baird J, Fisher D, Lucas P, Kleijnen J, Roberts H, Law C. Being big or growing fast: systematic review of size and growth in infancy and later obesity. *BMJ*. 2005;331(7522):929. doi:10.1136/bmj.38586.411273.E0
15. Gardner DSL, Hosking J, Metcalf BS, Jeffery AN, Voss LD, Wilkin TJ. Contribution of Early Weight Gain to Childhood Overweight and Metabolic Health: A Longitudinal Study (EarlyBird 36). *Pediatrics*. 2009;123(1):e67-e73. doi:10.1542/peds.2008-1292

16. Gillman MW. Early infancy – a critical period for development of obesity. *J Devel Orig Health Dis.* 2010;1(05):292-299. doi:10.1017/S2040174410000358
17. Social and Behavioral Theories. National Institutes of Health  
<https://obssr.od.nih.gov/sites/obssr/files/Social-and-Behavioral-Theories.pdf>
18. Theory at a Glance: A Guide for Health Promotion Practice. Createspace; 2012.
19. The Social-Ecological Model: A Framework for Prevention. Published online 2022.  
<https://www.cdc.gov/violenceprevention/about/social-ecologicalmodel.html>
20. Brennan L, Castro S, Brownson RC, Claus J, Orleans CT. Accelerating evidence reviews and broadening evidence standards to identify effective, promising, and emerging policy and environmental strategies for prevention of childhood obesity. *Annu Rev Public Health.* 2011;32:199-223. doi:10.1146/annurev-publhealth-031210-101206
21. Boak R, Virgo-Milton M, Hoare A, et al. Choosing foods for infants: a qualitative study of the factors that influence mothers. *Child: Care, Health and Development.* 2016;42(3):359-369. doi:10.1111/cch.12323
22. Lakhanpaul M, Benton L, Lloyd-Houldey O, et al. Nurture Early for Optimal Nutrition (NEON) programme: qualitative study of drivers of infant feeding and care practices in a British-Bangladeshi population. *BMJ Open.* 2020;10(6):e035347. doi:10.1136/bmjopen-2019-035347
23. Higgins B. Puerto Rican Cultural Beliefs: Influence on Infant Feeding Practices in Western New York. *J Transcult Nurs.* 2000;11(1):19-30.  
doi:10.1177/104365960001100105
24. Hamilton K, Daniels L, White KM, Murray N, Walsh A. Predicting mothers' decisions to introduce complementary feeding at 6 months. An investigation using an extended theory of planned behaviour. *Appetite.* 2011;56(3):674-681. doi:10.1016/j.appet.2011.02.002
25. Mutiso JM, Okello JJ, Lagerkvist CJ, Muoki P, Kosura WO, Heck S. Effect of nutrition education and psychosocial factors on child feeding practices: findings of a field experiment with biofortified foods and different women categories. *Ecology of Food and Nutrition.* 2018;57(4):346-371. doi:10.1080/03670244.2018.1492382

26. Horodynski M, Olson B, Arndt MJ, Brophy-Herb H, Shirer K, Shemanski R. Low-Income Mothers' Decisions Regarding When and Why to Introduce Solid Foods to Their Infants: Influencing Factors. *Journal of Community Health Nursing*. 2007;24(2):101-118. doi:10.1080/07370010701316247
27. Heinig MJ, Follett JR, Ishii KD, Kavanagh-Prochaska K, Cohen R, Panchula J. Barriers to Compliance With Infant-Feeding Recommendations Among Low-income Women. *J Hum Lact*. 2006;22(1):27-38. doi:10.1177/0890334405284333
28. Walsh A, Kearney L, Dennis N. Factors influencing first-time mothers' introduction of complementary foods: a qualitative exploration. *BMC Public Health*. 2015;15(1):939. doi:10.1186/s12889-015-2250-z
29. Taylor NJ, Sahota P, Sargent J, et al. Using intervention mapping to develop a culturally appropriate intervention to prevent childhood obesity: the HAPPY (Healthy and Active Parenting Programme for Early Years) study. *Int J Behav Nutr Phys Act*. 2013;10(1):142. doi:10.1186/1479-5868-10-142
30. on behalf of the BiB childhood obesity scientific group, McEachan RRC, Santorelli G, et al. The HAPPY (Healthy and Active Parenting Programme for early Years) feasibility randomised control trial: acceptability and feasibility of an intervention to reduce infant obesity. *BMC Public Health*. 2016;16(1):211. doi:10.1186/s12889-016-2861-z
31. Black MM, Siegel EH, Abel Y, Bentley ME. Home and Videotape Intervention Delays Early Complementary Feeding Among Adolescent Mothers. *PEDIATRICS*. 2001;107(5):e67-e67. doi:10.1542/peds.107.5.e67
32. Silk KJ, Horodynski MA, Rienzo M, Mercer L, Olson B, Aldrich R. Strategies to Increase Health Literacy in The Infant Feeding Series (TIFS): A Six-Lesson Curriculum for Low-Income Mothers. *Health Promotion Practice*. 2010;11(2):226-234. doi:10.1177/1524839908326380

Chapter 3: Perceived support for complementary infant feeding practices: A qualitative study of caregivers of Native Hawaiian, Other Pacific Islander, and Filipino infants.

### **Abstract**

Decisions about the timing and type of complementary foods are important determinants in the establishment of dietary patterns that promote healthy growth and long-term well-being. This qualitative study explored the perceptions of support from family, friends, and community for complementary feeding practices among caregivers of Native Hawaiian and Other Pacific Islander (NHPI) and Filipino infants. Twenty-nine caregivers of NHPI and Filipino infants age 3-12 months old residing on O‘ahu, Hawai‘i, were quota sampled from a larger study to include caregivers who exclusively fed human milk to their infants (n=16) and caregivers who did not exclusively feed human milk to their infants (n=13). Nearly 60% of the caregivers introduced complementary food when their infant was <6 months old. The majority of the caregivers who practiced timely complementary feeding practices did not exclusively feed human milk to their infants. Key sources of support were family and health professionals. A unique observation was caregivers who exclusively fed human milk were more likely to seek out and follow advice from health professionals compared to caregivers of infants not exclusively fed human milk. However, all the caregivers reported learning feeding practices initially from female family members, and then from personal experience, if they had previous children. Key aspects of complementary feeding that came from perceived supporters were advice on the timing and type of complementary foods. However, regardless of the caregivers' chosen complementary feeding practices, caregivers felt supported by their family, friends, and community for how they fed their infants. These findings point to the need for stronger, clearer and consistent messaging within the healthcare sector about the timing of complementary foods, and the inclusion of family in dispersing such messaging.

## **Introduction**

Overweight and obesity during childhood is a major health concern in the US. The Centers for Disease Control and Prevention (CDC) reports an estimated 14% of children ages 2-5 years old, and 20% of 6-19 years old, are obese.<sup>1</sup> Early childhood obesity is concerningly high among the Native Hawaiian and Other Pacific Islander (NHPI) and Filipino populations. The Supplemental Nutrition Program for Women, Infants and Children (WIC) in Hawai‘i observed that 17.5% of Samoan children, age 12 months, were at or above the 95th percentile of weight-for-age, compared to 5.9% of White children.<sup>2</sup> Moreover, Samoan children, 2-8 years of age, were almost 4 times as likely to have a Body Mass Index at or above the 95th percentile compared to White children of the same age.<sup>2</sup> In the US-Affiliated Pacific region, prevalence of obesity and acanthosis nigricans in children 2 – 8 years old were high among NHPI in comparison to other race or ethnic groups.<sup>3</sup> In Hawai‘i, a sample of children, predominantly NHPI and Filipino, who experienced rapid growth between 12 – 23 months were at the highest risk for child obesity at 4–5 years old compared to those who did not experience rapid growth during the same interval.<sup>4</sup> The gravity of childhood obesity is the progression of adverse health conditions and their persistence into adulthood.<sup>5</sup> The prevalence of obesity and type 2 diabetes in the Pacific region is among the highest in the world.<sup>6</sup> Research focused on the NHPI populations found these ethnicities are 3.3 times more likely to die from diabetes compared to the general population in Hawai‘i.<sup>7</sup>

Nutrition during the first 1000 days of life is paramount to establishing healthy outcomes later in life to decrease the risk for adverse health conditions including obesity.<sup>8</sup>

Complementary feeding is the stage in infant feeding when infants are transitioning from

consuming only human milk and/or infant formula to consuming other foods and beverages in addition.<sup>9,10</sup> Complementary feeding practices include the type, timing, and diversity of complementary (i.e. first) foods.<sup>11</sup> These practices shape long-term eating behaviors, and if unhealthy behaviors take hold, the likelihood of adverse health conditions are significant.<sup>12</sup> According to the Centers for Disease Control and Prevention, early introduction to food prevents infants from being exclusively breastfed during the first 6 months of life.<sup>13</sup> Effects of this include the increased likelihood of gastrointestinal infections for the infant and slower maternal weight loss after birth for the mother.<sup>13</sup> Moreover, early introduction to complementary foods (e.g. <4 months) increases the risk for overweight and obesity later in life.<sup>13</sup> How parents decided to meet the nutritional needs of their infants starting at birth<sup>14,15</sup> and continuing for the first 1,000 days postpartum profoundly impacts the infants nutrition and long-term health.<sup>16,17</sup>

In Hawai'i, complementary feeding practices differed across race or ethnic groups, with certain races or groups introducing complementary foods earlier than 4 months of age.<sup>11,18</sup> Moreover, body size of NHPI and Asian children was bigger compared to children from other race or ethnic groups.<sup>19</sup> Oshiro and colleagues suggested cultural aspects may contribute to disparities in childhood obesity, citing that child feeding practices are influenced by culture, and culture differs by race or ethnic groups.<sup>19</sup>

Complementary feeding practices present a significant disease prevention and health promotion stage especially for populations who suffer disproportionately from chronic disease<sup>20</sup> and obesity in comparison to other ethnic groups.<sup>3</sup> The influences on complementary feeding practices highlights the impact additional supports (e.g. support from

family and society) has on the behaviors of parents.<sup>16 21 22 2324</sup> For example, the internet provides support by giving parents information and access to educational resources.<sup>25 26</sup> Family provides support by giving tangible resources such as financial assistance.<sup>25 26</sup> This can be seen in the support grandparents give when they informally care for their grandchildren from which they influence the food and eating environments of these children.<sup>27</sup> Fathers of infants and licensed childcare providers are also known to influence infant feeding decisions.<sup>28,29</sup> Identifying supports for and influences on infant feeding practices is crucial to improving childhood nutrition, especially in unique populations like NHPI and Filipinos who are underrepresented in research.<sup>30</sup>

The purpose of this study was to qualitatively examine complementary feeding practices among caregivers of NHPI and Filipino infants. This study explored the perceptions caregivers have of the support from family, friends, and within their community for their chosen complementary feeding practices. Caregiver perceptions may differ between caregivers who follow feeding recommendations by feeding their infants at or after 6 months of age, and caregivers who do not follow feeding recommendations and fed before 6 months. Nutritional behaviors are known to be informed by personal beliefs and the socio-cultural environment.<sup>31,32</sup> Therefore, perceptions may differ between caregivers who fed only human milk and those who did not only feed human milk.

## **Methods**

Qualitative and quantitative methods were used to address the research question. All caregivers gave written consent to participate before data collection activities started. This study was deemed exempt by the University of Hawai'i Institutional Review Board.



## Study Sample

This sub-study was part of a larger study designed to examine complementary feeding practices among NHPI and Filipino infants residing on O‘ahu, Hawai‘i.<sup>11</sup> The larger study aimed to examine timing and types of complementary foods introduced first to NHPI and Filipino infants ages 3 – 12 months, and examine the dietary diversity of those NHPI and Filipino infants ages 6 – 12 months of age. Recruitment and data collection occurred from spring 2018 to spring 2019. The larger study recruited infants using convenience sampling through community-based events (e.g., Baby Expo), programs (e.g., WIC), professional networks (e.g., colleagues), and personal networks (e.g., friends and family). Infants were eligible if they were between the ages of 3 – 12 months, consuming complementary foods, and were at least one of the following ethnicities: Native Hawaiian, Other Pacific Islander or Filipino.<sup>11</sup> The aforementioned eligibility criteria were the criteria of the “Exploring First Foods of Keiki on O‘ahu, Hawai‘i” pilot project, and were informed by previous research.<sup>18</sup> A total of 70 infants and their caregivers completed the larger cross-sectional study.<sup>11</sup> A total of 32 caregivers completed this sub-study.

Researchers used the database from the larger study to draw a subsample of caregivers to interview about their complementary infant feeding practices. The subsample was quota sampled for caregivers’ initial infant feeding practice of only feeding human milk or not only feeding human milk. Caregivers self-reported which practice they did. The length of time feeding human milk was not accounted for as the recommendation to feed human milk is for at least the first year of life.<sup>9,33</sup> The goal was to interview 16 caregivers for each type of initial feeding practice. These interviews were optional, and caregivers were compensated with a

gift card at the end of the interview. Of the 32 caregivers, 29 were included in this qualitative study. Three caregivers were associated with foster care for their infant, and their interviews were excluded from this analysis due to not having an adequate sample to portray the foster care demographic accurately.

### Questionnaire

Data collection activities for the larger study included online surveys using a secure online web application. The researcher-developed demographic questionnaire collected information about the infant and the caregiver including caregiver-reported infant birth date, sex, race or ethnic groups, WIC and Supplemental Nutrition Assistance Program (SNAP) benefits, and infant feeding behaviors (e.g. human milk feeding and infant formula feeding). Data from the responses of the 29 caregivers interviewed were collated and used in this qualitative study.

### In-depth Interviews

The data collection activity in this qualitative study were in-depth, semi-structured interviews. All 29 caregivers gave permission to be audio recorded before the start of the interview, and all interviews were done at a date, time, and private location convenient for them. The interview protocol was adapted from the research by Fialkowski and colleagues and allowed interviewers to guide the conversation to gain specific information from the interviewees, as well as the flexibility to respond to the situation at hand (e.g., emerging worldview, new ideas or direction).<sup>34</sup> The research question that guided the qualitative data collection was “What influences decision-making on first foods of NHPI and Filipino infants?” Eleven leading questions and their follow-up questions were posed to all caregivers in the interviews (Table 4).

Two of the eleven leading questions were analyzed in this study (Table 4). The subset of questions being reported here are: “How did you learn to feed your baby?” and “Who do you go to for advice?” The researchers agreed on these questions to reveal whether caregivers perceived support from family and friends for their complementary feeding practices. These questions would also identify other supportive behaviors within their community.

**Table 4: In-depth Interview Questions asked to Caregivers.**

In-depth interview questions used to explore factors influencing complementary infant feeding practices of caregivers of Native Hawaiian and Other Pacific Islander and Filipino infants.

<ol style="list-style-type: none"> <li>1. Tell me about your childhood?             <ol style="list-style-type: none"> <li>a. Where did you grow up?</li> <li>b. Who raised you?</li> <li>c. What were some cherished memories from your childhood?</li> </ol> </li> <li>2. Tell me about what you ate growing up?</li> <li>3. What does a healthy baby look like to you?             <ol style="list-style-type: none"> <li>a. How do you know if a baby is sick?</li> </ol> </li> <li>4. What foods do you think are considered healthy for babies?</li> <li>5. How did you learn about what to feed your baby?<sup>a</sup> <ol style="list-style-type: none"> <li>a. Who are your kumu<sup>b</sup>?</li> <li>b. What are your kumu<sup>b</sup> skills?</li> <li>c. Where are they from?</li> </ol> </li> <li>6. What do you feed your baby?             <ol style="list-style-type: none"> <li>a. How is your baby’s food prepared? Mashed? Pureed? Pre-chewed?</li> <li>b. Who prepares your baby’s food?</li> <li>c. Where do you get your baby’s food?</li> </ol> </li> <li>7. Who do you go to for advice about feeding your baby?<sup>a</sup> <ol style="list-style-type: none"> <li>a. Do you go to a doctor? Nurse? Parent expert? Family?</li> <li>b. If someone gave you advice would you follow it?</li> <li>c. Were roles determined by age or gender?</li> </ol> </li> <li>8. When did you feed your baby something other than milk? Milk being breastmilk, formula, condensed milk, cow’s milk, or any other type of milk.             <ol style="list-style-type: none"> <li>a. Was this different from what you were told to do?</li> </ol> </li> <li>9. What are your earliest recollections about how baby(ies) were fed in your family?             <ol style="list-style-type: none"> <li>a. What were the roles of other family members in feeding the baby?</li> </ol> </li> </ol>
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- |   |
|---|
| <ul style="list-style-type: none"><li>b. Were roles determined by age or gender?</li></ul> <p>10. What ways of feeding babies have remained among your family?</p> <ul style="list-style-type: none"><li>a. In your family, how has the feeding of babies changed over time from your generation to the next?</li></ul> <p>11. Through your like experiences how has your perception of feeding babies changed?</p> <ul style="list-style-type: none"><li>a. What in our community supports parents in serving traditional Hawaiian foods to their babies?</li><li>b. What makes it difficult for parents who want to serve traditional Hawaiian foods to their babies?</li></ul> |
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<sup>a</sup> These are the questions were used in this study

<sup>b</sup> Kumu is the ‘Ōlelo Hawai‘i word for teacher.

<sup>c</sup> Kupuna is the ‘Ōlelo Hawai‘i word for grandparent.

## Analysis

Two researchers thematically analyzed the caregivers’ responses to the two interview questions together. Analysts debriefed to confirm the codebook and determine data saturation. Content analysis reduced the data and data saturation identified core themes and meanings.<sup>35</sup> Saturation is indicated by data replication or redundancy.<sup>36</sup> Qualitative trustworthiness, a means of rigor, was upheld through credibility, transferability, dependability, and confirmability techniques.<sup>37</sup> Transferability was supported through the use of representative quotes and rich descriptions of the context and of the participants. The qualitative data analysis occurred at the University of Hawai‘i at Mānoa campus. The Cohen’s kappa was used to determine interrater reliability between the two raters after the third interview. Frequencies of the emerging themes were compared within and between groups to explore the perceptions of infant feeding practices. The demographic data were descriptively analyzed with IBM SPSS Statistics Version 27.0 (SPSS Inc: Chicago, IL, USA). Study identification numbers were used in the place of names for analysis.

## Results

### Description of the Infants

There were 29 caregivers interviewed of which 16 only fed human milk (HM) to their infants and 13 who fed infant formula and human milk (IFHM) to their infants. 17 caregivers fed complementary food before their infant was 6 months old (<6 mo), and 12 caregivers fed complementary food at or above 6 months old ( $\geq 6$ mo). Nearly 60% of caregivers who fed  $\geq 6$ mo, had fed their infant infant formula and human milk (IFHM). Majority of caregivers who complementary fed their infants <6mo had exclusively fed human milk (HM) to their infants. More than half of all the infants were Native Hawaiian and between 6 to 12 months of age at the time of the interview. Most of the infants were female and had older siblings (Table 5).

**Table 5: Demographics of Caregivers and Infants Interviewed.**

Demographics and feeding practices of infants 3–12 months of age and their caregivers (n=29) separated into different infant feeding groups: Infants fed before 6 months of age (<6 months), infants fed at or above 6 months of age ( $\geq 6$  months), infants fed infant formula and human milk (IFHM), infants fed only human milk (HM)

Characteristic	<6 months n =17	$\geq 6$ months n =12	IFHM n =13	HM n =16
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Caregiver Age (years)	29.7(6)	31.9(5)	31.5(5)	29.9(5)
Infant Age (months)	6.3(1.8)	8.7(1.7)	7(2.5)	7.5(1.8)
	n(%)	n(%)	n(%)	n(%)
Age Group				
3–5 Months	7(41)	N/A	4(31)	3(19)
6–12 Months	10(59)	12(100)	9(69)	13(81)
Infant Sex				

Male	10(59)	2(17)	4(31)	8(50)
Female	7(41)	10(83)	9(69)	8(5)
<b>Infant Race or Ethnic Group</b>				
Native Hawaiian or Part-Native Hawaiian Only	14(82)	7(58)	7(54)	11(69)
Other Pacific Islander Only <sup>a</sup>	0(0)	1(8)	0(0)	1(6)
Filipino Only	3(18)	4(33)	6(46)	4(25)
<b>Caregiver Race or Ethnic Group</b>				
Native Hawaiian or Part-Native Hawaiian Only	8(47)	5(42)	6(46)	7(44)
Other Pacific Islander Only <sup>a</sup>	0(0)	1(8)	0(0)	1(6)
Filipino Only	3(18)	2(17)	4(31)	1(6)
Other <sup>b</sup>	6(35)	4(33)	3(23)	7(44)
<b>Birth order of infant</b>				
1 <sup>st</sup> child	8(47)	3(25)	5(39)	6(38)
2 <sup>nd</sup> or more child	9(53)	9(75)	8(62)	10(63)
<b>Primary Language Spoken in Home</b>				
English	15(88)	10(83)	11(85)	14(88)
Non-English	1(6)	0(0)	1(8)	0(0)
Missing Response	1(6)	2(16)	1(8)	2(13)
<b>Employment of caregiver</b>				
Unemployed <sup>c</sup>	3(18)	4(33)	2(15)	4(25)
Employed <sup>d</sup>	14(82)	8(67)	11(85)	12(75)
<b>Milk Types Fed</b>				
Human Milk Only	11(65)	5(42)	N/A	16(100)
Infant Formula and Human Milk	6(35)	7(58)	13(100)	N/A
<b>Timing of Complementary Food Introduction</b>				
Before 6 Months	17(100)	0(0)	6(46)	9(56)
6+ Months	0(0)	12(100)	6(46)	5(31)

Missing Response	0(0)	0(0)	1(8)	2(13)
Received Assistance to Pay for Food <sup>e</sup>	7(41)	5(42)	7(54)	5(31)

SD = Standard Deviation.

<sup>a</sup> Caregivers only identified their infants with the Other Pacific Islander ethnic group(s), including Chamorro, Samoan, Tongan, Maori, Tahitian, and others not specified.

<sup>b</sup> Participants self-reported identifying as Japanese, Chinese, Hispanic and White.

<sup>c</sup> Participants out of work for more than 1 year; Out of work for less than 1 year; Homemaker; Unable to work; Fishing/Farming; Subsistence; Retired.

<sup>d</sup> Participants employed for wages/salary in a full-time/part-time/seasonal vocation or as self-employed.

<sup>e</sup> Food assistance program reported were Special Supplemental Nutrition Program for Women, Infants, and Children (WIC).

#### Description of the Caregivers

Majority of the 29 caregivers were employed. More than half of the IFHM caregivers reported receiving WIC benefits. About 30% of the HM caregivers reported receiving WIC benefits. About 30% of IFHM caregivers and 6% of HM caregivers identified as Filipino. Nearly half of all the caregivers identified as Native Hawaiian (Table 5).

#### Thematic Content Analysis of In-depth Interview

The interrater reliability was 98%. Data saturation was reached by the 26<sup>th</sup> interview; however, all 29 interviews were analyzed. A total of 158 meaningful phrases from the interviews were coded into 7 themes exploring supports for feeding practices. Many of the responses were coded for multiple themes. Caregiver responses to a majority of the interview questions were similar. Key sources of support were family and health professionals (Tables

6 and 7). Key aspects of complementary feeding identified from supports were advice and teachings on when and what to feed infants (Tables 6 and 7).



**Table 6: Themes and Representative Quotes of Caregivers based on timing practice.**

Themes, support types and quotes regarding caregivers' perceived support from family, friends and within their community for their complementary infant feeding practices, separated into two groups of caregivers; caregivers who fed their infant before 6 months of age (n=17) and caregivers who fed their infant at or above 6 months of age (n=12).

Theme	Caregivers fed <6mo n(%)	Representative Quotes from Caregivers	Caregivers fed ≥6mo n(%)	Representative Quotes from Caregivers
Family Support	16(95)	<p>“The doctor said like 6 months but my mom said he can start eating already because he was eating a lot. So she thought it would make it fuller”</p> <p>“When I was with my brother’s girlfriend, I would just watch her and help her make my nephew’s food”</p>	10(83)	<p>“My mom told us what to do and stayed with us for six months.”</p> <p>“My older sisters, mom, mother-in-law, and aunties...I had so many around me and that was more than enough information.”</p>

Friend Support	3(18)	“My best friend. I would ask her what kind of things she would feed her son. She gave me the machine I use to make my daughter’s food.”	7(58)	“Who am I gonna rely on? My girlfriend, you know someone that I’m in constant communication with. I can text her right now and just say ‘you know I’m having a hard time with this what are you doing?’ I can count on my girlfriend”
Community Support: Health Professionals	15(88)	“My doctor said not yet and so we waited to feed him (baby).”  “We actually did give poi first because a doctor actually recommended it and told us the kind he likes.”	10(83)	“What the doctor advises, ultimately that's what I try to follow.”  “The nurse in the hospital was really hands-on. She made sure I knew what I was doing before we left. And I’m still following her instructions.”

Community Support: WIC Program	1(6)	“If I had questions I would ask WIC because I didn't know what to ask the doctor.”	3(25)	“At WIC, they told me I could start giving him solid foods, it was the same time they gave me the check for food vouchers.”
Community Support: Internet	11(65)	“I have a lot of parenting apps on my phone. An app is linked to how old she is.”	8(66)	“Google University is my number one.”

Community Support: Print Material	5(30)	“I would probably say I do read baby books, it's mostly reading.”	4(33)	“I was in the midst of my residency training, so based on what I learned in training and typical residency books, I went with that.”
Community Support: Acquaintance(s)	4(24)	“My babysitter plays a more significant role. She sees us most days and helps me when I’m worried about my daughter.”	4(33)	“I started going to this mommies hui when he was 2 and a half months old. This is my first child but some of the moms had multiple children. They were really helpful. They helped answer some of my questions. I thought three months would have been okay to give him food but one mom was like NO you should wait until he’s 6 months. I then did some research and found that she was right. I needed to wait. So I kept breastfeeding until he was 6 months.”

**Table 7: Themes and Representative Quotes from Caregivers based on feeding practice.**

Themes, support types and quotes regarding caregivers’ perceived support from family, friends and within their community for their complementary infant feeding practices, separated into the Infant Formula and Human milk (IFHM) caregiver feeding group (n=13), and the Human milk only (HM) caregiver feeding group (n=16).

Theme	IFHM Caregivers n(%)	Representative Quotes from IFHM Caregivers	HM Caregivers n(%)	Representative Quotes from HM Caregivers
Family Support	11(85)	<p>“My mom doesn’t need to give me advice because she has already instilled in me what I need to know.”</p> <p>“I have 6 kids so I have raised children before. I am doing what has always worked for me and them.”</p> <p>“My In-laws gave me jarred baby food”</p> <p>“We've already been given so much advice from our family, we're basically a product of a lot of influences”</p>	15(94)	<p>“My mom is a go-to source. She did raise three great kids.”</p> <p>“I would ask my mom, ‘Am I doing it right? Can you come help me?’ “ She kept encouraging me, ‘Oh, keep trying, keep trying.’ ”</p> <p>“This isn’t my first rodeo you know? I have learned a lot from my first and second.”</p> <p>“My husband taught me.”</p>

Friend Support	5(39)	<p>“I have a friend with kids, and I ask her, she tells. She’s Poly too.”</p> <p>“I do get help from my friends. We share things we find. We all believe in the same things.”</p>	6(38)	<p>“My friend who is my neighbor. She knows her stuff and has babies, she’s right there. I just ask her. I’m fortunate to have that source when I need it.”</p>
Community Support: Health Professionals	10(77)	<p>“I do ask the doctor, especially with my baby and his allergies”</p>	16(100)	<p>“The nurse in the hospital was really hands-on. She made sure I knew what I was doing before we left. And I’m still following her instructions.”</p>

Community Support: WIC Program	4(31)	“I also get WIC and so I get advice from them. I try to do what they tell me.”	0(0)	
Community Support: Internet	8(62)	“Pinterest and YouTube actually...me and my husband YouTubed everything.”  “I've read what's on baby websites.”	11(69)	“I have the app...I like the tips for my baby and for me”  “YouTube and like the Internet taught me.”

Community Support: Print Material	4(31)	“I have books about baby’s first year and also on the first two years, I like reading them.”	5(31)	“I kind of know about nutrition from my nursing classes and books.”
Community Support: Acquaintance(s)	1(8)	“A lot of people are giving us advice, like our coworkers and neighbors. it's cool, I appreciate them for sharing. And they generally get excited sharing.”	6(38)	“I have a Facebook group with other pediatricians who are moms. I really appreciate it, because we share new information as it comes out from the literature.”



Theme: Perceived support from family

Caregivers perceived support from family, saying they learned complementary feeding practices from family members (Tables 6 and 7). Regardless of the timing of complementary feeding (<6 months or ≥6 months), a majority of caregivers said their family supported their decisions to feed their infants the way they do. Caregivers said family members gave advice, suggestions, and information on key aspects of complementary feeding. Key aspects were when to start feeding by recognizing cues and signs of readiness or at what age the infant will be ready and what to start with such as fresh poi (steamed and mashed taro root) or homemade purees.

Family members mentioned were female members (i.e. mothers, grandmothers, sisters, aunts), spouses and partners. Caregivers with other children mentioned their personal experience feeding their other children supports their infant feeding practices. HM caregivers said they received encouragement, validation and advice from family regarding their complementary feeding practices. IFHM caregivers said they received food and childcare from their family (Table 7).

Theme: Perceived support from friends

Caregivers perceived support from friends, saying they received advice and instructions from friends on complementary feeding practices. Support from friends was mentioned by nearly 60% of caregivers who fed ≥6 months (Table 6). In contrast, 18% of caregivers who fed <6 months perceived support from their friends. As for the caregivers who fed IFHM, they were more likely to seek advice on feeding practices from friends compared to HM caregivers (Table 7): advice on complementary feeding practices were on the foods and recipes to try and cookware devices to use.

Theme: Perceived support from within their community

Health professionals in the community mentioned by caregivers were pediatricians and nurses. Nearly 80% of the caregivers who fed  $\geq 6$  months and about 90% of caregivers who fed  $< 6$  months said they get support from health professionals in the form of advice and information (i.e. when to start and what to start with). Caregivers who fed only HM were more likely to seek out and follow complementary feeding advice and recommendations from health professionals (Table 7). They were also more likely to view these professionals as advisers compared to the caregivers who fed IFHM (Table 7).

Even though 40% of the caregivers in this study reported receiving WIC assistance in their demographic questionnaire (Table 5), only four caregivers mentioned they received education and advice from WIC regarding complementary feeding recommendations like when to start and what foods to start with (Table 6). Three of these caregivers who mentioned WIC support introduced complementary food at 6 months.

Majority of caregivers perceived the internet and its online communities as support, saying they received advice on complementary feeding practices. Advice mentioned were about the signs of readiness and weaning techniques, and what foods to feed and recipes to try. Internet platforms mentioned were Google, YouTube, Pinterest, blogs and mobile device applications.

Nearly a third of caregivers said they read printed materials available to them from their community. Printed materials mentioned were baby books, parenting magazines, academic textbooks and pamphlets from medical offices. Caregivers said these printed materials

informed them on the timing of complementary feeding practices and strategies to get their infants to eat recommended foods.

## **Discussion**

This study to qualitatively explored caregivers' perspectives on complementary feeding practices for NHPI and Filipino infants. Sources of support frequently mentioned were family and health professionals. However, caregivers did perceive support from their friends and the internet. Support came in the form of advice and information on when to introduce complementary food and what the food should be. Overall, caregivers perceived general support for their decisions from these entities regardless of their chosen complementary feeding practices.

Family members were frequently mentioned by all the caregivers as teachers of and advisers on complementary feeding practices. This was also observed by Abel and colleagues in their study of Pacific Islander (i.e. Maori, Tongan, Samoan, Cook Islanders, Niuean) mothers of infants.<sup>38</sup> Abel et al. observed family was central in providing support and advice to these mothers. Mothers were observed to frequently negotiate between their cultural ways of rearing children and Western ideologies.<sup>38</sup> Elsewhere, Australian mothers were observed to also highly value advice from family and friends, perceiving their advice as more practical.<sup>39</sup>

A noteworthy observation is a low mention of WIC support by caregivers. A goal of the WIC program is to support increased consumption of healthful food groups among infants.<sup>40</sup> This food assistance program provides a coping mechanisms to protect infants from being disadvantaged nutritionally.<sup>40</sup> This highlights the impact socio and economic environments

have on caregivers' feeding decisions.<sup>31</sup> According to Black and colleagues, cultural barriers exist when mothers shape their feeding perceptions about what they hear to be in line with their cultural norms.<sup>41</sup> WIC may benefit from additional approaches that are inclusive of their clients' culture and lifestyles in their initiatives to promote feeding recommendations.

According to the CDC, early introduction to complementary food differs by the milk type being fed to infants.<sup>13</sup> About 32% of infants who received both infant formula and human milk were observed to be eating complementary food at 4 months, while 19% of infants receiving only human milk were eating complementary food at 4 months.<sup>13</sup> This national trend was not seen among the infants in this study. This could point to the cultural characteristic of the Native Hawaiian, Other Pacific Islander and Filipino populations and the diverse cultural environment in Hawai'i, both of which influence feeding behaviors.

The internet with its information has fostered an online learning environment. Adults between the ages of 21-34 years are the highest adopters of technology.<sup>42</sup> The average age of the caregivers who fed <6mo was 30 years while the average age of the caregivers who fed ≥6mo was 32 years. Although learning from print material was mentioned, more caregivers said they learned from online platforms about complementary feeding practices. This suggests the internet is a source of support for caregivers when they are searching for information to form their decisions on when, what and how to feed their infants.

Caregivers with previous children looked to themselves for support, citing their personal experience with complementary feeding as their guide. Schön and Silvén's supports caregivers' assertion of themselves citing the natural parenting approach and the instincts

most parents possess.<sup>43</sup> Online learning coupled with instinctive parenting may strengthen caregivers' view of their infant feeding decisions, and therefore they need not look elsewhere for support.

Although there were small sample sizes of NHPI and Filipino caregivers in this study, differences in perceptions of support were observed between the groups. NHPI and Filipino caregivers who fed HM were more likely to perceive support from others compared to NHPI and Filipino caregivers who fed IFHM. A possible explanation for why these caregivers perceived support for their chosen complementary feeding practices is the initial support they received to feed only HM to their infants was also applied to their complementary feeding decisions. It is known that caregivers who feed only HM to their infants experience greater support for this feeding decision.<sup>16,44-46</sup> Nonetheless, this observation reveals an opportunity for researchers and educators to include health professionals, family members and friends in their efforts to improve the practice of complementary feeding recommendations to better the health and nutrition of infants.

Future studies should further explore the area of social support by having a representative sample of the NHPI and Filipino ethnicities. This will allow for an interesting and important analysis comparing the types of social supports between the ethnic groups. Social support is distinguished by its positive nature and the willingness of those offering the support to help.<sup>24</sup> Wright and colleagues observed family and the internet gave educational resources and informational support to mothers in a rural community; the mothers used this support throughout their infants' first year to make their decision.<sup>24</sup>

Strengths of this study include the focus on NHPI and Filipino infants, their caregivers and their complementary feeding experiences in Hawai‘i. Inclusion of this underrepresented demographic into the current public health literature will expand the existing body of literature on nutritional behaviors to include those of the NHPI and Filipino populations. Moreover, the unique perspectives of these ethnic groups reveals opportunities to improve the health of NHPI and Filipino infants. People are known to change their health behaviors, including dietary habits, in response to their environment and people in their environment.<sup>47,48</sup>

This study worked towards transferability by providing descriptions of the participants, caregivers and the qualitative results so others can determine applicability to their own situation.<sup>34</sup> Researchers acknowledged the inherent difference between caregivers who fed at recommended times ( $\geq 6$  months) and those that did not ( $< 6$  months), as well as the difference between caregivers who fed only human milk and those that fed infant formula and human milk. The range of perspectives collected here are crucial to understanding determinants of complementary feeding practices. This research can be used as a framework for studies aiming to understand influences shaping infant nutrition. Furthermore, this work may inform approaches to increase efficacy of programs and activities through acknowledging and incorporating family, friends, and the community.

Limitations of this study include the convenience sample and quota sampling done. Such sampling techniques may not be representative of the ethnic groups of focus. The self-reporting of ethnic and racial identity(s) by caregivers introduced the additional limitation of self-selection bias. The participants and caregivers in this study were not equally represented

in their demographics (i.e., age, sex, racial/ethnic identification(s), education, occupation, marital status). The researchers acknowledge the potential influence of variables such as age, sex, education, occupation, income, family size, on perceptions and behaviors. Additionally, the focus on NHPI and Filipino ethnic groups, although warranted by their disproportional risk for chronic disease, makes the results not generalizable to a larger population. Future studies will benefit from a larger sample size of Native Hawaiian, Other Pacific Islander and Filipino infants to further ascertain relevant supports shaping complementary infant feeding practices in this population. This will address the need for additional rigorous qualitative research to address the persistent literature gap on the rationales governing complementary infant feeding practices among NHPI and Filipino infants.

## **Conclusion**

Caregivers felt overall support from their family, friends, and community for their complementary feeding practices, regardless if they followed or practiced the recommendations for complementary feeding. These findings point to the need for stronger, clearer and consistent messaging from health professionals about appropriate timing and type of complementary foods. It also points to the need to include family and friends in such messaging efforts. Complementary feeding practices are important milestones in the development of eating behaviors. By understanding sources of support that influence infant nutritional behaviors, opportunities to establish healthy dietary patterns can be identified to help reduce health inequities early on.

## References

1. Prevalence of Childhood Obesity in the United States. Centers for Disease Control and Prevention Accessed February 9, 2022. <https://www.cdc.gov/obesity/data/childhood.html>
2. Baruffi G, Hardy CJ, Waslien CI, Uyehara SJ, Krupitsky D. Ethnic differences in the prevalence of overweight among young children in Hawaii. *Journal of the American Dietetic Association*. 2004;104(11):1701-1707. doi:10.1016/j.jada.2004.08.027
3. Novotny R, Li F, Fialkowski MK, et al. Prevalence of obesity and acanthosis nigricans among young children in the children's healthy living program in the United States Affiliated Pacific. *Medicine*. 2016;95(37):e4711. doi:10.1097/MD.0000000000004711
4. Okihira M, Davis J, White L, Derauf C. Rapid Growth from 12 to 23 Months of Life Predicts Obesity in a Population of Pacific Island Children. Published online 2013:11.
5. Cameron N, Demerath EW. Critical periods in human growth and their relationship to diseases of aging. *Am J Phys Anthropol*. 2002;119(S35):159-184. doi:10.1002/ajpa.10183
6. Hawley NL, McGarvey ST. Obesity and Diabetes in Pacific Islanders: the Current Burden and the Need for Urgent Action. *Curr Diab Rep*. 2015;15(5):29. doi:10.1007/s11892-015-0594-5
7. M A Look, S Soong, J K Kaholokula. Assessment and Priorities for Health and Well-Being in Native Hawaiians and Pacific Islanders. Published online 2020. doi:10.13140/RG.2.2.22162.89286
8. Grote V, Theurich M, Koletzko B. Do complementary feeding practices predict the later risk of obesity?: *Current Opinion in Clinical Nutrition and Metabolic Care*. 2012;15(3):293-297. doi:10.1097/MCO.0b013e328351baba
9. World Health Organization (WHO). Indicators for Assessing Infant and Young Child Feeding Practices: Conclusions of a Consensus Meeting Held 6-8 November 2007 in Washington D.C., USA. World Health Organization (WHO); 2008.



10. Thompson AL, Bentley ME. The critical period of infant feeding for the development of early disparities in obesity. *Social Science & Medicine*. 2013;97:288-296. doi:10.1016/j.socscimed.2012.12.007
11. Fialkowski MK, Ng-Osorio J, Kai J, et al. Type, Timing, and Diversity of Complementary Foods Among Native Hawaiian, Pacific Islander, and Filipino Infants. *Hawaii J Health Soc Welf*. 2020;79(5 Suppl 1):127-134.
12. Fewtrell M, Bronsky J, Campoy C, et al. Complementary Feeding: A Position Paper by the European Society for Paediatric Gastroenterology, Hepatology, and Nutrition (ESPGHAN) Committee on Nutrition. *Journal of Pediatric Gastroenterology & Nutrition*. 2017;64(1):119-132. doi:10.1097/MPG.0000000000001454
13. Chiang KV, Hamner HC, Li R, Perrine CG. Timing of Introduction of Complementary Foods — United States, 2016–2018. *MMWR Morb Mortal Wkly Rep*. 2020;69(47):1787-1791. doi:10.15585/mmwr.mm6947a4
14. MacDonald T, Noel-Weiss J, West D, et al. Transmasculine individuals' experiences with lactation, chestfeeding, and gender identity: a qualitative study. *BMC Pregnancy Childbirth*. 2016;16(1):106. doi:10.1186/s12884-016-0907-y
15. Dinour LM. Speaking Out on “Breastfeeding” Terminology: Recommendations for Gender-Inclusive Language in Research and Reporting. *Breastfeeding Medicine*. 2019;14(8):523-532. doi:10.1089/bfm.2019.0110
16. Blair A, MacGregor E, Lee N. Childhood Obesity and Breastfeeding Rates in Pennsylvania Counties—Spatial Analysis of the Lactation Support Landscape. *Front Public Health*. 2020;8:123. doi:10.3389/fpubh.2020.00123
17. Pietrobelli A, Agosti M, the MeNu Group. Nutrition in the First 1000 Days: Ten Practices to Minimize Obesity Emerging from Published Science. *IJERPH*. 2017;14(12):1491. doi:10.3390/ijerph14121491
18. Goldberg DL, Novotny R, Kieffer E, Mor J, Thiele M. Complementary Feeding and Ethnicity of Infants in Hawaii. *Journal of the American Dietetic Association*. 1995;95(9):1029-1031. doi:10.1016/S0002-8223(95)00280-4

19. Oshiro CES, Novotny R, Grove JS, Hurwitz EL. Race/Ethnic Differences in Birth Size, Infant Growth, and Body Mass Index at Age Five Years in Children in Hawaii. *Childhood Obesity*. 2015;11(6):683-690. doi:10.1089/chi.2015.0027
20. Mau MK, Sinclair K, Saito EP, Baumhofer KN, Kaholokula JK. Cardiometabolic Health Disparities in Native Hawaiians and Other Pacific Islanders. *Epidemiologic Reviews*. 2009;31(1):113-129. doi:10.1093/ajerev/mxp004
21. Scott JA, Binns CW, Graham KI, Oddy WH. Predictors of the early introduction of solid foods in infants: results of a cohort study. *BMC Pediatr*. 2009;9(1):60. doi:10.1186/1471-2431-9-60
22. Duan Y, Yang Z, Lai J, et al. Exclusive Breastfeeding Rate and Complementary Feeding Indicators in China: A National Representative Survey in 2013. *Nutrients*. 2018;10(2):249. doi:10.3390/nu10020249
23. Tatone-Tokuda F, Dubois L, Girard M. Psychosocial Determinants of the Early Introduction of Complementary Foods. *Health Educ Behav*. 2009;36(2):302-320. doi:10.1177/1090198107303307
24. Wright ME. Sources of Infant Care Informational Social Support for Mothers of Infants in the Appalachian Region. Florida Atlantic University; 2015. <http://eres.library.manoa.hawaii.edu/login?url=https://www.proquest.com/dissertations-theses/sources-infant-care-informational-social-support/docview/1780295044/se-2?accountid=27140>
25. Glanz K, Rimer BK, Viswanath K, eds. *Health Behavior and Health Education: Theory, Research, and Practice*. 4th ed. Jossey-Bass; 2008.
26. House JS. *Work Stress and Social Support*. 2. print. Addison-Wesley; 1983.
27. Farrow C. A comparison between the feeding practices of parents and grandparents. *Eating Behaviors*. 2014;15(3):339-342. doi:10.1016/j.eatbeh.2014.04.006
28. Bentley M, Gavin L, Black MM, Teti L. Infant feeding practices of low-income, African-American, adolescent mothers: an ecological, multigenerational perspective. *Social Science & Medicine*. 1999;49(8):1085-1100. doi:10.1016/S0277-9536(99)00198-7

29. Wasser HM, Thompson AL, Maria Siega-Riz A, Adair LS, Hodges EA, Bentley ME. Who's feeding baby? Non-maternal involvement in feeding and its association with dietary intakes among infants and toddlers. *Appetite*. 2013;71:7-15. doi:10.1016/j.appet.2013.06.096
30. Kai J, Chen JJ, Braun KL, et al. Associations between Cultural Identity, Household Membership and Diet Quality among Native Hawaiian, Pacific Islander, and Filipino Infants in Hawai'i. *Children*. 2022;9(1):48. doi:10.3390/children9010048
31. Birch LL, Fisher JO. Mothers' child-feeding practices influence daughters' eating and weight. *The American Journal of Clinical Nutrition*. 2000;71(5):1054-1061. doi:10.1093/ajcn/71.5.1054
32. Byrne R, Magarey A, Daniels L. Food and beverage intake in Australian children aged 12-16 months participating in the NOURISH and SAIDI studies. *Australian and New Zealand Journal of Public Health*. 2014;38(4):326-331. doi:10.1111/1753-6405.12249
33. Breastfeeding: Frequently Asked Questions (FAQ). Centers for Disease Control and Prevention; 2021. Accessed February 24, 2022. <https://www.cdc.gov/breastfeeding/faq/index.htm#howlong>
34. Fialkowski MK, Fonseca-Smith T, Pinto P o EK, Ng-Osorio J. Native Hawaiian Complementary Feeding Practices as Told by Grandparents: A Transgenerational Experience. *Current Developments in Nutrition*. 2021;5(Supplement\_4):40-53. doi:10.1093/cdn/nzaa086
35. Patton MQ, Patton MQ. *Qualitative Research and Evaluation Methods*. 3 ed. Sage Publications; 2002.
36. Bowen GA. Naturalistic inquiry and the saturation concept: a research note. *Qualitative Research*. 2008;8(1):137-152. doi:10.1177/1468794107085301
37. Lincoln YS, Guba EG. *Naturalistic Inquiry*. Sage Publications; 1985.
38. Abel S, Park J, Tipene-Leach D, Finau S, Lennan M. Infant care practices in New Zealand: a cross-cultural qualitative study. *Social Science & Medicine*. 2001;53(9):1135-1148. doi:10.1016/S0277-9536(00)00408-1

39. Russell CG, Taki S, Azadi L, et al. A qualitative study of the infant feeding beliefs and behaviours of mothers with low educational attainment. *BMC Pediatr.* 2016;16(1):69. doi:10.1186/s12887-016-0601-2
40. Campbell S, Chen JJ, Boushey CJ, Eicher-Miller H, Zhu F, Fialkowski MK. Food Security and Diet Quality in Native Hawaiian, Pacific Islander, and Filipino Infants 3 to 12 Months of Age. *Nutrients.* 2020;12(7):2120. doi:10.3390/nu12072120
41. Black MM, Siegel EH, Abel Y, Bentley ME. Home and Videotape Intervention Delays Early Complementary Feeding Among Adolescent Mothers. *PEDIATRICS.* 2001;107(5):e67-e67. doi:10.1542/peds.107.5.e67
42. Boushey C, Spoden M, Delp E, et al. Reported Energy Intake Accuracy Compared to Doubly Labeled Water and Usability of the Mobile Food Record among Community Dwelling Adults. *Nutrients.* 2017;9(3):312. doi:10.3390/nu9030312
43. Schön RA, Silvén M. Natural Parenting — Back to Basics in Infant Care. *Evol Psychol.* 2007;5(1):147470490700500. doi:10.1177/147470490700500110
44. Nickerson LE, Sykes AC, Fung TT. Mothers' experience of fathers' support for breast-feeding. *Public Health Nutr.* 2012;15(9):1780-1787. doi:10.1017/S1368980011003636
45. Hay AE. Volunteer counsellors for supporting breast feeding: Support for breast feeding must be proactive. *BMJ.* 2004;328(7435):349.1. doi:10.1136/bmj.328.7435.349
46. Sciacca JP, Dube DA, Phipps BL, Ratliff MI. A breast feeding education and promotion program: Effects on knowledge, attitudes, and support for breast feeding. *J Community Health.* 1995;20(6):473-490. doi:10.1007/BF02277064
47. Novotny R, Chen C, Williams AE, et al. US Acculturation Is Associated with Health Behaviors and Obesity, but not Their Change, with a Hotel-Based Intervention among Asian-Pacific Islanders. *Journal of the Academy of Nutrition and Dietetics.* 2012;112(5):649-656. doi:10.1016/j.jand.2012.02.002
48. Nelson-Peterman JL, Toof R, Liang SL, Grigg-Saito DC. Long-Term Refugee Health: Health Behaviors and Outcomes of Cambodian Refugee and Immigrant Women. *Health Educ Behav.* 2015;42(6):814-823. doi:10.1177/1090198115590779

Chapter 4: Associations between cultural identity, household membership and diet quality among Native Hawaiian, Pacific Islander, and Filipino infants in Hawai‘i

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### **Abstract**

Public health efforts to reduce diet-related health disparities experienced by indigenous peoples could be enhanced by efforts to improve complementary infant feeding practices. The latter is possible through interventions informed by cultural determinants. This cross-sectional secondary analysis explored possible determinants of the complementary feeding practices of Native Hawaiian, Pacific Islander, and/or Filipino infants (NHPIF) in Hawai‘i, ages 3 – 12 months. The objective was to determine the association between caregiver cultural identity and infant household membership with indicators of infant diet healthfulness. The cultural identities, infant household memberships, early infant feeding practices and additional demographic information (infant age and sex, household income) were assessed via an online questionnaire. Surrogate reporting of the infants’ diets over four days was evaluated using an image-based mobile food record (mFR). Data collected by the mFR were evaluated to derive the World Health Organization’s minimum dietary diversity (MDD) indicator and food group consumption. Data were summarized by descriptive statistics and analyzed using multivariate linear and logistic regressions. Seventy infant participants, ages 3 – 12 months, and their primary caregivers completed the study. Of these, there were 56 infant participants between the age of 6 – 12 months. A total of 48 infants were fed infant formula (either exclusively or in addition to human milk), 39 participants were fed complementary foods before 6 months or older, and an average of about four food groups of out eight groups

were consumed over four days. Approximately 10% of infants, ages 6 – 12 months, met MDD for all four days. Meeting MDD and the number of food groups consumed were significantly associated with age. Caregiver cultural identity, infant household membership and infant sex had non-significant associations with indicators of infant diet quality. Findings inform the influences shaping dietary patterns of Native Hawaiian, Pacific Islander and Filipino infants in Hawai‘i

## **Introduction**

Unhealthy long-term eating patterns, resulting in a multitude of negative consequences and sequelae, often originate during childhood with unhealthy feeding practices.<sup>1,2</sup> Important characteristics of such infant feeding practices include the timing and type of complementary food introduction, both of which impact the foundations of nutritional status and health.<sup>3</sup> Complementary feeding is the stage in infant feeding where infants are transitioning from consuming only human milk and/or infant formula to consuming other nutritive foods and beverages in addition.<sup>3,4</sup>

Diet quality is crucial in relating complementary infant feeding practices to childhood health and nutritional status. The quality of the diet and the quantity of foods consumed are nutritional contributors to diet-related illnesses, such as obesity and diabetes.<sup>5</sup> Diet quality contributing to the risk of becoming obese among older individuals can be seen in the associations between low intakes of nutrient-dense foods, high intakes of energy-dense foods, and indicators of body size.<sup>6</sup> Among infants, dietary diversity is an indicator of the quality of the diet. Diet diversity is a proxy measure of the nutrient density of the foods and liquids consumed. A diverse diet is associated with a better quality diet and can be used to predict the

micronutrient density among infants.<sup>4</sup> However, the diversity of infant diets in the first year of life was observed to be low with sugar sweetened beverage commonly consumed as the first food, and low consumption of fruits and vegetables.<sup>7</sup>

Sound nutritional practices during the first years of life are paramount for healthy growth and development. Research has shown that establishing healthy infant and young child feeding/eating practices during the first 1,000 days of life leads to healthy outcomes experienced throughout an individual's life.<sup>6</sup> In a similar but opposing manner, unhealthy feeding/eating practices established during infancy and childhood may lead to adverse health outcomes.<sup>8</sup> Thus, nutrition early in the lifespan sets the health trajectory of an individual.

The influence nutrition has on the health of infants can be seen by the effect nutrient consumption has on energy availability, metabolism, and growth measures. Rapid growth of Native Hawaiian, Pacific Islander and/or Filipino infants, 12 – 23 months old, was predictive of obesity at 4 – 5 years old.<sup>2</sup> An estimated 14% of children, 2-8 years old, in the US-Affiliated Pacific region were observed to be obese, with the prevalence of obesity higher among the older children in the study.<sup>9</sup> Together, these findings are concerning given the progression of adverse health conditions (i.e., obesity, hypertension, type 2 diabetes) experienced by children and their persistence into adulthood.<sup>10</sup> The prevalence of obesity during adulthood and type 2 diabetes in the Pacific region is among the highest in the world.<sup>11</sup> Native Hawaiian and Pacific Islanders were found to be 3.32 times more likely to die from diabetes compared to the general population in Hawai'i.<sup>12</sup> Rapid infant growth is believed to be a precursor to childhood obesity, and obesity during childhood likely continues into adulthood.<sup>13</sup> A previous study on complementary infant feeding in Hawai'i observed

race or ethnic group differences between infants identified as White, Japanese, Filipino and Native Hawaiian, with the latter race introducing solids earlier than 4 months of age.<sup>14</sup>

A key contributor to an obesogenic environment is the shift from traditional diets high in fiber to diets high in sugars, fat, and animal food sources seen in Western styled eating patterns. These dietary changes result from economic and infrastructure changes and urbanization, ushering in changes to the local food ecosystem.<sup>15</sup> The shift away from traditional foods is impactful, as these foods support spiritual connections between the people preparing and consuming the foods, the natural source of the foods, and the culture and traditions of the people.<sup>16</sup> However, a dilemma exists among indigenous peoples' food and their wider environment as Western-based food types and eating habits have undermined traditional hunting, gathering and growing systems long practiced by these racial and ethnic groups.<sup>16</sup> The normalization of non-traditional diets among indigenous people due to the colonization of indigenous lands and food systems, has ushered in the transition away from cultural dietary patterns to those of another dominating culture.<sup>16-19</sup>

Possible determinants of eating behaviors include social environments such as household environments. From 2009 – 2011, the US Census Bureau found 8% of households with a multiracial householder were multi-generational<sup>20</sup>. Among Native Hawaiian and other Pacific Islander households, about 18% consisted of three or more generations, while 3.7% of non-Hispanic White households and 9% of Black and Asian households were multi-generational.<sup>20,21</sup> Pacific Islanders have reported family, particularly female family members, as central in providing support and advice especially in regard to infant care and feeding.<sup>22</sup>



According to a Consumer Expenditure Survey, such multigenerational households spend less on childcare.<sup>23</sup> Grandparents were found to be an adaptive strategy for low-income or single parent households in offsetting living costs, allowing greater financial investments in the children.<sup>24</sup> The practice and perpetuation of culture, such as preparing and consuming cultural foods, may be supported in a living arrangement where multiple persons have knowledge of and practice cultural traditions and customs.

It is unclear how these influences shape nutrition among Native Hawaiian, Pacific Islander and Filipino infants. This examination is a beginning step in establishing good feeding/eating practices, and progress towards preventing unhealthy behaviors. The researchers here address the need for literature on social and cultural environments of infants to identify determinants of dietary behaviors. The study, which is a secondary analysis, aimed to examine the association between the cultural identity(s) of caregivers, the membership of households, and dietary diversity among NHPIF infants in Hawai'i. Currently, this is the first study to focus on multigenerational households, caregiver cultural identity and the association of these with infant complementary feeding practices in Hawai'i.

## **Methods**

### **Study Design and Setting**

Institutional Review Board (IRB) approval from the University of Hawai'i was received prior to the collection of data (IRB reference number: 2017-00845). The criteria for participation included the infant participant resided on the island of O'ahu at the time of data collection, the caregiver of the infant participant had to be 18 years of age or older, have an iOS mobile device, and have reliable access to the internet and to the iOS device. The infant participant

had to start complementary feeding prior to enrollment and be reported by the caregiver as at least part Native Hawaiian, Pacific Islander or Filipino.

### Recruitment and Consent

A convenience sample of NHPIF infants was recruited through community-based events (e.g., Baby Expo), programs (e.g., Women Infant and Children), professional networks (e.g., colleagues), and personal networks (e.g., friends and family). Consent was obtained in writing from the caregivers for both their participation and their infant's participation prior to collecting any data. Data were collected between March 2018–February 2019.

### Study Outcomes

Caregivers completed online questionnaires using a secure online web application. Questions included feeding behaviors prior to enrollment in the study, place of birth/delivery, annual household income, participation in food assistance programs. Caregivers were asked who currently lives in the child's home and how they are related to the child. Caregivers were also asked to select what specific race or ethnic group(s) best describes their child. The cultural identity scales used here were validated in studies examining the degree of Native Hawaiian cultural and US, Mainland mainstream cultural identifications.<sup>25,26</sup> Briefly, the 8-item cultural identity questionnaire had two subscales: a 4-item ethnic cultural identity subscale and a 4-item US cultural identity subscale. Each subscale asked the caregivers about their degree of identity with involvement in, feelings toward, and knowledge about each cultural group, and the impact each cultural group has on their lifestyle. Responses to each item were reversed scored, so that 1 corresponded to very knowledgeable, very positive, or very involved and 5 corresponded to not knowledgeable at all, very negative, or disinterested. The total possible

scores ranged from 5 to 25, with lower scores indicating a stronger identity.<sup>25,26</sup>

Household composition was examined by categorizing the household into two groups. Modifying Lane and colleagues<sup>27</sup> household composition categories, the following categories were applied in this study: households with only the parent(s) and parent(s) and sibling(s) and households with extended family members including maternal and paternal grandparents, aunts, uncles, cousins, and nonrelative individuals. This variable was used as a proxy for the number of individuals likely to be physically interacting with, caring for, and sharing a common environment with the infant participants on a regular basis.

Infant dietary assessment was completed through surrogate (i.e., caregiver) reporting with the mobile food record (mFR). The mFR is an application designed specifically for the assessment of dietary intake from the Technology Assisted Dietary Assessment (TADA) project (<http://tadaproject.org/>) which uses the camera on a mobile device to capture food and beverage intake, which is then used to estimate energy, nutrients, food and beverage intakes.<sup>28,29</sup> The mFR was loaded onto the caregiver's iOS mobile device and training on the mFR application was completed prior to data collection.

Caregivers were instructed to take before and after images of all foods and beverages the participant consumed over a 4-day collection period (Thursday–Sunday). After the collection period concluded, a member of the research team reviewed the images with caregivers to verify content, as needed, and to probe for any forgotten foods or beverages. At the end of the data collection period, caregivers were compensated with a \$40 gift card.

## Analysis

This study used the global metric Minimum Dietary Diversity (MDD) score from the World Health Organization (WHO) indicators for assessing infant and young child feeding practices.<sup>30</sup> The MDD score provides an indication of the infant's diet quality based on the awareness that consuming a wide range of foods is a tenet of a healthy diet, as it increases the likelihood of meeting nutrient needs. For infants, the number of food groups consumed can predict the nutrient density of the diet.

The MDD indicator is appropriate for use with infants and young children between the ages of 6 – 23 months old. The revised MDD indicator has 8 defined food groups: (1) grains, roots, and tubers; (2) legumes and nuts; (3) dairy products (milk, including formula, yogurt, cheese); (4) flesh foods (meat, fish, poultry, liver/organ meats); (5) eggs; (6) vitamin A-rich fruits and vegetables; (7) other fruits and vegetables; and (8) human milk.<sup>30</sup> All solid foods and liquids consumed over the four days of data collection were enumerated using the mFR. Human milk was counted as consumed daily across the four data collection days for those participants reported as being breastfed. The consumption of human milk was extrapolated from the infant feeding behavior survey question “Is your child still breastfeeding?” The WHO MDD guidelines specifically state the indicator was met if five or more food groups were consumed, on average, each day by infants 6 – 12 months old.<sup>30</sup> For all the infant participants, ages 3 – 12 months old, the average number of food groups consumed over the data collection period was analyzed.

Descriptive statistics were used to summarize the frequencies, means, and standard deviations (n=70). The response variables were the infants' number of daily food group consumption, a

continuous variable, for infants 3 – 12 months old, and the MDD indicator, a dichotomous variable, for infants 6 – 12 months old. The explanatory variables were the continuous cultural identity scores of the caregivers, and the infants’ household composition, a categorical variable. Multivariable linear regression was used to determine if an association exists between the explanatory variables and the number of food groups consumed, after adjusting for sex and age. Logistic regression was conducted to assess the association between the explanatory variables and meeting or not meeting the MDD indicator, after adjusting for sex and age. Statistical significance was set at P-value <.05. All analyses were conducted in IBM SPSS Statistics Version 27.0 (SPSS Inc: Chicago, IL).

## Results

### Descriptive statistics

Seventy infant participants completed the study. Of those who consented, 13 were lost to follow up, resulting in an attrition rate of about 16%. The majority of the infant participants were between 6 – 12 months old and about half were males (Table 8). More than 70% of infant participants were identified by their caregivers as Part-Native Hawaiian or Native Hawaiian, and about 50% were reported as part-Filipino or Filipino. English was the most commonly spoken language in the participants’ homes.

**Table 8: Demographics of Caregivers and Infants with Food Records.**

Demographics and feeding practices of infants 3 – 12 months of age (n=70)

Characteristic	n(%) <sup>a</sup>	Mean(SD)
<b>Age (months)</b>		7.4 (2.1)
Age Group: 3 – 5 Months	14 (20.0)	
Age Group: 6 – 12 Months	56 (80.0)	
<b>Sex</b>		

Male	38 (54.3)	
Female	32 (45.7)	
<b>Race or Ethnic Group<sup>b</sup></b>		
Part-Native Hawaiian or Native Hawaiian Only	50 (71.4)	
Pacific Islander Only <sup>c</sup>	4 (5.7)	
Part-Filipino or Filipino Only	35 (50.0)	
<b>Primary Language Spoken in Home</b>		
English	64 (91.4)	
Non-English	3 (4.3)	
Missing Response	3 (4.3)	
<b>Human Milk or Formula Feeding</b>		
Human Milk Only	22 (31.4)	
Human Milk and Formula <sup>d</sup>	44 (62.9)	
Formula Only	4 (5.7)	
Currently Receiving Human Milk	40 (57.1)	
<b>Timing of Complementary Food Introduction</b>		
Before 6 Months	39 (55.7)	
3 Months or Less	4 (5.7)	
4 – 5 Months	35 (50)	
6+ Months	31 (44.3)	
<b>Timing of Complementary Foods (in Months) by Milk Type</b>		
Human Milk Only (n=21, Missing Response=1)		4.9 (1.4)
Human Milk and Formula (n=42, Missing Response=2)		5.2 (1.2)
Formula Only (n=4)		4.6 (1.3)
<b>Received Assistance to Pay for Food<sup>e</sup></b>	26 (37.1)	
<b>Household Membership Category</b>		
Parent(s) only or Parent(s) and Sibling(s) <sup>f</sup>	44 (62.9)	
Extended family <sup>g</sup> included	26 (37.1)	
<b>Ethnic Group Cultural Identity Score</b>		7.8 (2.5)
<b>US, Mainland Cultural Identity Score</b>		10 (3.2)

<sup>a</sup> May not add up to 100% due to rounding

<sup>b</sup> More than one race or ethnic group may have been self-selected, therefore will not add to 100%

<sup>c</sup> Participants only self-reported identifying with Pacific Islander ethnic groups, including Chamorro, Samoan, Tongan, Maori, Tahitian, and other not specified.

<sup>d</sup> Includes infants who have received infant formula at some point or are currently receiving infant formula

<sup>e</sup> Includes assistance from Supplemental Nutrition Education Program (SNAP) and Special Supplemental Nutrition Program for Women, Infants, and Children (WIC)

<sup>f</sup> Includes households with only the parent(s) and households with parent(s) and sibling(s)

<sup>g</sup> Includes households with maternal and paternal grandparents, aunts, uncles, cousins, and nonrelative individuals.

SD = Standard Deviation

More than 60% of the infants were fed both human milk and infant formula. About 30% of the participants were fed only human milk. Half of the participants were still consuming human milk during the study. About half of the infants were fed non-human milk or infant formula foods (i.e., rice cereal, poi, baby food purees) before turning 6 months old. Across all the participants and the different modes of feeding (i.e., human milk, infant formula or both) the mean age when non-human milk or infant formula foods were introduced was similar at about 5 months of age (Table 8). Household membership was categorized into two groups (Table 8). More than half of the infant participants lived in a household consisting of parent(s) or parent(s) and sibling(s).

### Dietary Healthfulness

Approximately four food groups on average were consumed across the four days of data collection (Table 9). The mean number of days the MDD indicator was met by participants, ages 6 – 12 months, was 2.0 (SD = 1.6). About 10% of participants met the MDD all four days of the data collection (Table 9). No difference was observed in the proportion meeting the indicator by the day of the week (Table 10).

**Table 9: Consumption of Food Groups.**

Number of food groups recorded for infant participants, ages 3 – 12 months (n=70), across the 4 days and by day of the week.

Consumption of Food Groups	Mean (SD)
Across all 4 days	3.7 (1.3)
<b>By day of week</b>	
Thursday	3.9 (1.4)
Friday	3.8 (1.3)
Saturday	3.6 (1.2)
Sunday	3.6 (1.2)

**Table 10: Meeting MDD Indicator.**

Frequency of number of days infant participants, ages 6 – 12 months (n=56), met the Minimum Diet Diversity (MDD)<sup>a</sup> and by day of week.

Meeting MDD Indicator	n(% <sup>b</sup> )
<b>Days Met</b>	
0	22 (39.3)
1	12 (21.4)
2	8 (14.3)
3	8 (14.3)
4	6 (10.7)
<b>Met MDD By Day of Week</b>	
Thursday	24 (10.7)
Friday	19 (8.5)
Saturday	18 (8.0)
Sunday	15 (6.7)

<sup>a</sup> Meeting MDD if the infant is reported to have consumed five or more of the eight food groups.

<sup>b</sup> Numbers may not add up to 100% due to rounding.

### Multivariate Regression Models

Consumption of all eight food groups was not observed among the participants. In the multivariate linear regression models, older age was significantly associated with more food groups consumed (Table 11). In the multivariable logistic regression models, only age was significantly associated with the likelihood of meeting the MDD indicator (Table 12).



**Table 11: Multivariable Linear Regression.**

Multivariable linear regression examining the association between the number of food groups consumed and selected explanatory variables<sup>a</sup> in infants 3 – 12 Months (n=70).

	Model 1		Model 2		Model 3		Model 4		Model 5	
	B(SE)	95% CI	B (SE)	95% CI	B (SE)	95% CI	B (SE)	95% CI	B (SE)	95% CI
Constant	2.0 (0.4)	1.2 – 2.8	1.6 (0.5)	0.7 – 2.6	1.3 (0.5)	0.2 – 2.3	1.4 (0.7)	0.4 – 3.0	1.3 (0.7)	-0.2 – 2.7
Age	0.2 (0.05)***	0.1– 0.3	0.2 (0.05)***	0.1 – 0.3	0.2 (0.06)***	0.1 – 0.4	0.2 (0.06)***	0.1 – 0.4	0.2 (0.06)** *	0.1 – 0.4
Sex			0.3 (0.2)	-0.2 – 0.7	0.3 (0.2)	-0.2 – 0.7	0.3 (0.2)	-0.2 – 0.8	0.3 (0.2)	-0.2 – 0.8
Household Membership					-0.03 (0.2)	-0.5 – 0.5	-0.03 (0.2)	-0.2 – 0.4	-0.05 (0.3)	-0.5 – 0.5
Ethnic Cultural Identity							-0.2 (0.05)	-0.1 – 0.1	-0.03 (0.05)	-0.1 – 0.1
US Mainland Cultural Identity									0.02 (0.04)	-0.1 – 0.1
R-Squared	0.24		0.26		0.27		0.25		0.25	
Adjusted R-Squared	0.23		0.24		0.23		0.21		0.20	
<sup>a</sup> explanatory variables are age, sex, household membership categories, ethnic cultural identity categories and US Mainland cultural identity categories of caregivers *** indicates P-value <0.05 Model 1: Age										

Model 2: Age + Sex  
 Model 3: Age + Sex + household membership categories  
 Model 4: Age + Sex + household membership categories + ethnic cultural identity categories  
 Model 5: Age + Sex + household membership categories + ethnic cultural identity categories + US Mainland cultural identity categories

**Table 12: Multivariable Logistic Regression.**

Multivariable logistic regression results examining the association between meeting the MDD indicator and selected explanatory variables<sup>a</sup> in infants 6 – 12 Months (n=56).

	Crude Analysis		Adjusted Analysis	
	Odds ratios	95% C.I.	Odds ratios	95% C.I.
Sex	2.0	0.7 – 6.0	1.9	0.6 – 6.2
Age	1.6***	1.1 – 2.4	1.6*	1.1 – 2.4
Ethnic cultural identity score	1.0	0.8 – 1.3	1.0	0.8 – 1.3
US, Mainland cultural identity score	1.0	0.8 – 1.2	0.9	0.8 – 1.2
“Extended family” household <sup>a</sup>	0.6	0.2 – 2.0	0.6	0.2 – 4.7
“Parent(s) only or sibling(s) included” household <sup>b</sup>				

\*\*\* indicates P-value <0.05

<sup>a</sup> Households include members who are not parents or siblings

<sup>b</sup> reference group. Household have parent(s) or parent(s) and sibling(s)

## Discussion

This is the first study examining the relationship between cultural identity and household composition on diet quality of NHPIF infants in Hawai'i. In this examination of potential determinates of dietary diversity of infants, age was significantly associated with diet outcomes. This is expected as the infant gains motor control and develops advanced eating skills (i.e., mastication, swallow, acceptance of broader food consistencies, texture, taste). Other studies have made similar observations.<sup>31-33</sup> No associations were observed between household composition, degree of ethnic identity and US, Mainland identity, and diet quality among the 70 infant participants.

This study examined indicators of acculturation (e.g. multigenerational households and cultural identity) to investigate cultural influences on diet. The cultural identity scales used here were adapted from the studies by Kaholokula and colleagues.<sup>25,26</sup> Kaholokula's scales are used as surrogate factors to measure the degree of ethnic cultural identity and US cultural identity of Native Hawaiians. These scales use a bidirectional approach as people can simultaneously identify with two identities to varying degrees.<sup>25</sup> Although there are other scales to examine indicators of acculturation, the scales used in this study are more representative of the history and experiences of the populations of focus.

The lack of literature on indicators of acculturation and diet quality among infants persists. Among the few studies published, Zhang and Benton observed feeding styles and diet quality were not correlated with acculturation among first-generation Chinese immigrant mothers in England.<sup>34</sup> Zhang and Benton assessed acculturation using the Mutual Intercultural Relations in Plural Societies (MIRIPS) Questionnaire. Although Zhang and Benton categorized their participants by acculturation modes, and this study did not, similar findings were observed. However, among US Latino caregivers, low acculturation scores were associated with a parent feeding style related to poorer infant diet quality.<sup>35</sup> Possibly the different acculturation tools used could explain the different associations.<sup>34,35</sup> The Short Acculturation Scale for Hispanics (SASH) is based on language preference which introduces variability of the measurement and proves difficult to make conclusions and comparisons.<sup>35</sup> The literature highlights other factors potentially affecting dietary choices including food availability and familiarity, marketing and advertising, and comprehension of nutrition education.<sup>36,37</sup> Perhaps the ethnic identity a caregiver chooses to associate with is not the strongest influence on their infant's dietary quality.

Although this study observed no association between household membership and diet quality, other studies have found otherwise. Lane and colleagues observed differences in the fecal bacterial composition of infants of different household compositions.<sup>27</sup> Research on aboriginal infants and children in northern Australia found those living in a household of 3 – 5 people had higher meal frequencies compared to those in larger households.<sup>38</sup> However, unlike the research here and by Lane, the relationships between the individuals and the infants and children were not defined.<sup>27</sup> A possible explanation is larger households with more individuals to feed presents additional economic challenges, resulting in less quality foods consumed. Securing traditional and cultural foods for some ethnic groups is financially costly and time consuming.

The joining of family and non-family members into a single cohesive unit potentially misrepresents the living situation.<sup>39</sup> Family encompasses relationships across generations.<sup>40</sup> These intergenerational relationships are diverse in structure and functions, with certain relationships being valuable resources for families.<sup>40</sup> One such valuable intergenerational relationship is that with grandparents. Grandparents may potentially have an important part in family life by providing financial, emotional and practical care and support to their adult children and grandchildren.<sup>41</sup> Benefits of multigenerational households include increased spending on education, decreased spending on childcare, companionship, support and increased likelihood of daily conversations supporting transgenerational exchanges of knowledge and perspectives.<sup>21,23,40,41</sup> Older generations potentially shape infant feeding practices (i.e. timing of solid food introductions). This is seen in the important role female family members have in infant care in Pacific Islander families.<sup>22</sup>

Although there are clear advantages for multigenerational family housing where the grandparents provide support rather than are in need of support, these types of living arrangements are associated with socio-economic disadvantage and lack of personal privacy and control.<sup>39,41</sup> Research focused on African-American families observed non-maternal caregivers such as grandmothers, fathers and licensed childcare providers had a negative effect on age appropriate infant feeding practices.<sup>42,43</sup> This highlights the dynamic nature of family, and how individuals with different roles and varying degrees of control, interact with one another to impact the growth development of infants.

At the time of this research and dietary analysis, the Dietary Guidelines for Americans 2020 – 2025 were not designed, and so the researchers used the WHO dietary diversity indicator as the measurement of diet healthfulness.<sup>4,30</sup> The underlying assumption of the WHO guidelines

is infants will be exclusively fed human milk and/or infant formula until the age of 6 months. Furthermore, WHO designed the dietary diversity score and other measures of Infant and Young Children Feeding Practices (IYCFP) for low income countries, making it inherently more sensitive in settings where food availability is limited.<sup>4</sup> The MDD indicator is designed for infants 6 – 23 months old.<sup>30</sup> Participants in this study included 3 – 5 months old, and therefore, the dietary diversity indicator could not be applied to these participants. The age restriction limits the investigating into the influences shaping early feeding practices in this sub-populations known to introduce solid foods at an early age.<sup>14,31</sup> Exclusively human milk and/or infant formula feeding from birth to 6 months was not seen among the study's participants with 50% of the infants consuming non-human milk and/or infant formula foods before 6 months (i.e. did not meet the WHO timing recommendation for complimentary feeding). This highlights an issue with the indicator as non-human milk and/or infant formula food introductions before the age of 6 months may result in higher dietary diversity scores at the 6 months timepoint. Thus, if an infant started eating non-human milk and/or infant formula at 3 months old, by the time the infant is 6 months, s/he will have 3 months of non-human milk and/or infant formula food exposure compared to an infant starting at the recommended age of 6 months. Therefore, higher dietary diversity scores could be associated with early feeding practices, thus potentially misleading the association between early feeding practices and more diverse diets.

As mentioned previously, the consumption of human milk was constructed from the online survey in which caregivers answered if they were currently breastfeeding. The use of the term breastfeeding presents a limitation and the researchers here recognize that the provision of human milk occurs through multiple means (e.g., breastfeeding, chest feeding, and/or bottle feeding). Using more inclusive terms may have captured infants fed human milk via other methods.

This study was limited by the small sample size of 70 participants between the ages of 3 – 12 months old, and a sub-sample of 56 between the ages of 6 – 12 months old. The participants and caregivers in this study were not equally represented in their demographics (i.e. age, sex, education, occupation, marital status, racial/ethnic identification(s), household membership, income). The researchers acknowledge the potential influence of these caregiver variables (sex, age, education, occupation, etc.) and/or family factors (income, family size, etc.) as limitations of this study.

The convenience sample used in this study may not be representative of the targeted racial or ethnic groups. This study focused on NHPIF infants as a group and was not designed for comparisons between different ethnic groups. Race or ethnic group was self-reported, with over 25% of participants being from more than one racial group. As a result, the infants' race(s) were not included into the analysis. The researchers recognize there could be selection biases or confounding. Future studies should consider using disaggregated race or ethnic group data with purposeful sampling. Furthermore, the sampling has inherent limitations in the statistical analysis approach, including the regression approach possibly being influenced by outliers. Researchers recognize the model described an association with little statistical power to demonstrate statistically significant relationship(s). The associational effect observed may be influenced by section biases and variables having predictor and confounder influences. Confounding variables unknown to the researchers were not also adjusted for in the model.

This study is a secondary analysis of a cross-sectional pilot study focused on infants of racial and ethnic groups, a poorly represented demographic in the current public health literature. The work here not only adds a unique focus on health issues of this population but also examines unique characteristics of this population and the potential these characteristics modify the caregiver and infant feeding relationship.

Finally, this study used an innovative mobile technology-based dietary assessment tool (e.g. mFR) to improve the accuracy of dietary intakes and reduce the risk of recall bias.<sup>31</sup> The dietary data collected was the first time an image-based dietary assessment tool was used to enumerate the intake of infants. The mFR used in this study was designed for iOS mobile devices, limiting the study to those with this mobile operating system. Future studies using the mFR for infant dietary intakes should include users of other mobile operating systems. Although the explanatory variables of interest were not significantly associated with diet diversity, recognizing the transition individuals from racial and ethnic groups undergo as their environments and the surrounding cultures change, is crucial to understanding how people adapt to the dominate culture(s) around them.

## **Conclusions**

The influence of culture on health and lifestyle behaviors emphasizes the importance of understanding the attitude and beliefs surrounding a person's cultural identify. Adverse health outcomes such as diet-related illnesses, are associated with aspects of life such as food intake, physical activity, language comprehension, education and knowledge, all of which are

influenced by culture.<sup>44,45</sup> Research suggests people will change their health behaviors including dietary habits and physical activity to reflect the dominant culture of their surrounding environment.<sup>14,42,43</sup> Initiatives to improve health outcomes will be strengthened when appropriate, and respectful incorporation of culture, traditions and ways of living are part of the design and administration of such strategies.<sup>1</sup> Primary prevention strategies stand to benefit from understanding the influence of people's social and cultural environments on their dietary behaviors. These strategies should encompass complementary infant feeding practices, which are important milestones in the development of an individual's health and thus impact long-term health and nutrition status.

## References

1. Lloyd LJ, Langley-Evans SC, McMullen S. Childhood obesity and risk of the adult metabolic syndrome: a systematic review. *Int J Obes.* 2012;36(1):1-11. doi:10.1038/ijo.2011.186
2. Okihiro M, Davis J, White L, Derauf C. Rapid Growth from 12 to 23 Months of Life Predicts Obesity in a Population of Pacific Island Children. Published online 2013:11.
3. Thompson AL, Bentley ME. The critical period of infant feeding for the development of early disparities in obesity. *Social Science & Medicine.* 2013;97:288-296. doi:10.1016/j.socscimed.2012.12.007
4. World Health Organization (WHO). Indicators for Assessing Infant and Young Child Feeding Practices: Conclusions of a Consensus Meeting Held 6-8 November 2007 in Washington D.C., USA. World Health Organization (WHO); 2008.
5. Azadbakht L, Esmailzadeh A. Dietary diversity score is related to obesity and abdominal adiposity among Iranian female youth. *Public Health Nutr.* 2011;14(1):62-69. doi:10.1017/S1368980010000522
6. Grote V, Theurich M, Koletzko B. Do complementary feeding practices predict the later risk of obesity?: Current Opinion in Clinical Nutrition and Metabolic Care. 2012;15(3):293-297. doi:10.1097/MCO.0b013e328351baba
7. Laving AR, Hussain SR, Atieno DO. Overnutrition: Does Complementary Feeding Play a Role? *Ann Nutr Metab.* 2018;73(1):15-18. doi:10.1159/000490088
8. Cusick S, Georgieff MK. The First 1,000 Days of Life: The Brain's Window of Opportunity. UNICEF; 2013. <https://www.unicef-irc.org/article/958-the-first-1000-days-of-life-the-brains-window-of-opportunity.html>

9. Novotny R, Li F, Fialkowski MK, et al. Prevalence of obesity and acanthosis nigricans among young children in the children's healthy living program in the United States Affiliated Pacific. *Medicine*. 2016;95(37):e4711. doi:10.1097/MD.0000000000004711
10. Cameron N, Demerath EW. Critical periods in human growth and their relationship to diseases of aging. *Am J Phys Anthropol*. 2002;119(S35):159-184. doi:10.1002/ajpa.10183
11. Hawley NL, McGarvey ST. Obesity and Diabetes in Pacific Islanders: the Current Burden and the Need for Urgent Action. *Curr Diab Rep*. 2015;15(5):29. doi:10.1007/s11892-015-0594-5
12. M A Look, S Soong, J K Kaholokula. Assessment and Priorities for Health and Well-Being in Native Hawaiians and Pacific Islanders. Published online 2020. doi:10.13140/RG.2.2.22162.89286
13. Monasta L, Batty GD, Cattaneo A, et al. Early-life determinants of overweight and obesity: a review of systematic reviews: Early-life determinants of obesity. *Obesity Reviews*. 2010;11(10):695-708. doi:10.1111/j.1467-789X.2010.00735.x
14. Goldberg DL, Novotny R, Kieffer E, Mor J, Thiele M. Complementary Feeding and Ethnicity of Infants in Hawaii. *Journal of the American Dietetic Association*. 1995;95(9):1029-1031. doi:10.1016/S0002-8223(95)00280-4
15. Popkin BM. The Nutrition Transition and Obesity in the Developing World. *The Journal of Nutrition*. 2001;131(3):871S-873S. doi:10.1093/jn/131.3.871S
16. Haman F, Fontaine-Bisson B, Batal M, Imbeault P, Blais JM, Robidoux MA. Obesity and type 2 diabetes in Northern Canada's remote First Nations communities: the dietary dilemma. *Int J Obes*. 2010;34(S2):S24-S31. doi:10.1038/ijo.2010.236
17. Skinner K, Pratlley E, Burnett K. Eating in the City: A Review of the Literature on Food Insecurity and Indigenous People Living in Urban Spaces. *Societies*. 2016;6(2):7. doi:10.3390/soc6020007
18. Chun KM, Balls Organista P, Marín G, eds. *Acculturation: Advances in Theory, Measurement, and Applied Research*. American Psychological Association; 2003. doi:10.1037/10472-000
19. Kim HS, Park SY, Grandinetti A, Holck PS, Waslien C. Major dietary patterns, ethnicity, and prevalence of type 2 diabetes in rural Hawaii. *Nutrition*. 2008;24(11-12):1065-1072. doi:10.1016/j.nut.2008.05.008
20. Historical Living Arrangements of Children - United States Census Bureau.; 2020. <https://www.census.gov/data/tables/time-series/demo/families/children.html>



21. Lofquist DA. Multigenerational Households: 2009–2011 American Community Survey Briefs. Published online October 2012.  
<https://www2.census.gov/library/publications/2012/acs/acsbr11-03.pdf>
22. Abel S, Park J, Tipene-Leach D, Finau S, Lennan M. Infant care practices in New Zealand: a cross-cultural qualitative study. *Social Science & Medicine*. 2001;53(9):1135-1148. doi:10.1016/S0277-9536(00)00408-1
23. American Community Survey - United State Census Bureau.  
<https://www.census.gov/acs/www/data/data-tables-and-tools/geographic-comparison-tables/>
24. Amorim M. Are grandparents a blessing or a burden? Multigenerational coresidence and child-related spending. *Social Science Research*. Published online 2019:13.
25. Kaholokula JK, Nacapoy AH, Grandinetti A, Chang HK. Association Between Acculturation Modes and Type 2 Diabetes Among Native Hawaiians. *Diabetes Care*. 2008;31(4):698-700. doi:10.2337/dc07-1560
26. Kaholokula JK, Iwane MK, Nacapoy AH. Effects of perceived racism and acculturation on hypertension in Native Hawaiians. *Hawaii Med J*. 2010;69(5 Suppl 2):11-15.
27. Lane AA, McGuire MK, McGuire MA, et al. Household composition and the infant fecal microbiome: The INSPIRE study. *Am J Phys Anthropol*. 2019;169(3):526-539. doi:10.1002/ajpa.23843
28. Aflague T, Boushey C, Guerrero R, Ahmad Z, Kerr D, Delp E. Feasibility and Use of the Mobile Food Record for Capturing Eating Occasions among Children Ages 3–10 Years in Guam. *Nutrients*. 2015;7(6):4403-4415. doi:10.3390/nu7064403
29. Boushey CJ, Spoden M, Zhu FM, Delp EJ, Kerr DA. New mobile methods for dietary assessment: review of image-assisted and image-based dietary assessment methods. *Proc Nutr Soc*. 2017;76(3):283-294. doi:10.1017/S0029665116002913
30. World Health Organization. Global Nutrition Monitoring Framework: Operational Guidance for Tracking Progress in Meeting Targets for 2025. World Health Organization; 2017. Accessed November 4, 2021.  
<https://apps.who.int/iris/handle/10665/259904>
31. Fialkowski MK, Ng-Osorio J, Kai J, et al. Type, Timing, and Diversity of Complementary Foods Among Native Hawaiian, Pacific Islander, and Filipino Infants. *Hawaii J Health Soc Welf*. 2020;79(5 Suppl 1):127-134.

32. Mok E, Vanstone CA, Gallo S, Li P, Constantin E, Weiler HA. Diet diversity, growth and adiposity in healthy breastfed infants fed homemade complementary foods. *Int J Obes.* 2017;41(5):776-782. doi:10.1038/ijo.2017.37
33. Woo JG, Herbers PM, McMahon RJ, et al. Longitudinal Development of Infant Complementary Diet Diversity in 3 International Cohorts. *The Journal of Pediatrics.* 2015;167(5):969-974.e1. doi:10.1016/j.jpeds.2015.06.063
34. Zhang, Benton. The Association of Acculturation and Complementary Infant and Young Child Feeding Practices Among New Chinese Immigrant Mothers in England: A Mixed Methods Study. *IJERPH.* 2019;16(18):3282. doi:10.3390/ijerph16183282
35. Dancel LD, Perrin E, Yin SH, et al. The relationship between acculturation and infant feeding styles in a Latino population: Acculturation and Infant Feeding Styles. *Obesity.* 2015;23(4):840-846. doi:10.1002/oby.20986
36. Kirshner L, Yi SS, Wylie-Rosett J, Matthan NR, Beasley JM. Acculturation and Diet Among Chinese American Immigrants in New York City. *Current Developments in Nutrition.* 2020;4(1):nzz124. doi:10.1093/cdn/nzz124
37. Bolstad AL, Bungum T. Diet, acculturation, and BMI in Hispanics living in southern Nevada. *Am J Health Behav.* 2013;37(2):218-226. doi:10.5993/AJHB.37.2.9
38. Leonard D, Aquino D, Hadgraft N, Thompson F, Marley JV. Poor nutrition from first foods: A cross-sectional study of complementary feeding of infants and young children in six remote Aboriginal communities across northern Australia: Poor nutrition from first foods in remote northern Australia. *Nutr Diet.* 2017;74(5):436-445. doi:10.1111/1747-0080.12386
39. Easthope H, Liu E, Judd B, Burnley I. Feeling at Home in a Multigenerational Household: The Importance of Control. *Housing, Theory and Society.* 2015;32(2):151-170. doi:10.1080/14036096.2015.1031275
40. Bengtson VL. Beyond the Nuclear Family: The Increasing Importance of Multigenerational Bonds. THE BURGESS AWARD LECTURE\*. *J Marriage and Family.* 2001;63(1):1-16. doi:10.1111/j.1741-3737.2001.00001.x
41. Glaser K, Stuchbury R, Price D, Di Gessa G, Ribe E, Tinker A. Trends in the prevalence of grandparents living with grandchild(ren) in selected European countries and the United States. *Eur J Ageing.* 2018;15(3):237-250. doi:10.1007/s10433-018-0474-3
42. Bentley M, Gavin L, Black MM, Teti L. Infant feeding practices of low-income, African-American, adolescent mothers: an ecological, multigenerational perspective. *Social Science & Medicine.* 1999;49(8):1085-1100. doi:10.1016/S0277-9536(99)00198-7

43. Wasser HM, Thompson AL, Maria Siega-Riz A, Adair LS, Hodges EA, Bentley ME. Who's feeding baby? Non-maternal involvement in feeding and its association with dietary intakes among infants and toddlers. *Appetite*. 2013;71:7-15. doi:10.1016/j.appet.2013.06.096
44. Novotny R, Chen C, Williams AE, et al. US Acculturation Is Associated with Health Behaviors and Obesity, but not Their Change, with a Hotel-Based Intervention among Asian-Pacific Islanders. *Journal of the Academy of Nutrition and Dietetics*. 2012;112(5):649-656. doi:10.1016/j.jand.2012.02.002
45. Nelson-Peterman JL, Toof R, Liang SL, Grigg-Saito DC. Long-Term Refugee Health: Health Behaviors and Outcomes of Cambodian Refugee and Immigrant Women. *Health Educ Behav*. 2015;42(6):814-823. doi:10.1177/1090198115590779

## Chapter 5: Discussion and Conclusion

### **Discussion**

Improving complementary infant feeding practices is a complex undertaking. It requires addressing multiple factors at multiple levels. The complexity of this task is seen in the necessity to include culture, ways of life, family, health professionals, nutrition assistance programs, and other community networks and important factors in designing and implementing campaigns and outreach activities to improve complementary feeding practices.<sup>1-4</sup> Moreover, for efforts to be relevant and impactful, understanding and valuing the caregivers' personal beliefs, the societal customs they encounter, the observational learning they undergo, and the food accessibility they experience, among others, are critical in grasping the enormity of this nutritional phenomenon.<sup>5-7</sup>

This dissertation explored complementary feeding through multiple means to gain a greater understanding of caregiver feeding behaviors and the influences on key aspects of complementary feeding practices (i.e. timing and type of complementary foods). The literature review on health behavior theories surrounding complementary feeding practices in chapter 2 and the qualitative exploration of caregivers' perspective of supports in chapter 3 examined reasons caregivers decide to feed their infants the way they do while chapter 4 looked at the influences on the dietary quality of complementary feeding.

Chapter 2 was based on a search of the following data sources for available literature on health behavior theories: PubMed, Web of Science, Academic Search Complete, Agricola, CINAHL, ERIC, Open Dissertations, Psychology and Behavioral Sciences, Social Work Abstracts, and Medline. Chapters 3 and 4 explored complementary feeding in infants of Native Hawaiian and Other Pacific Islander (NHPI) and Filipino ethnicities. Multiple types of data were examined including dietary data collected using an innovative mobile food record, demographic data through an online questionnaire and caregiver perceptions through in-depth interviews collected over an 11-month period.<sup>8-10</sup>

## **Summary of main findings**

In the literature review of research using health behavior theories to explain caregiver's feeding behavior, it was clear the complementary feeding behavior of caregivers is shaped by constructs at multiple levels: 1) intrapersonal<sup>11-17</sup> 2) interpersonal<sup>5,6</sup> 3) community and societal.<sup>18-20</sup> Of the twelve studies reviewed, six observational studies and one intervention study used the intrapersonal level theories of planned behavior and/or transtheoretical stages of change. Constructs of these theories focused on the individual (e.g. intentions and attitudes of the caregiver, caregiver's belief of approval from others, caregiver's perceived behavioral control; caregiver's place in the process of change). The other three observational studies and two intervention studies used theories on the interpersonal level (e.g. social cognitive theory; culture care theory) and/or the community and societal level (theoretical domains, socioecological model). The intervention by Black and colleagues used relationships caregivers had with another person to model recommended feeding behaviors.<sup>6</sup> The observational study by Boak and colleagues used the constructs of social norms and food environment in describing caregivers' food choices.<sup>18</sup> The multi-level constructs of these theories help to show the many influences shaping caregiver feeding behavior. Much like the socio-ecological perspective, each level and its theories and their constructs, are critical in building up the framework in which to view health behaviors.<sup>2</sup>

All three intervention studies retrieved from the literature search were examined. All three intervention studies showed each were able to produce a positive behavioral change (e.g. activity(s) applied delayed the timing of complementary food introduction or decreased excessive weight gain of infants). However, only one study had a high/medium intervention duration. The intervention study by Taylor and colleagues had a duration of greater than or equal to 12 months. Thus, the intervention study by Taylor et al. was considered effective by meeting both the duration and net positive effect size criteria based on the scale by Brennan et al.<sup>20,21</sup> The review of literature on health behavior theories shows the ability of theories to

serve as a roadmap in examining and/or intervening on a given health behavior.<sup>22</sup> The potential of this is research efforts can be guided by these theories to be more targeted to influencing a desired behavioral change.<sup>23</sup>

The qualitative exploration conducted in this dissertation of 29 caregiver interviews provided the means to robustly explore how the influence of support from others affected feeding practices.<sup>24</sup> Family, friends and health professionals, specifically pediatricians, are relevant sources of complementary feeding information for caregivers. An interesting and novel observation made was caregivers in Hawai'i of NHPI and Filipino infants, perceived support from key individuals regardless of how they chose to feed their infant (e.g. complementary food before 6 months; feeding human milk exclusively). Additional in-depth qualitative research exploring the types of support caregivers receive will greatly help to distinguish differences between caregivers.<sup>25,26</sup>

The findings of the qualitative study reflect constructs of health behavior theories reviewed in the literature review of this dissertation. The perception of support from caregivers' family is in-line with the construct of subjective norm in the theory of planned behavior, and the construct of social influences in the theoretical domains framework.<sup>2,22</sup> Moreover, the social cognitive theory centers on interpersonal relationships, and this was seen in the support perceived from family, friends and health professionals in the qualitative study.<sup>23</sup>

The advice (operational learning) caregivers receive from important key individuals which they have a relationship with presents intervention opportunities to improve complementary feeding practices. An important intervention opportunity identified is improving the clarity and consistency of complementary feeding messaging from health care professionals. In addition, the inclusion of family and friends of caregivers in the dissemination of information on complementary feeding recommendations, is another opportunity identified in this study.

Prevention strategies can be informed by the suggestion to include these key individuals in programmatic efforts.

The final study completed in this dissertation examined if cultural and environmental characteristics of the caregiver influenced diet quality of the infant. This was largely informed by the notion that expressions of culture influence dietary behaviors.<sup>27-30</sup> This study did not find a relationship between the caregiver's cultural identity, household membership and the infant's diet quality. The lack of an association is similar to the findings of Kim and colleagues who suggest ethnic identity is not the strongest influence on dietary patterns.<sup>31</sup> Further explanation of this observation is needed to determine if socioeconomic status and lifestyle factors potentially mute the influence of cultural identity and household membership. However, it can be proposed that cultural identity and household membership are attributes of socioeconomic status and lifestyles.<sup>32</sup>

The 2008 and 2017 World Health Organization (WHO) reports on indicators for assessing infant and young child feeding practices (IYCFP) recommend the following: 1) exclusive human milk feeding under 6 months of age; 2) introduction of complementary food that is soft, semi-solid or solid, at 6 months of age at least; and 3) to provide foods from eight defined foods groups from ages 6 – 23 months.<sup>33,34</sup> Few infants were fed human milk until 6 months of age, while a majority were fed complementary food before 6 months. These findings suggest WHO IYCFP recommendations were generally not followed, particularly in this population of NHPI and Filipino infants in Hawai'i. This brings forth the conflicting complementary feeding recommendations caregivers experience. The Centers for Disease Control and Prevention (CDC), the American Academy of Pediatrics (AAP), and the Dietary Guidelines for Americans, 2020 – 2025, recommend introducing solid foods at 6 months, however, in their guidelines they also recommend introducing solid foods when infants show signs of developmental readiness.<sup>35-37</sup> These signs include neck and head control (e.g. holding up the head), doubling birth weight, and ability to swallow.<sup>36</sup> The age (in months)

when these signs appear is dependent on the infant; some may show them at 4 months while others may show them later at 8 months.<sup>38</sup> The recommendation for caregivers to recognize signs and cues of readiness, and then feed responsively and accordingly, sheds insight into why caregivers might feed solids before their infant is 6 months.<sup>14</sup> The clearer and stronger messaging about the 6 month timepoint to commence complementary feeding is critical, especially for research investigating reasons and solutions for untimely feeding recommendations.

Interestingly, the findings of chapter 4 somewhat contradicts the findings of chapters 2 and 3 of this dissertation. For example, caregivers mentioned family being a support in the in-depth interviews, and Black and colleagues found their intervention, which involved the infant's family, got caregivers to practice recommendations<sup>6</sup>, yet the results of the analysis conducted in chapter 4 did not find the members of the household to be a significant factor in infant diet quality. Not observing a significant relationship could be due to the small sample size of the study which resulted in low statistical power and the reduced likelihood of detecting a true effect. Future research will greatly benefit from having a robust sample of caregiver-infant dyads to explore the influence from the household (e.g. membership composition) on diet quality. Nonetheless, the evidence-based findings in this dissertation can still be a guide to inform future studies on designs and approaches to better observe, quantitatively and qualitatively, the influences on infants' diet. For example, defining the relationships among the household members and the infant-caregiver dyad can identify aspects of the household influential on feeding behavior and infant diet.<sup>39</sup> The caregiver's awareness and practice of sociocultural beliefs and values associated with his/her cultural identity, can help inform services to optimize the practice of feeding recommendations. Improvements to the nutritional health of infants and young children within the first 1,000 days is possible through learning from what others have found and complementing their findings.<sup>2</sup>



## **Strengths and limitations**

The first 1,000 days are a window of opportunity for optimal healthy growth and development.<sup>7,40,41</sup> This study examined what influences the complementary feeding behaviors and practices of caregivers of NHPI and Filipino infants. The NHPI and Filipino population is under-researched and experiences significant health disparities.<sup>10,42</sup>

A limitation of the research is the small sample size of NHPI and Filipino participants. A total of 70 infants (3-12 months old) and their caregivers participated in this study, of which 56 infants were 6-12 months old and 14 were 3-5 months old. The small sample size, which resulted in weak statistical power, reduced the likelihood of observing relationships as well as inhibited determining the true significance of associations. Moreover, in the quantitative examination of food group consumption presented in Chapter 4, the multivariable linear regression included infants 3 months old. The linear regression (Table 11) is appropriate for infants 4 – 6 months old since the number of food groups consumed will increase with the infant's age. However, the inclusion of infants less than 4 months old confounds the regression since food group consumption at this age signifies early introduction to complementary food. This further explains why a lack of associations was seen among the variables in the regression. However, it must be noted that literature shows infants are being fed complementary foods at 3 months old.<sup>10,24</sup> This complementary feeding practice is not recommended but is occurring. Therefore, research quantifying untimely complementary feeding and its effects on dietary behaviors is critical to understanding drivers of infant and childhood health. There are multiple perspectives for and against the inclusion of 3 month old infants in dietary research. Future studies on diet diversity and food group consumption should investigate these perspectives in their literature review and explain the inclusion of or the exclusion of infants 3 months old in the multivariable linear regression models. A further suggestion is if such an age is included, a multivariable logistic regression would be better suited as cut points can be defined and used in examining the associations.

A limitation of the literature review is the studies reviewed did not include NHPI and Filipinos. This leads to questioning the relevancy of the literature to the NHPI and Filipino population. Further research within this population is needed to address the literature gap. The barriers to recruiting minority populations in research, particularly biomedical and behavioral research, have persisted despite the National Institutes of Health (NIH) Revitalization Act of 1993.<sup>43</sup> This act aims to increase representation of people from diverse backgrounds, including gender and racial and ethnic groups, in research.<sup>44</sup> Recognizing the inherent barriers and finding ways to minimize their effect on recruitment will oversee the increase of diversity in research as well as limiting the likelihood of small sample sizes. This research followed the recommendations for recruitment in minority populations by having the researchers be from the same community as the participants and reflect the diversity of the community.<sup>43,44</sup> Participant compensation of a \$40.00 gift card to a local grocery store with many locations helped ease the burden of participation. Furthermore, researchers met participants at times, days and locations most convenient for the participants to ease the burden of additional travel costs for the participants.

Another limitation of this research was the sampling technique used in this research. Recruitment of participants applied a sampling of convenience. Therefore, there was not equal representation of participants in their demographics (i.e. age, sex, education, occupation, marital status, racial/ethnic identification(s), household membership, income). As a result, the sample populations of these empirical studies presented in this dissertation may not be representative of the targeted racial/ethnic groups. The influence of caregiver variables (e.g. sex, age, education, occupation, etc.) and/or family factors (e.g. income, family size, etc.) cannot be overlooked and limits the application of the findings in the research of this dissertation.<sup>9</sup> However, this research was able to implement a culturally sensitive and community orientated pilot project. This research examined caregiver complementary feeding behavior and practices through multiple means, including a mixed methods approach and

using an innovative mobile technology-based dietary research tool to record food intake.<sup>8</sup> This research provides evidence-based findings to be used to design unique, feasible and population-targeted integrated participatory approaches and partnerships to improve the complementary feeding practices of caregivers of NHPI and Filipino infants in Hawai‘i.

This dissertation highlights the effectiveness of the community-oriented approach employed and the inclusion of a diverse research team in the achievement of successfully completing this research project. Research focused on NHPI and Filipino populations is imperative to improving the future health outlook for these vulnerable communities.<sup>42,45-47</sup> This dissertation highlights the impact culturally respectful methodologies has on participants. It also emphasizes the need to build a research workforce that is reflective of the populations of interest.

### **Implications of findings: recommendations**

Based on the findings from this dissertation research, the following are recommendations to improve complementary feeding practices in the Native Hawaiian, Other Pacific Islander and Filipino populations in Hawai‘i:

1. Theory-informed research: health behaviors can be multilayered and contain multiple constructs. Studies on infant complementary feeding would benefit from grounding their design and approach on the health behavior theories on the intrapersonal, interpersonal, and community and social levels. For example, the Social Ecological Model (SEM) addresses the interactive relationship between influences and the action/behavior. Moreover, there exists a need to examine and explain the interactions and connections between these levels in order to improved multilevel intervention research.<sup>2</sup>
2. Clear messaging: mixed messaging among influential people, specifically health care professionals, has potentially misguided caregivers in their infant

complementary feeding practices. The healthcare sector needs to deliver strong, clear and consistent messaging on the timing of complementary feeding.

3. Involve important individuals: family and friends are important individuals to the caregivers. Including family and friends in dispersing infant complementary feeding messaging will greatly improve efforts.

### **Implications of findings: future research**

Results from the dissertation indicated the need for additional research to understand the influences on caregivers and identify opportunities to improve the practice of infant complementary feeding:

1. Larger studies: robust sample sizes provide greater power to explore associations. Given the barriers minority populations experience in research participation but the need to include their diversity in research, future research should intentionally employ the strategies to overcome these barriers.
2. Participant-researcher relationship: building relationships and trust with the population of interest and its community is critical in research participation. Comprehensively addressing health disparities requires a degree of comfort between the participants and researchers. Building relationships is an important strategy to foster familiarity with the community/population of interest. Future research would benefit from intentionally having the research team be from the population/community of interest and reflect the diversity sought after. This will help to establish familiarity among the participants.
3. Representative study sample: unequal representation of participants and their demographics limits the generality and application of the research findings. Future research should use disaggregated race or ethnic group data and do purposeful sampling to obtain a sample that is more representative of the population and community of interest.

4. Qualitative research: non-numerical data to contribute to the comprehensive understanding of nuances is the strength of qualitative approaches designed to collect audio, text, video data from participants. Future research should aim to increase the rigorous research on complementary feeding practices in Hawai'i to address the persistent literature gap on the rationales governing complementary infant feeding practices among NHPI and Filipino infants.
5. Systematic literature review: literature review needs to expand beyond only examining theory. Future research would benefit from comparing theory-based interventions to non-theory based interventions. This would guide the field in determining the most efficacious approach.

## **Conclusions**

The purpose of this dissertation was to understand, through a literature review and a mixed methods study design, why caregivers feed their infants the way they do. The literature on health behavior theories showed the many different constructs influencing caregiver feeding behavior. The qualitative study showed caregivers perceived support from their family, friends and within their community for their complementary feeding practices. The quantitative study showed the lack of a relationship between caregiver cultural identity and household membership, and infant dietary healthfulness. The data from this dissertation can further the knowledge of caregiver feeding behaviors and give guidance to future intervention activities.

The impetus of this dissertation is the prevalence of childhood obesity and associated diseases, and the frequency of these in NHPI and Filipino populations.<sup>48,49</sup> Nutritional behaviors and changes thereof is a complex undertaking requiring synergy of multiple factors. However, the identification of these multiple factors is the crucial first step in improving complementary feeding practices.<sup>22</sup> Primary prevention strategies will benefit from research attempting to pinpoint important factors that influence the nutritional health of

infants.<sup>23</sup> As this dissertation highlights, caregivers and aspects of them (e.g. knowledge, attitudes, beliefs, relationships, subjective norms, socioeconomic status, food environment) are critical in this development and implementation of complementary feeding practices and infant nutrition.

## References

1. Brophy-Herb HE, Silk K, Horodynski MA, Mercer L, Olson B. Key Theoretical Frameworks for Intervention: Understanding and Promoting Behavior Change in Parent–Infant Feeding Choices in a Low-Income Population. *J Primary Prevent.* 2009;30(2):191-208. doi:10.1007/s10935-009-0169-9
2. The Social-Ecological Model: A Framework for Prevention. Published online 2022. <https://www.cdc.gov/violenceprevention/about/social-ecologicalmodel.html>
3. Egyir B, Ramsay S, Bilderback B, Safaii S. Complementary Feeding Practices of Mothers and Their Perceived Impacts on Young Children: Findings from KEEA District of Ghana. *Maternal & Child Health Journal.* 2016;20(9):1886-1894. doi:10.1007/s10995-016-1994-0
4. Ferreira SS, Marchioni DML, Wall CR, et al. Prevalence and maternal determinants of early and late introduction of complementary foods: results from the Growing Up in New Zealand cohort study. *Br J Nutr.* Published online April 11, 2022:1-12. doi:10.1017/S000711452200112X
5. Higgins B. Puerto Rican Cultural Beliefs: Influence on Infant Feeding Practices in Western New York. *J Transcult Nurs.* 2000;11(1):19-30. doi:10.1177/104365960001100105
6. Black MM, Siegel EH, Abel Y, Bentley ME. Home and Videotape Intervention Delays Early Complementary Feeding Among Adolescent Mothers. *PEDIATRICS.* 2001;107(5):e67-e67. doi:10.1542/peds.107.5.e67
7. Taveras EM, Perkins ME, Boudreau AA, et al. Twelve-Month Outcomes of the First 1000 Days Program on Infant Weight Status. *Pediatrics.* 2021;148(2):e2020046706. doi:10.1542/peds.2020-046706
8. Fialkowski MK, Kai J, Young C, et al. An Active Image-Based Mobile Food Record Is Feasible for Capturing Eating Occasions among Infants Ages 3–12 Months Old in Hawai‘i. *Nutrients.* 2022;14(5):1075. doi:10.3390/nu14051075

9. Kai J, Chen JJ, Braun KL, et al. Associations between Cultural Identity, Household Membership and Diet Quality among Native Hawaiian, Pacific Islander, and Filipino Infants in Hawai'i. *Children*. 2022;9(1):48. doi:10.3390/children9010048
10. Fialkowski MK, Ng-Osorio J, Kai J, et al. Type, Timing, and Diversity of Complementary Foods Among Native Hawaiian, Pacific Islander, and Filipino Infants. *Hawaii J Health Soc Welf*. 2020;79(5 Suppl 1):127-134.
11. Heinig MJ, Follett JR, Ishii KD, Kavanagh-Prochaska K, Cohen R, Panchula J. Barriers to Compliance With Infant-Feeding Recommendations Among Low-income Women. *J Hum Lact*. 2006;22(1):27-38. doi:10.1177/0890334405284333
12. Horodyski M, Olson B, Arndt MJ, Brophy-Herb H, Shirer K, Shemanski R. Low-Income Mothers' Decisions Regarding When and Why to Introduce Solid Foods to Their Infants: Influencing Factors. *Journal of Community Health Nursing*. 2007;24(2):101-118. doi:10.1080/07370010701316247
13. Walsh A, Kearney L, Dennis N. Factors influencing first-time mothers' introduction of complementary foods: a qualitative exploration. *BMC Public Health*. 2015;15(1):939. doi:10.1186/s12889-015-2250-z
14. Hamilton K, Daniels L, White KM, Murray N, Walsh A. Predicting mothers' decisions to introduce complementary feeding at 6 months. An investigation using an extended theory of planned behaviour. *Appetite*. 2011;56(3):674-681. doi:10.1016/j.appet.2011.02.002
15. Mutiso JM, Okello JJ, Lagerkvist CJ, Muoki P, Kosura WO, Heck S. Effect of nutrition education and psychosocial factors on child feeding practices: findings of a field experiment with biofortified foods and different women categories. *Ecology of Food and Nutrition*. 2018;57(4):346-371. doi:10.1080/03670244.2018.1492382
16. Newby R, Brodribb W, Ware RS, Davies PSW. Infant Feeding Knowledge, Attitudes, and Beliefs Predict Antenatal Intention Among First-Time Mothers in Queensland. *Breastfeeding Medicine*. 2014;9(5):266-272. doi:10.1089/bfm.2014.0012
17. Silk KJ, Horodyski MA, Rienzo M, Mercer L, Olson B, Aldrich R. Strategies to Increase Health Literacy in The Infant Feeding Series (TIFS): A Six-Lesson Curriculum for Low-Income Mothers. *Health Promotion Practice*. 2010;11(2):226-234. doi:10.1177/1524839908326380
18. Boak R, Virgo-Milton M, Hoare A, et al. Choosing foods for infants: a qualitative study of the factors that influence mothers. *Child: Care, Health and Development*. 2016;42(3):359-369. doi:10.1111/cch.12323
19. Lakhanpaul M, Benton L, Lloyd-Houldey O, et al. Nurture Early for Optimal Nutrition (NEON) programme: qualitative study of drivers of infant feeding and care practices in a

- British-Bangladeshi population. *BMJ Open*. 2020;10(6):e035347. doi:10.1136/bmjopen-2019-035347
20. Taylor NJ, Sahota P, Sargent J, et al. Using intervention mapping to develop a culturally appropriate intervention to prevent childhood obesity: the HAPPY (Healthy and Active Parenting Programme for Early Years) study. *Int J Behav Nutr Phys Act*. 2013;10(1):142. doi:10.1186/1479-5868-10-142
  21. Brennan L, Castro S, Brownson RC, Claus J, Orleans CT. Accelerating evidence reviews and broadening evidence standards to identify effective, promising, and emerging policy and environmental strategies for prevention of childhood obesity. *Annu Rev Public Health*. 2011;32:199-223. doi:10.1146/annurev-publhealth-031210-101206
  22. *Theory at a Glance: A Guide for Health Promotion Practice*. Createspace; 2012.
  23. *Social and Behavioral Theories*. National Institutes of Health  
<https://obssr.od.nih.gov/sites/obssr/files/Social-and-Behavioral-Theories.pdf>
  24. Goldberg DL, Novotny R, Kieffer E, Mor J, Thiele M. Complementary Feeding and Ethnicity of Infants in Hawaii. *Journal of the American Dietetic Association*. 1995;95(9):1029-1031. doi:10.1016/S0002-8223(95)00280-4
  25. Wright ME. *Sources of Infant Care Informational Social Support for Mothers of Infants in the Appalachian Region*. Florida Atlantic University; 2015.  
<http://eres.library.manoa.hawaii.edu/login?url=https://www.proquest.com/dissertations-theses/sources-infant-care-informational-social-support/docview/1780295044/se-2?accountid=27140>
  26. House JS. *Work Stress and Social Support*. 2. print. Addison-Wesley; 1983.
  27. Novotny R, Chen C, Williams AE, et al. US Acculturation Is Associated with Health Behaviors and Obesity, but not Their Change, with a Hotel-Based Intervention among Asian-Pacific Islanders. *Journal of the Academy of Nutrition and Dietetics*. 2012;112(5):649-656. doi:10.1016/j.jand.2012.02.002
  28. Skinner K, Pratley E, Burnett K. Eating in the City: A Review of the Literature on Food Insecurity and Indigenous People Living in Urban Spaces. *Societies*. 2016;6(2):7. doi:10.3390/soc6020007
  29. Arandia G, Sotres-Alvarez D, Siega-Riz AM, et al. Associations between acculturation, ethnic identity, and diet quality among U.S. Hispanic/Latino Youth: Findings from the HCHS/SOL Youth Study. *Appetite*. 2018;129:25-36. doi:10.1016/j.appet.2018.06.017



30. Aubel J. The role and influence of grandmothers on child nutrition: culturally designated advisors and caregivers: Grandmothers: nutrition advisors and caregivers. *Maternal & Child Nutrition*. 2012;8(1):19-35. doi:10.1111/j.1740-8709.2011.00333.x
31. Kim HS, Park SY, Grandinetti A, Holck PS, Waslien C. Major dietary patterns, ethnicity, and prevalence of type 2 diabetes in rural Hawaii. *Nutrition*. 2008;24(11-12):1065-1072. doi:10.1016/j.nut.2008.05.008
32. Historical Living Arrangements of Children - United States Census Bureau.; 2020. <https://www.census.gov/data/tables/time-series/demo/families/children.html>
33. World Health Organization (WHO). Indicators for Assessing Infant and Young Child Feeding Practices: Conclusions of a Consensus Meeting Held 6-8 November 2007 in Washington D.C., USA. World Health Organization (WHO); 2008.
34. World Health Organization. Developing and Validating an Iron and Folic Acid Supplementation Indicator for Tracking Progress towards Global Nutrition Monitoring Framework Targets: Final Report June 2018. World Health Organization; 2018. Accessed November 4, 2021. <https://apps.who.int/iris/handle/10665/274372>
35. Breastfeeding: Frequently Asked Questions (FAQ). Centers for Disease Control and Prevention; 2021. Accessed February 24, 2022. <https://www.cdc.gov/breastfeeding/faq/index.htm#howlong>
36. Infant Food and Feeding. Published online 2021. <https://www.aap.org/en-us/advocacy-and-policy/aap-health-initiatives/HALF-Implementation-Guide/Age-Specific-Content/Pages/Infant-Food-and-Feeding.aspx>
37. Dietary Guidelines for Americans, 2020-2025. Dietary Guidelines for Americans <https://www.dietaryguidelines.gov/resources/2020-2025-dietary-guidelines-online-materials>
38. When, What, and How to Introduce Solid Foods. Centers for Disease Control and Prevention <https://www.cdc.gov/nutrition/infantandtoddlernutrition/foods-and-drinks/when-to-introduce-solid-foods.html>
39. Lane AA, McGuire MK, McGuire MA, et al. Household composition and the infant fecal microbiome: The INSPIRE study. *Am J Phys Anthropol*. 2019;169(3):526-539. doi:10.1002/ajpa.23843
40. Pietrobelli A, Agosti M, the MeNu Group. Nutrition in the First 1000 Days: Ten Practices to Minimize Obesity Emerging from Published Science. *IJERPH*. 2017;14(12):1491. doi:10.3390/ijerph14121491

41. Cusick S, Georgieff MK. The First 1,000 Days of Life: The Brain's Window of Opportunity. UNICEF; 2013. <https://www.unicef-irc.org/article/958-the-first-1000-days-of-life-the-brains-window-of-opportunity.html>
42. M A Look, S Soong, J K Kaholokula. Assessment and Priorities for Health and Well-Being in Native Hawaiians and Pacific Islanders. Published online 2020. doi:10.13140/RG.2.2.22162.89286
43. Ejiogu N, Norbeck JH, Mason MA, Cromwell BC, Zonderman AB, Evans MK. Recruitment and Retention Strategies for Minority or Poor Clinical Research Participants: Lessons From the Healthy Aging in Neighborhoods of Diversity Across the Life Span Study. *The Gerontologist*. 2011;51(Supplement 1):S33-S45. doi:10.1093/geront/gnr027
44. Williams S. Overcoming the Barriers to Recruitment of Underrepresented Minorities. THE ASSOCIATION OF CLINICAL RESEARCH PROFESSIONALS; 2018. <https://acrpnet.org/2018/08/14/overcoming-the-barriers-to-recruitment-of-underrepresented-minorities/>
45. Kaholokula JK, Iwane MK, Nacapoy AH. Effects of perceived racism and acculturation on hypertension in Native Hawaiians. *Hawaii Med J*. 2010;69(5 Suppl 2):11-15.
46. Mau MK, Sinclair K, Saito EP, Baumhofer KN, Kaholokula JK. Cardiometabolic Health Disparities in Native Hawaiians and Other Pacific Islanders. *Epidemiologic Reviews*. 2009;31(1):113-129. doi:10.1093/ajerev/mxp004
47. Ho-Lastimoso I, Chung-Do JJ, Hwang PW, et al. Integrating Native Hawaiian tradition with the modern technology of aquaponics. *Glob Health Promot*. 2019;26(3\_suppl):87-92. doi:10.1177/1757975919831241
48. Prevalence of Childhood Obesity in the United States. Centers for Disease Control and Prevention; 2021. <https://www.cdc.gov/obesity/data/childhood.html>
49. Novotny R, Li F, Fialkowski MK, et al. Prevalence of obesity and acanthosis nigricans among young children in the children's healthy living program in the United States Affiliated Pacific. *Medicine*. 2016;95(37):e4711. doi:10.1097/MD.0000000000004711