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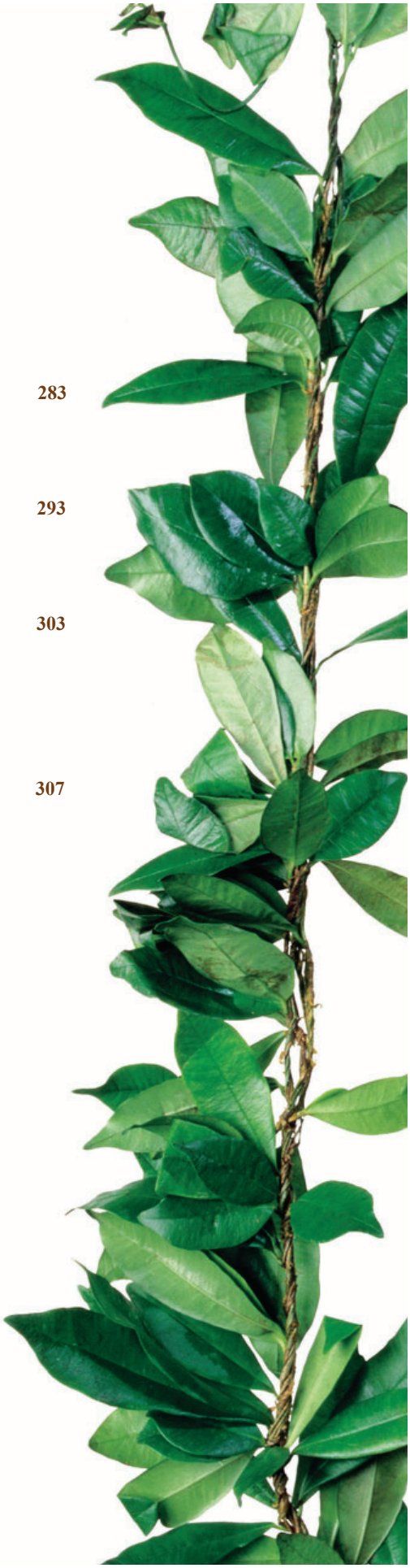

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The aim of the Hawai‘i Journal of Health & Social Welfare is to advance knowledge about health and social welfare, with a focus on the diverse peoples and unique environments of Hawai‘i and the Pacific region.

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Journal Contact Information:

Mailing Address: Hawai‘i Journal of Health & Social Welfare
University of Hawai‘i at Mānoa
Thompson School of Social Work & Public Health
2430 Campus Road, Gartley Hall
Honolulu, Hawai‘i 96822

Website: http://hawaiijournalhealth.org/

Email: hjhsw@hawaii.edu

Socioeconomic Risk Factors for Extreme Preterm Birth in Hawai'i

Joanna P Reinhardt, MD, MPH[1], Maile M Taualii, PhD, MPH[2]

[1] Internal Medicine, Kaiser Permanente Moanalua Medical Center, [2] Kaiser Permanente

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Abstract

Socioeconomic status and race/ethnicity are widely understood to be determinants of adverse birth outcomes, but studies have been limited by lack of income data in health records and aggregation of racial groups in reporting. This study aims to evaluate the relationship of socioeconomic status to extreme preterm birth outcomes in the diverse ethnic population of Hawai'i. Statistical analyses were conducted on Hawai'i birth records 2004-2013 linked to American Community Survey data by maternal residence. Community-level income demographics were stratified into wealth quintiles and stratum specific odds ratios were calculated for extreme preterm birth with analysis focused on the highest and lowest income-quintiles. The overall rates of extreme preterm birth were similar in high vs low-income communities, yet the individual risk factors were significantly different. In low-income communities, increased risk of extreme preterm birth was identified for women less than 20 years old and Black women, while in high-income communities, Native Hawaiian and Black women were at increased risk. Previous preterm birth, birth of a first child and cumulative maternal medical conditions were significant risk factors at all income levels. For Native Hawaiian women, the significant overall increased risk of extreme preterm birth persists in high-income communities but not in low-income communities, suggesting that increased risks previously attributed to Native Hawaiian race/ethnicity may be partially explained by low socioeconomic status.

Abbreviations

ACS = American Community Survey
EPTB = Extreme Preterm Birth
GA = Gestational Age
PCSA = Primary Care Service Area

Introduction

Racial disparities in infant mortality persist in the United States, with non-Hispanic Blacks having a 3-fold increase and Native Hawaiians/Pacific Islanders having a rate 2.6 times that of Asian Americans, the racial group with the lowest rate.[1] Preterm birth is the most significant cause of infant mortality, with 65% of infant deaths in the United States in 2022 occurring among babies born preterm.[2] Among Native Hawaiians in Hawai'i from 2002-2009, 43.9% of excess infant mortality was attributed to preterm related causes.[3]

Income inequality has been identified as a significant factor in preterm birth and infant mortality disparities in the United States and around the world.[4-9] Significant income inequality exists in Hawai'i and has been steadily increasing since the mid-1950s.[10] Of ethnic groups in Hawai'i, Native Hawaiian families have the lowest median income, the largest average family size and per capita income of 69.2% of the statewide level.[11] Income inequality and low socioeconomic status have been proposed as contributing to a wide range of health disparities for Native Hawaiian families.[12-15] A 2022 study by the National Bureau of Economic Research examined parental income and race/ethnicity for births in California and found significant disparities in an aggregated subgroup of "Asian or Pacific Islander", but did not disaggregate race/ethnicity for Native Hawaiian or Asian American populations.[16] The diverse racial population of Hawai'i provides an opportunity to extend the analysis to include Asian Americans, Native Hawaiians, and other Pacific Islander populations, which continue to be underrepresented in national health data with rare subgroup disaggregation.[3,17] This study aims to provide additional insight into the relationship of socioeconomic status to preterm birth for disaggregated racial groups in Hawai'i.

The extent of prematurity is a critical factor when studying preterm birth, as those born at the extreme of viability are at the highest risk of demise.[2] Babies born at less than 28 weeks of gestation are categorized as "extremely preterm". Native Hawaiian women are 2.2 times more likely than White women to have babies born extremely low birthweight (<1000 g) and extremely preterm.[3] In addition to its causal role in infant mortality, a focus on extreme preterm birth is important because of the health complications and long-term disabilities associated with surviving preterm babies and the high societal and economic costs of preterm birth.[18] The excess cost associated with prematurity for the 2016 US birth cohort was estimated to be $25.2 billion, with over one-third of this cost attributable to the 7% of births which occur before 28 weeks of gestation.[19]

Researchers have used a variety of approaches to evaluate the effects of socioeconomic factors on health disparities.[6,7,13,20] In Hawai'i, the birth file is based on Vital Statistics birth records and does not contain maternal income demographics. This is a widespread shortcoming of birth records which has made it difficult to perform analysis of the effects of socioeconomic status on birth outcomes.[16] In this study, an ecological approach was taken to evaluate socioeconomic status, wherein the per capita income level of the community in which the mother resided at the time of the infant's birth was assigned to each birth record as a proxy for maternal income.[21] The authors assess the re-

lationships between community-level income and extreme preterm birth in conjunction with other factors that may be associated with increased risk of extreme preterm birth.

Methods

State of Hawai'i Birth Records from 2004-2013 (N = 188 076) were obtained from the Hawai'i Department of Health and used to identify extreme preterm births based on gestational age greater than 16 weeks and less than 28 weeks. This gestational age was chosen to maximize capture of adverse birth outcomes, which may have resulted in either a live birth or a fetal death, where a birth certificate was issued. Analysis was limited to mothers who identified as Hawai'i residents at the time of the baby's birth and had a recorded gestational age greater than 16 weeks (600 records excluded). Data suppression was applied for demographics with n<10 according to National Center for Health Statistics guidelines. Demographic variables included in all models: age, race/ethnicity, education, marital status, previous preterm birth or first-time birth and a count of preexisting maternal medical conditions. The maternal medical conditions included on the birth record as checkbox items include anemia, cardiac disease, lung disease, diabetes, genital herpes, oligohydramnios, hemoglobinopathy, chronic hypertension, pregnancy-associated hypertension, eclampsia, incompetent cervix, previous fetal macrosomia, previous preterm infant, renal disease, Rh sensitization, uterine bleeding, and other. The Hawai'i Department of Health, Office of Health Status and Monitoring assigns all people that report more than one race on the birth certificate to a single race for reporting purposes. If more than one race/ethnicity is reported, the following rules apply: If Hawaiian is one of the multiple ethnicities listed, Part Hawaiian is coded; If any non-White ethnicity is listed in combination with White, the first non-White ethnicity is coded; If more than one non-White ethnicity is listed, the first one is coded.[22]

Community-level average per capita income data was taken from the American Community Survey (ACS) from 2006-2010. This ACS period was chosen as it approximates a midsection of the birth records period. Communities were defined using Primary Care Service Areas (PCSA) created by stakeholders in Hawai'i through the Primary Care Access Plan in the mid-1990s with modifications by the Hawai'i Department of Health to provide more detail in the 3 largest identified areas.[23] PCSA's were chosen for this analysis as they standardize availability and utilization of health care resources at the community level.[24] Mothers were assigned to one of Hawai'i 35 PCSAs based on resident census tract at the time of the infant's birth. There were 344 birth records (0.2%) with Hawai'i addresses that were not able to be linked and were excluded from the community-level analysis. ACS per capita income data was stratified into the wealthiest 20% (high-income), middle 60% and the poorest 20% (low-income), utilizing methodology from the 20:20 ratio of income inequality.[25] Analysis focused on the differences between the highest-income and lowest-income communities.

The research protocol was submitted to and approved by the University of Hawai'i Office of Research Compliance Human Studies Program as an exempt study, protocol number CHS#23517.

All analysis was conducted in SAS version 9.2 (SAS Institute, Cary, North Carolina). The study population was summarized using descriptive statistics. Chi-square tests were used to calculate *P* values. Potential confounding variables were included in the models. Multiple logistic regression models were created to explore associations between community-level income and extreme preterm birth outcomes. Adjusted odds ratios (AOR) and 95% confidence intervals (CI) were obtained using these models. Statistical significance was set at $P < .05$.

Results

Maternal demographics of all births and extreme preterm births are presented in **Table 1**. Variables found to be significant by *P*-value include maternal age, race/ethnicity, marital status, previous preterm birth, and cumulative maternal medical conditions. Demographics with increased distribution of extreme preterm birth compared to all birth included women less than 20 years old (+5.4%), greater than 35 years old (+1.5%), Native Hawaiians (+7.4%), Blacks (+5.9%), less than high school education (+2.0%), not married (+7.6%), previous preterm birth (+2.3%), first child (+7.7%), and those with one or more maternal medical condition. Native Hawaiians accounted for 27.4% of all births, had the highest distribution of extreme preterm birth at 34.8%, with an extreme preterm birth rate of 0.81 per 100 live births. Black women accounted for 2.6% of all births, had 8.5% of the extreme preterm births, with the highest extreme birth rate of all race/ethnicities at 2.06 per 100 live births.

Population, income, and birth demographics of the high and low-income communities are presented in **Table 2**. The total population of the high-income communities is 1.60 times that of the low-income communities, yet the total number of births is remarkably similar (37 945 vs 37 651 births) due to a higher crude birth rate in the low-income communities (17.8 vs 11.2 births per 1000 persons per year). The extreme preterm birth rate in the high-income area is 0.60 while the low-income area rate is similar at 0.67 per 100 live births. The income-inequality ratio of per capita income in the highest income community (Hawai'i Kai-Kaimuki, $46,800) to the lowest income community (Waianae, $17,300) is 2.70.

The maternal demographics of extreme preterm birth by community-level income stratification is presented in **Table 3**. In high-income communities, the distribution of extreme preterm birth increases in a stepwise fashion with increasing age with women 35 years or older accounting for 3.7 times more of the extreme preterm birth than women less than 20 years. In low-income communities, the distribution of extreme preterm birth is skewed towards younger women, with women less than 20 years accounting for 2.0 times more of the extreme preterm birth than women 35 years or older.

Table 1. Maternal Demographics of Births and Extreme Preterm Births in Hawai'i (2004-2013)

	All Births		EPTB			
Characteristic (bivariate *P*-value)	**No.**	**(%)**	**No.**	**(%)**	**EPTB Rate[a]**	**Variance EPTB vs Birth (%)**
Total Births Included in Analysis	187476		1195		0.64	
Age, years (*P*<.001)						
<20	14019	*(7.5)*	154	*(12.9)*	1.10	*5.4*
20-24	44400	*(23.7)*	261	*(21.8)*	0.59	*(1.9)*
25-29	51198	*(27.3)*	293	*(24.5)*	0.57	*(2.8)*
30-34	44952	*(24.0)*	259	*(21.7)*	0.58	*(2.3)*
>=35	32907	*(17.6)*	228	*(19.1)*	0.69	*1.5*
Race/Ethnicity (*P*<.001)						
Native Hawaiian	51437	*(27.4)*	416	*(34.8)*	0.81	*7.4*
White	41382	*(22.1)*	162	*(13.6)*	0.39	*(8.5)*
Filipino	33643	*(17.9)*	211	*(17.7)*	0.63	*(0.2)*
Japanese	19095	*(10.2)*	96	*(8.0)*	0.50	*(2.2)*
Other Pacific Islanders	17205	*(9.2)*	89	*(7.4)*	0.52	*(1.8)*
Other Asian	13981	*(7.5)*	77	*(6.4)*	0.55	*(1.1)*
All Others	5645	*(3.0)*	27	*(2.3)*	0.48	*(0.7)*
Blacks	4897	*(2.6)*	101	*(8.5)*	2.06	*5.9*
Race Unknown	191	*(0.1)*	16	*(1.3)*	8.38	*1.2*
Education (*P*=.149)						
High School or Less	86162	*(46.0)*	574	*(48.0)*	0.67	*2.0*
Some College or More	101314	*(54.0)*	621	*(52.0)*	0.61	*(2.0)*
Marital Status (*P*<.001)						
Married	117995	*(62.9)*	661	*(55.3)*	0.56	*(7.6)*
Not Married	69481	*(37.1)*	534	*(44.7)*	0.77	*7.6*
Previous Preterm Birth (*P*<.001)						
Yes	1048	*(0.6)*	35	*(2.9)*	3.34	*2.3*
No	110708	*(59.1)*	585	*(49.0)*	0.53	*(10.1)*
First child	75720	*(40.4)*	575	*(48.1)*	0.76	*7.7*
Maternal Medical Conditions (*P*<.001)						
0 Medical conditions	127252	*(67.9)*	565	*(47.3)*	0.44	*(20.6)*
1 Medical conditions	46612	*(24.9)*	423	*(35.4)*	0.91	*10.5*
2 Medical conditions	10853	*(5.8)*	151	*(12.6)*	1.39	*6.8*
3 Medical conditions	2272	*(1.2)*	38	*(3.2)*	1.67	*2.0*
4+ Medical conditions	487	*(0.3)*	18	*(1.5)*	3.70	*1.2*
Primary Care Service Areas (*P*=.52)						
Highest 20% income stratum	37945	*(20.2)*	228	*(19.1)*	0.60	*(1.1)*
Middle 60% income stratum	111536	*(59.5)*	712	*(59.6)*	0.64	*0.1*
Bottom 20% income stratum	37651	*(20.1)*	251	*(21.0)*	0.67	*0.9*
Address Unknown or not linked	344	*(0.2)*	*nr*			

Abbreviations: EPTB=Extreme Preterm Birth (gestational age < 28 weeks)
[a]EPTB Rate=(No. EPTB / No. Total Births) * 100

The distribution of extreme preterm birth by race/ethnicity (**Table 3**) identifies that 44.6% of extreme preterm birth in low-income communities (112 cases) and 32.0% of extreme preterm birth in high-income communities (73 cases) during the period were to Native Hawaiian mothers. In low-income communities, the distribution of extreme preterm birth for Native Hawaiians is 3.0 times that of the next closest racial group (44.6% in Native Hawaiians versus 14.7% in Whites). In high-income communities, there are 2.3 times more cases of extreme preterm birth among Native Hawaiians than in the next closest racial group (32.0% in Native Hawaiians vs. 14.0% in Japanese). The extreme preterm birth rate for Native Hawaiians is similar in high-income (0.87) and low-income (0.84) communities.

Results of the multivariate regression analyses for all extreme preterm birth and high and low-income communities are presented in **Table 4**. In the unstratified model for all extreme preterm birth, significant risk factors include age

Table 2. Population, Income and Birth Demographics of Hawai'i Communities by Primary Care Service Areas

Primary Care Service Area	Per capita Income	Total Population	No. of Births	Crude Annual Birth Rate[a]	No. of EPTB	EPTB Rate[b]
Hawai'i Kai-Kaimuki, O'ahu	$ 46,800	71026	5773	8.1	32	0.55
South Kohala, Hawai'i	$ 36,400	17752	2533	14.3	20	0.79
McCully-Makiki, O'ahu	$ 35,100	59080	5227	8.8	34	0.65
Lāhainā, Maui	$ 34,100	20497	3014	14.7	12	0.40
Makawao, Maui	$ 34,000	42416	4744	11.2	23	0.48
'Ewa-Kalaeloa, O'ahu	$ 33,400	56026	9175	16.4	70	0.76
Ala Moana-Nu'uanu, O'ahu	$ 32,700	71114	7583	10.7	37	0.49
Highest: excluded due to missing data			*-104*			
Highest 20% Income Stratum	**$ 36,071**	**337911**	**37945**	**11.2**	**228**	**0.60**
Middle 60% Income Stratum	**$ 26,995**	**811055**	**111536**	**13.8**	**712**	**0.64**
Hāna, Maui	$ 23,200	02351	309	13.1	*nr*	
Ko'olauloa, O'ahu	$ 22,800	19634	3871	19.7	19	0.49
Downtown-Kalihi, O'ahu	$ 22,500	66102	8945	13.5	54	0.60
Lāna'i	$ 21,200	03335	405	12.1	*nr*	
Wahiawā, O'ahu	$ 20,800	36724	9140	24.9	64	0.70
Puna, Hawai'i	$ 19,300	36707	5690	15.5	26	0.46
Wai'anae, O'ahu	$ 17,300	46482	9441	20.3	84	0.89
Lowest: excluded due to missing data			*-150*			
Lowest 20% Income Stratum	**$ 21,014**	**211335**	**37651**	**17.8**	**251**	**0.67**

Data from: American Community Survey 2006-2010 and State of Hawaii Birth Records 2004-2013
Communities ordered and stratified by per capita income level, from highest to lowest.
Abbreviations: EPTB=Extreme Preterm Birth (gestational age < 28 weeks)
Data suppression: Per National Center for Health Statistics guidelines, grouping with n<10 are suppressed (*nr*)
[a]Crude annual birth rate: Births per 1000 persons per year
[b]EPTB Rate=(No. EPTB / No. Total Births) * 100

less than 20, Native Hawaiian, Filipino, Black, not-married, previous preterm birth, birth of a first child and cumulative maternal medical conditions for which risk increases in a step-wise fashion with increasing number of conditions. When the model is stratified by income levels, the significance of many of these factors is reduced or eliminated. In low-income communities, women less than 20 years old (AOR 1.62, 95% CI 1.04-2.53) and Black women (AOR 2.39, 95% CI 1.30-4.38) have increased risk of extreme preterm birth. In high-income communities, Native Hawaiian (AOR 2.18, 95% CI 1.37-3.45) and Black women (AOR 4.36, 95% CI 2.09-9.07) are at increased risk of extreme preterm birth while no age groupings are at increased risk. Maternal medical conditions, previous preterm birth, and birth of a first child were significant risk factor at all income levels.

Discussion

In this analysis, community-level income stratification of the Hawai'i birth records enables the identification of socioeconomic population trends associated with risk of extreme preterm birth and allows critical consideration of the role of socioeconomic status. When extreme preterm birth is stratified by community-level income, the demographic patterns and risks differ between high and low-income communities.

In low-income communities, the significance of race/ethnicity as a risk factor is eliminated (for Native Hawaiian and Filipinos) or reduced (for Blacks) in multivariate analysis, suggesting that risks associated with race/ethnicity are better explained by low socioeconomic status.[26] Socioeconomic disadvantage has been widely shown to be associated with adverse birth outcomes.[27] Factors such as access to safe food, housing, education and medical care and stressors related to housing insecurity, domestic violence, low-literacy and unemployment may contribute to adverse birth outcomes.[28] Issues with affordability, access to and utilization of health care may be barriers to low-income mothers seeking preventative and prenatal health care services.[29]

In low-income communities in Hawai'i, women less than 20 years old are at increased risk for extreme preterm birth, while this pattern is not observed in high-income communities. Adolescent pregnancy in low and middle-income countries has been previously found to be associated with increased risks of adverse birth outcomes.[30] Factors associated with poverty that are believed to contribute to adolescent pregnancy include low-quality education, a negative perception of the future, limited employment opportunities, and feelings of helplessness and alienation.[31]

Table 3. Maternal Demographics of Births and Extreme Preterm Birth in Hawai'i (2004-2013) in High and Low-Income Community Stratuma

	High-Income Stratum No of births (%)					Low-Income Stratum No of births (%)				
Characteristic (bivariate *P*-value)	All		EPTB		EPTB Rate[b]	All		EPTB		EPTB Rate[b]
Age, years	*P*=.026					*P*<.001				
<20	2001	*(5.3)*	19	*(8.3)*	0.95	3852	*(10.2)*	49	*(19.5)*	1.27
20-24	6575	*(17.3)*	33	*(14.5)*	0.50	11406	*(30.1)*	66	*(26.3)*	0.58
25-29	9638	*(25.4)*	51	*(22.4)*	0.53	10686	*(28.2)*	68	*(27.1)*	0.64
30-34	10696	*(28.2)*	56	*(24.6)*	0.52	7223	*(19.0)*	43	*(17.1)*	0.60
>=35	9035	*(23.8)*	69	*(30.3)*	0.76	4484	*(11.8)*	25	*(10.0)*	0.56
Race/Ethnicity	*P*<.001					*P*=.006				
Native Hawaiian	8422	*(22.2)*	73	*(32.0)*	0.87	13278	*(35.0)*	112	*(44.6)*	0.84
White	8030	*(21.2)*	28	*(12.3)*	0.35	6971	*(18.4)*	37	*(14.7)*	0.53
Filipino	5843	*(15.4)*	31	*(13.6)*	0.53	6131	*(16.2)*	34	*(13.5)*	0.55
Japanese	5709	*(15.0)*	32	*(14.0)*	0.56	1523	*(4.0)*	*nr*		
Other Pacific Islanders	3148	*(8.3)*	15	*(6.6)*	0.48	5202	*(13.7)*	26	*(10.4)*	0.50
Other Asian	4945	*(13.0)*	24	*(10.5)*	0.49	2171	*(5.7)*	12	*(4.8)*	0.55
All Others	1202	*(3.2)*	*nr*			1110	*(2.9)*	*nr*		
Blacks	615	*(1.6)*	10	*(4.4)*	1.63	1215	*(3.2)*	15	*(6.0)*	1.23
Race Unknown	*31*	*(0.1)*	*nr*			*50*	*(0.1)*	*nr*		
Education	*P*=.161					*P*=.771				
High School or Less	14440	*(38.1)*	97	*(42.5)*	0.67	21409	*(56.4)*	145	*(57.8)*	0.68
Some College or More	23505	*(61.9)*	131	*(57.5)*	0.56	16242	*(42.8)*	106	*(42.2)*	0.65
Marital Status	*P*=.111					*P*=.101				
Married	25505	*(67.2)*	142	*(62.3)*	0.56	20835	*(54.9)*	126	*(50.2)*	0.60
Not Married	12440	*(32.8)*	86	*(37.7)*	0.69	16816	*(44.3)*	125	*(49.8)*	0.74
Previous Preterm Birth	*P*<.001					*P*<.001				
Yes	158	*(0.4)*	*nr*			269	*(0.7)*	*nr*		
No	21086	*(55.6)*	111	*(48.7)*	0.53	23939	*(63.1)*	126	*(50.2)*	0.53
First Child	16701	*(44.0)*	109	*(47.8)*	0.65	13443	*(35.4)*	119	*(47.4)*	0.89
Maternal Medical	*P*<.001					*P*<.001				
0 Medical conditions	25987	*(68.5)*	91	*(39.9)*	0.35	24078	*(63.5)*	122	*(48.6)*	0.51
1 Medical conditions	9332	*(24.6)*	95	*(41.7)*	1.02	10080	*(26.6)*	86	*(34.3)*	0.85
2 Medical conditions	2120	*(5.6)*	29	*(12.7)*	1.37	2726	*(7.2)*	36	*(14.3)*	1.32
3 Medical conditions	423	*(1.1)*	*nr*			610	*(1.6)*	*nr*		
4+ Medical conditions	83	*(0.2)*	*nr*			157	*(0.4)*	*nr*		
Total	**37945**		**228**		**0.60**	**37651**		**244**		**0.65**

Abbreviations: EPTB=Extreme Preterm Birth (gestational age < 28 weeks)
Data suppression: Per National Center for Health Statistics guidelines, grouping with n<10 are suppressed (*nr*)
[a]High and Low-income stratum = Top and bottom quintile per capita income levels
[b]EPTB Rate=(# EPTB / # Total Births) * 100

Native Hawaiian mothers have a higher percent distribution of extreme preterm birth compared to all births across community-income stratifications. Native Hawaiians also have the lowest median and per capita income of ethnic groups in Hawai'i.[11] This relationship between extreme preterm birth and socioeconomic status is consistent with study findings that the highest rates of preterm birth in California in 2022 occurred in American Indian or Alaska Native, Black, or Native Hawaiian/Pacific Islander individuals with public health insurance.[32]

In community-level income stratification, this study finds that Native Hawaiians are at increased risk of preterm birth in high-income communities. While the specific factors that may increase and mitigate risk for Native Hawaiians in high-income communities are beyond the scope of this study, this finding merits further consideration in

Table 4. Risk factors for Extreme Preterm Birth in Hawai'i (2004-2013): Adjusted Odds Ratios for All, High-Income and Low-Income Community Stratum[a].

	All EPTB		High-Income Stratum		Low-Income Stratum	
Characteristic	AOR	95% CI	AOR	95% CI	AOR	95% CI
Age, years						
<20	**1.41**	**(1.13-1.77)**	1.25	(0.70-2.26)	**1.62**	**(1.04-2.53)**
20-24	0.92	(0.77-1.09)	0.85	(0.54-1.34)	0.83	(0.58-1.19)
25-29	ref		ref		ref	
30-34	1.04	(0.88-1.23)	1.08	(0.73-1.60)	0.93	(0.63-1.37)
>=35	1.17	(0.98-1.41)	1.33	(0.90-1.98)	0.86	(0.54-1.38)
Race/Ethnicity						
Native Hawaiian	**1.72**	**(1.41-2.09)**	**2.18**	**(1.37-3.45)**	1.42	(0.95-2.13)
White	ref		ref		ref	
Filipino	**1.39**	**(1.12-1.71)**	1.38	(0.82-2.32)	0.95	(0.59-1.54)
Japanese	1.14	(0.88-1.47)	1.46	(0.87-2.43)	0.69	(0.29-1.66)
Other Pacific Islanders	1.18	(0.90-1.54)	1.26	(0.66-2.40)	0.91	(0.54-1.52)
Other Asian	1.28	(0.97-1.68)	1.28	(0.74-2.22)	0.98	(0.51-1.89)
All Others	1.13	(0.75-1.71)	1.99	(0.93-4.26)	1.29	(0.60-2.80)
Blacks	**5.20**	**(4.04-6.70)**	**4.36**	**(2.09-9.07)**	**2.39**	**(1.30-4.38)**
Education						
High School or Less	0.97	(0.85-1.11)	1.19	(0.87-1.63)	0.88	(0.66-1.17)
Some College or More	ref		ref		ref	
Marital Status						
Married	ref		ref		ref	
Not Married	**1.16**	**(1.01-1.33)**	1.05	(0.76-1.46)	0.93	(0.69-1.25)
Previous Preterm Birth						
Yes	**5.06**	**(3.56-7.21)**	**6.73**	**(3.12-14.48)**	**3.62**	**(1.56-8.39)**
No	ref		ref		ref	
First Child	**1.43**	**(1.26-1.63)**	**1.34**	**(1.00-1.79)**	**1.54**	**(1.15-2.06)**
Maternal Medical						
0 Medical conditions	ref		ref		ref	
1 Medical conditions	**1.98**	**(1.74-2.26)**	**2.71**	**(2.01-3.64)**	**1.68**	**(1.27-2.22)**
2 Medical conditions	**3.01**	**(2.50-3.63)**	**3.56**	**(2.32-5.47)**	**2.60**	**(1.77-3.80)**
3 Medical conditions	**3.49**	**(2.49-4.89)**	**3.95**	**(1.79-8.70)**	0.94	(0.30-2.98)
4+ Medical conditions	**7.00**	**(4.29-11.42)**	**16.42**	**(6.73-40.06)**	**4.85**	**(1.73-13.60)**

Abbreviations: EPTB=Extreme Preterm Birth (gestational age < 28 weeks)
[a]High and Low-income stratum = Top and bottom quintile per capita income levels

future studies. The legacy of colonization in Hawai'i has created complex psychosocial impacts for Native Hawaiians, including historical trauma, which can affect individuals regardless of their socioeconomic status and contribute to health disparities.[33] Income inequality may also have a more significant effect on Native Hawaiians than on other race/ethnic groups in Hawai'i due to the cultural discordance between traditional practices and Western economic systems, as has been proposed in study of health disparities in other Indigenous peoples.[12,34,35]

Preexisting maternal medical conditions, previous preterm birth, and birth of a first child were risk factors at all income levels, which is consistent with previous studies.[5,36] A gradient response in risk was observed with increasing number of maternal medical conditions. Although the collinearity of maternal advance age (>35) and preexisting maternal medical conditions was not directly evaluated in this study, it is probable that older women have more preexisting medical conditions than younger women, which would increase their risk of extreme preterm birth. Additionally, older women with preexisting medical conditions may be more likely to undergo assistive reproductive therapy in order to conceive, which has been shown in previous studies to be associated with a 3-fold increase in preterm birth.[37] A collinearity between maternal young age and birth of a first child may contribute to the increased risk associated with birth of a first child.

Finally, although the Black population in Hawai'i is a small subset of the total population (2.6% of all births), the rates of extreme preterm birth among Black women are increased in all models and are the highest of any race/ethnic group. These findings are consistent with other studies for Black Americans which show persistent racial disparities regardless of income levels, with suggested mechanisms

including access to and utilization of high-quality health care, lasting effects of income inequality, policy-induced racial segregation, and cumulative stress due to racial discrimination.[16,32,38] These findings merit further study in the Hawai'i population.

Limitations

Limitations to this analysis stem from the use of vital statistics which are based on hospital birth records but not actual clinical records and may be subject to various reporting discrepancies, biases and limitations.[39] Maternal medical conditions may be under reported.[40] Tobacco and alcohol use are not reliably reported on birth certificates.[41] Preliminary analysis of tobacco and alcohol reporting in the data set supported this assertion, so these variables could not be used in this analysis. An additional birth certificate limitation is that while the Hawai'i birth certificate allows for self-identification of multiple races, the recorded data on racial identification is limited to one racial group, as described in the methods section, thus limiting the ability to consider ethnic admixing which occurs widely in Hawai'i and has been observed to have a significant correlation with health-related factors.[13,42]

An additional limitation for this study is that the low-income and high-income stratification is based on community-level average per capita income. The actual income level of each individual is not known and may not be consistent with the overall area average income. Mixed economic communities occur frequently in Hawai'i where high-value land, such as ocean-front properties, in low-income communities are owned by wealthier individuals. The opposite scenario, with low-income families residing in high-income communities, also occurs due to homestead lands, generational transfers of property and multi-generational living arrangements. This variation between the average income and individual incomes is a differential bias that is likely to understate the significance of findings in the study. Future studies could consider alternative complex social determinant measures such as concentrated disadvantage to evaluate socioeconomic status and social determinants.[43]

An additional consideration is the study size and timeframe of the data. The data used for this study included birth records from 2004-2013. While the rate of preterm birth has remained stable over the period 2013-2023 (10.2% in 2013, 10.1% in 2023), the rate of extremely preterm birth is not available for comparison and may have changed in the interval period.[44] Changes in approaches to preterm birth prevention may also have occurred which would affect the generalizability of this study. In addition, although the study included 10 years of birth records which allowed for significance in the full database, it is possible that the disaggregation to community-level income in conjunction with the rare outcome of extreme preterm birth did not find significance in some variables due to small numbers.

While more recent data may be available through the State of Hawai'i Department of Health, there are protocols that are prohibitive due to time constraints and cost. The authors share what was discovered, in hopes that those with current access to the data could repeat the analysis and update the study.

Conclusion

These findings support a multifaceted approach to address extreme preterm birth disparities which focuses on the diverse and specialized needs of each community. The significance of socioeconomic status as a risk factor for poor birth outcomes should provide an impetus for medical providers to address socioeconomic risk factors and economic needs of patients.

Conflict of Interest Statement

None of the authors identify any conflicts of interest.

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Migdol S, Henry L. Impacts of the Farm to Keiki Program: An Anthropological Evaluation. *Hawaii J Health Soc Welf*. 2025;84(12):293-302. doi:10.62547/UVUI8788

Impacts of the Farm to Keiki Program: An Anthropological Evaluation

Steve Migdol, MS, BSN, RN, CEN[1], Lisa Henry, PhD[1]

[1] Anthropology, University of North Texas

Keywords: Farm to Keiki, farm to preschool, farm to school, medical anthropology, Hawaii, Native Hawaiian, nutrition, program evaluation, evaluation anthropology, Kamehameha Schools

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Abstract

Native Hawaiian health has been adversely impacted by dietary and cultural changes that resulted from colonization. Farm to Keiki is a farm-to-preschool program that introduces children in Hawai'i to healthy eating through gardening and eating local produce, including traditional Native Hawaiian foods. This study utilized anthropological theory and ethnographic evaluation methods to deepen the understanding of the Farm to Keiki program's impact through interviews with family members and focus groups with teachers at 2 Kamehameha preschools. The results demonstrate that children, families, and teachers learned about plants and healthy eating, and made healthier dietary changes following the program. Additionally, participants described ways in which the program helps bolster Native Hawaiian culture and benefits the local community.

Abbreviations

ECE = Early Childcare and Education
FTK = Farm to Keiki
FTS = Farm-to-School
IRB = Institutional Review Board
KS = Kamehameha Schools

Introduction

Hawai'i is often described as being the healthiest state in the US due to its long life expectancies and low rates of obesity, substance use, and diabetes-related deaths.[1-3] However, this is not the case for all Hawai'i residents. Native Hawaiian life expectancies are at least 10 years less than those of the state's Chinese-American residents, due in part to higher rates of cardiometabolic diseases like diabetes, hypertension, and coronary artery disease among Native Hawaiians.[4,5] Native Hawaiians, including children, experience high rates of overweight and obesity.[6]

Although conventional science often seeks to explain these health disparities in terms of genetic anomalies,[7] complex socioeconomic factors, many of which stem from more than 2 centuries of colonialism that led to the loss of land and traditional ways of life, contribute to health outcomes. Whereas foods like *kalo* (taro), *'ulu* (breadfruit), and *'uala* (sweet potato) once were grown as a community and shared, 85-90% of food in Hawai'i is now imported thousands of miles.[8] Obtaining traditional, healthy foods like these plants, fish, *limu* (seaweed), and poi has become expensive and time-consuming.[9]

One approach to addressing such health disparities involves increasing access to fresh, healthy foods, especially for *keiki* (children). Early childhood is an important time for the development of food preferences, which can influence the development of obesity.[10] As a result, Farm to School (FTS) and Farm to Early Childcare and Education (ECE) programs are increasing due to their promise for improving knowledge, attitudes, and behaviors about fruits and vegetables.[11] Extensive research has been published about FTS programs[10-18]; however, at the time of this writing, only 2 studies[10,12] examine the impacts of FTS programs in Native communities, and none involved Native Hawaiians.

Farm to Keiki (FTK) was created in 2011 by Kaua'i-born nutritionist Tiana Kamen to improve preschool-aged children's access to healthy foods and promote healthy farm-to-table food networks.[19] Farm to Keiki developed an educational curriculum that includes lessons on healthy nutrition, participation in school gardens, trying new foods, and other activities to engage *keiki*.

A pilot program was conducted at 2 Kamehameha Schools (KS) preschools on Kaua'i in 2021-2023 (funded by Hawai'i Pacific Health). The program included local food sourcing, FTK curriculum, and *'ohana* (family) education, as well as quantitative research for implementation of FTK programming in other preschools. Each month, FTK provided the schools with locally grown foods purchased from Mālama Kaua'i, a local food hub. The *kumu* (teachers) prepared foods and encouraged tasting by the *keiki*. Each classroom also had a garden that *keiki* helped plant and maintain. Monthly newsletters included recipes and information about the foods the *keiki* had learned about and recipes that could be made at home.

To complement the existing quantitative evaluation (discussed below), Migdol conducted an ethnographic program evaluation as part of his medical anthropology master's thesis. Medical anthropology seeks to understand how people approach health and illness, with a strong focus on the social, historical, and environmental factors that influence health. Its mostly qualitative approach empowers participants to speak open-endedly. This article presents the first study of an FTS program for Native Hawaiians by highlighting the rich insight into the impacts of FTK on the *keiki*, *'ohana*, and *kumu* through ethnographic evaluation methods.

Methods

This was a non-randomized, mixed-methods study with qualitative and quantitative data to evaluate the impact of

FTK interventions on the *keiki*, their *'ohana*, and *kumu* in areas such as diet, knowledge, behaviors, attitudes, overall health, and cultural values.

Participants

The 2 main research populations were the *kumu* (teachers) and school staff from the 2 preschools and the *'ohana* (specifically, the parents and caregivers) of the students. The children themselves did not directly participate in research activities; impacts upon them were evaluated through the reports of the *kumu* and *'ohana* and through secondary data from FTK.

The participants included 15 *kumu* (all women) and 14 parents (12 women), including 5 from Kaumakani preschool (representing 6% of students) and 9 from Anahola preschool (representing 23% of students). *Kumu* were notified that optional focus groups would be conducted in the afternoon of a professional development day. Fifteen of the 18 *kumu* (83% of the *kumu in the* 2 preschools) chose to attend the focus groups and signed the IRB-approved consent. *'Ohana* were emailed an IRB-approved flyer and were asked to provide their contact information to *kumu* if they were interested in participating. Additional respondents were recruited via word of mouth and directly by Migdol at the preschools before and after school. Demographic data such as age, ethnicity, and socioeconomic status were not recorded to avoid inadvertently revealing participants' identities, given the small class sizes and close-knit communities. However, 99.9% of KS *keiki* and 45% of *kumu* have Native Hawaiian ancestry.[20]

Data Collection and Analysis

FTK implemented an evaluation plan before Migdol's involvement, with quantitative measures including:

- Taste-testing tracker: teachers recorded the names and quantities, preparation methods, and *keiki* approval of foods onto Google Sheets spreadsheets each month. To determine approval, *kumu* asked *keiki* to give a "thumbs-up" or "thumbs-down" after they ate and recorded the responses. Some teachers provided numerical details on the breakdown of responses and others just recorded an overall "yes" or "no" whether the majority of students gave a thumbs-up or down to the particular food.
- Garden tracker: plants growing in each classroom's garden and any foods that the *keiki* tasted from the garden were recorded on Google Sheets spreadsheets by teachers each month.
- Curriculum trackers: monthly Google Sheets documentation of how lesson components were implemented, what teachers believed worked well, and what did not.
- Resource trackers: Google Sheets documentation of the items purchased for gardens or food preparation.
- *Keiki* "bingo cards" (**Figure 1**): photos of 9 foods included in the curriculum. The *keiki* were individually asked at the start and end of the schoolyear to identify each food, which foods they had eaten before, and which they would eat if it were served at school. This served as a pre- and post-test by comparing the numbers of foods selected by *keiki* on each question, with a maximum score of 9 per question (representing the 9 foods). Students' first names or initials were recorded by *kumu*, enabling independent and paired sample t-tests to be performed with chi square analysis using SPSS software Version 29.0.1 (IBM Corporation, Armonk, NY).
- Year-end *'ohana* surveys: An anonymous 11-question Google Forms survey assessing experiences with FTK and any changes in *keiki*'s and *'ohana*'s knowledge, attitudes, and behaviors associated with the program. Voluntary participants were solicited directly via email by Farm to Keiki.
- Anonymous *kumu* surveys: A 12-question paper survey, adapted from Sharma et al,[13] assessing teachers' comfort level with the program components, *keiki* and *kumu* knowledge and attitudes, effectiveness of interventions, and overall program satisfaction (at the school year start and end).

To supplement these quantitative measures, Migdol designed an ethnographic evaluation to provide greater insight into the participants' experiences with the program. He conducted semi-structured interviews with parents exploring how the program impacted the *'ohana*'s diet, behavior, interpersonal interactions, finances, and health. Two in-person focus groups were held with *kumu* to understand the program's implementation, successes and areas for improvement, and the impacts on the *keiki* and *kumu*.

The interviews and focus groups were transcribed verbatim and uploaded into MAXQDA Analytics Pro 2022 (Verbi Software, Berlin, Germany). Migdol identified keywords in participants' responses and then grouped those keywords into codes, such as "eating healthy" or "behavioral changes". Next, Migdol re-read the transcripts and searched for instances of those codes being used in other participants' interviews, then revised the codes as necessary, repeating this process until he had exhausted all potential codes. This process facilitated the analysis of the common themes in the interviews. These qualitative data were collected through the lens of interpretive theory, which prefers exploring nuance in people's words and actions over seeking a measurable objective "truth." Thus, additional raters were not utilized to confirm the identified codes.

This study was approved by the University of North Texas Institutional Review Board (IRB) (#22-824). Study participation was voluntary and written consent was obtained using IRB-approved informed consent forms prior to participation.

Results

Analysis of the tracking spreadsheets, surveys, and *keiki* bingo cards provided useful data to guide future development. The taste testing tracker offered insight into which foods were popular with the *keiki*, including cucumber, ba-

Figure 1. Keiki "Bingo Card", Annotated with Food Names Used by Farm to Keiki

[1] Kalo (Taro) [2] 'Uala (Sweet Potato) [3] Mai'a (Banana) [4] Cucumber [5] Beans and Peas [6] Citrus [7] Leafy Greens [8] 'Ulu (Breadfruit) [9] Asian Vegetables

nana, poi, and citrus fruits, but data was inconsistently recorded. Although this presents limited scientific value, it helped the program identify foods to emphasize in the future. Similarly, data on amounts of food needed and costs helped the program plan the following year's curriculum.

The *keiki* bingo cards demonstrated changes in knowledge and food consumption before and after the program. In independent samples t-tests of combined student results, there was a statistically significant increase in the number of plants the *keiki* could identify, from 6.92 out of 9 plants on the pre-test to 8.4 on the post-test (n= 74 and 63 respectively, $P<.001$); this indicates that students had learned at least 1 new plant. Paired sample t-tests showed an increase of 2 new plants identified, from 6.57 plants before to 8.51 after (n=49, $P<.05$). The bingo cards also showed an increase in the number of foods *keiki* re-

Table 1. Pre- and Post-Program Bingo Card Findings about Foods in the Farm to Keiki Program, Kauaʻi 2022-2023

	Independent Samples T-Tests			Paired Samples T-Tests		
	Pre-test	Post-test	*P* value	Pre-test	Post-test	*P* value
Number of plants *keiki* could identify (out of 9)	6.92 *(n=74)*	8.4 *(n=63)*	<.001	6.57 *(n=49)*	8.51 *(n=49)*	.002
Number of foods *keiki* recalled eating before (out of 9)	6.5 *(n=74)*	8.44 *(n=63)*	<.001	6.31 *(n=49)*	8.41 *(n=49)*	.049
Number of foods *keiki* were willing to try (out of 9)	7.14 *(n=74)*	7.71 *(n=62)*	.046	6.81 *(n=47)*	7.57 *(n=47)*	.001

ported having eaten, from 6.5 out of 9 plants on the pre-test to 8.44 out of 9 on the post-test (n=74 and 63 respectively, *P*<.001) using independent samples t-tests, and an increase of more than 2 plants utilizing paired sample t-tests, from 6.31 to 8.41 plants before and after (n=49, *P*<.05). Independent samples t-tests showed an increase in the number of foods they were willing to try, from 7.14 before to 7.71 at the end of the school year (n=73 and 62 respectively, *P*=<.05), and paired samples t-tests showed an increase from 6.81 to 7.57 foods (n=47, *P*=<.01). This demonstrates that the students had eaten at least 2 new plants and were slightly more willing to try eating new plants. There were no statistically significant differences between the preschool classes. **Table 1** provides a summary of these findings.

Year-end *ʻohana* surveys were completed by 31 family members (61% from Anahola preschool, 39% from Kaumakani). As they were anonymous, it is unknown how many respondents also participated in interviews.

Analysis of the interviews and focus groups provided deeper insights into the impacts of the program, not only on the students, families, and teachers as intended by this study, but also for the community and for Native Hawaiian culture. Using MAXQDA to label themes described in the interviews, it was possible to obtain percentages of interviewed parents who described particular observations. In the following section, percentages denote the number of parents who spoke about a given theme during their interview, divided by the total number of interviewees.

Benefits for Keiki

Parents and teachers associated several positive changes with the FTK curriculum, including new excitement about plants and food, new knowledge, changes in attitude and behavior, and eating healthier. Almost all parents (93%, *n*=13) mentioned their child becoming more interested in or excited by plants/new foods, which they attributed to active participation in growing and harvesting food. Several parents noted their children began proudly reciting facts about plants.

Participants also discussed improvements in the children's behavior, including increased confidence, improved mood, and greater open-mindedness about trying foods. The vast majority (86%, *n*=12) of parents noted their *keiki* became more willing to try new fruits and vegetables, which they attributed to the teacher's influence and positive peer pressure. This aligned almost exactly with the year-end *ʻohana* survey, in which 27 out of 31 respondents (87%) answered "yes" when asked the same question. When asked in interviews about changes in their children's eating habits, about 25% of parents described a shift from their children perceiving new foods as disgusting (with many using the word "ewww!") to being desirable (or "cool", as many parents described.)

Importantly, *ʻohana* and *kumu* noticed the *keiki* began eating healthier. *Kumu* saw *keiki* bringing more fruits and vegetables to school and making connections between the foods in their classmates' lunches. By the year's end, 79% of parents (*n*=11) interviewed reported their *keiki* were eating more produce, and those who did not notice a change typically remarked that their *keiki* already regularly ate fruits and vegetables before the program. Parents also noted *keiki* choosing fruit and vegetable snacks over chips and other unhealthy foods, and started requesting foods like kale and pesto. One child reportedly told his mother that he wanted to become a vegetarian. **Table 2** presents key themes identified regarding keiki impacts.

Benefits for the ʻohana

Although FTK focuses on children, families reported positive impacts on other family members, including changes in diet, health, knowledge, interactions, and finances. About a third of parents interviewed mentioned siblings' willingness to try new foods. Half of parents said they started preparing foods with more vegetables, even adding vegetables into processed foods like macaroni and cheese. Most parents did not notice any personal health changes associated with the program, but 1 parent said that she was sleeping better and had more energy. Another said her husband lost 30 pounds, which she attributed to his new awareness of food consumption.

Most parents (69%) spoke about learning new things through their child's participation in FTK, including the nutritional benefits of foods like *ʻulu* and new options for obtaining fresh local produce. Newsletters were described as helpful, particularly the recipes, cooking tips, and Hawaiian cultural lessons. Of those who indicated that they did not learn anything, many added that they were not as involved with the program as they would have liked to have been.

Table 2. Benefits for *Keiki* Described by Participants in *'Ohana* Interviews and *Kumu* Focus Groups

Theme	How Demonstrated	Sample Quotes
New Excitement About Plants and Foods	• Interest in watching plants grow • Enjoyment of garden work • Talking more about plants/food	"He's more excited to eat fruits and vegetables now, and I think that the fact that they're trying new foods, and seeing their peers trying them, really helps spark more interest… He talks about plants a lot more now, like, "Poi comes from *kalo*, and *kalo* has apple snails." He's eager to share what he's learned at school." *(Mother at Anahola)*
New Knowledge	• Understanding life cycles and parts of plants • Observations of animals/pests associated with plants • Increase in plant identification • Understanding how food comes from plants • Mentions of nutritional values of foods, especially vitamins	"He knows like, bananas, you pick off of a tree. Oranges you pick off of a tree. The *'uala*, the sweet potato - he always like talks about how it comes from the ground." *(Mother at Kaumakani)* "I learned that carrot is a good snack and apples is a good snack…You know what is not good? Chips." *(Mother at Kaumakani, quoting her son.)*
Changes in Attitude	• Increased confidence • Better behavior • More open-minded • Increased willingness to taste food • Positive peer pressure	"He definitely has a lot more energy and less anger, since he started eating healthy… if you give kids too much to artificial sugars and ingredients and all that kind of stuff, it affects their brain and their mood… he isn't as short tempered in the past 6 months or so." *(Mother at Kaumakani)*
Eating Healthier	• More fruits/vegetables in lunches • Increased number of fruits/vegetables eaten • *Keiki* choosing healthy snacks	"My son loves fruits and vegetables now… if he wants to be a vegetarian, I think that's great and awesome…" *(Mother at Kaumakani)*

All parents described how FTK activities brought their family closer together, including discussing what was learned at school, gardening, cooking, and *keiki* helping around the house. Most parents (73%) mentioned gardening or growing plants at home. Three parents (21%) already had gardens, and 2 (14%) restarted their old gardens. Six parents (43%) planted foods or started a new garden due to their child's interest in gardening. This aligns with the year-end *'ohana* survey, in which 18 of 31 (58%) reported starting a garden because of the program and 7 of 31 (23%) had existing gardens. About half of parents interviewed also noted their *keiki* have developed an interest in cooking and helping in the kitchen, a finding supported by the year-end survey in which 20 of 31 respondents (65%) reported that *keiki* began wanting to help cook as a result of the program.

Most parents did not immediately identify any potential economic impacts of the program; however, all but 1 parent mentioned the produce that was sent home with the *keiki* periodically, and most found this saved them money and time. **Table 3** offers key themes related to impacts on *'ohana,* and **Figure 2** shows the results of the year-end *'ohana* survey.

Benefits for Kumu

The *kumu* described personal benefits, including new knowledge of plants and nutrition and improvements in their own diets. Learning to garden was valuable for promoting sustainability and potentially saving money. Kumu also noticed that their own eating habits changed as the year progressed. The program provided access to fresh produce and offered an incentive to set a better example for the students. **Table 4** demonstrates the impacts of the program based on the kumu focus groups.

Benefits for Hawaiian Culture

Although preserving Hawaiian culture was not an objective for FTK, this was a major theme during the *kumu* focus groups and the *'ohana* interviews. Specific elements referenced were education about Hawaiian history, the return to traditional Hawaiian values, and the use of traditional Hawaiian plants and foods. Hawaiian children's books and *'ohana* newsletters incorporated Hawaiian history and *mo'olelo* (stories) about "canoe plants" brought by the original Polynesian settlers.

Kumu and 93% of parents (*n*=13) drew a connection between the FTK activities and a return to traditional Hawaiian values, especially *mālama 'āina*, described as "taking care of the land that takes care of us." *Kuleana,* a reciprocal responsibility between 2 people or entities, was also referenced. *Kumu* described how the *keiki* had a *kuleana* to help maintain the garden by watering the plants or removing weeds. Sharing food was the third most referenced traditional Hawaiian value and examples were provided by *kumu* and *'ohana* in which *keiki* took pride in bringing home food to share with their families.

Kumu and *'ohana* praised FTK's use of Hawaiian native plants and canoe plants. Parents mentioned 13 Hawaiian foods, including *kalo* (taro, named by 79% of parents), *'ulu* (breadfruit, 71%) and *'uala* (sweet potato, 64%). Parents frequently described these as Hawaiian "staple" foods offering health benefits and sustainability. Asked if any traditional Hawaiian foods may have been omitted, parents overwhelmingly responded that the program covered the

Table 3. Benefits for *'Ohana* Described by Participants in *'Ohana* Interviews

Theme	How Demonstrated	Sample Quotes
Dietary Changes	• Other family members became more willing to try fruits/vegetables • Parents tried new foods they hadn't eaten before	"I don't think my older daughter would have tried some of the things if her little sister wasn't bragging about how she ate all of this stuff and had that at school." *(Anahola mother)*
New Knowledge	• Learned nutritional value of traditional foods • Learned options for obtaining local produce	"We learned about poi, and citrus, and about the vitamins in the foods. The flyers tell you why it's good for you to eat, how it can grow, and then a simple recipe that you can make. I learned a lot, and seeing my children being excited about foods like this really helps encourage me to want to learn more too. *(Anahola Mother)*
Family Interactions	• Provided an opportunity for family to discuss activities/ lessons • Families started or resumed gardening at home • *Keiki* started helping in the kitchen	"One of the best things about the program is doing these projects at home,.. cooking is time that gets spent with the kids… to take the time to be like, "Let's make this together." That's something that memories and knowledge that you can't ever get back that time, you know?" *(Anahola Mother)*
Economic Impacts	• Produce sent home with *keiki* offered savings and convenience	"We've been getting bags of poi and just a whole bunch of great vegetables. I, we really appreciate it, especially with the price of food nowadays." *(Anahola mother)*

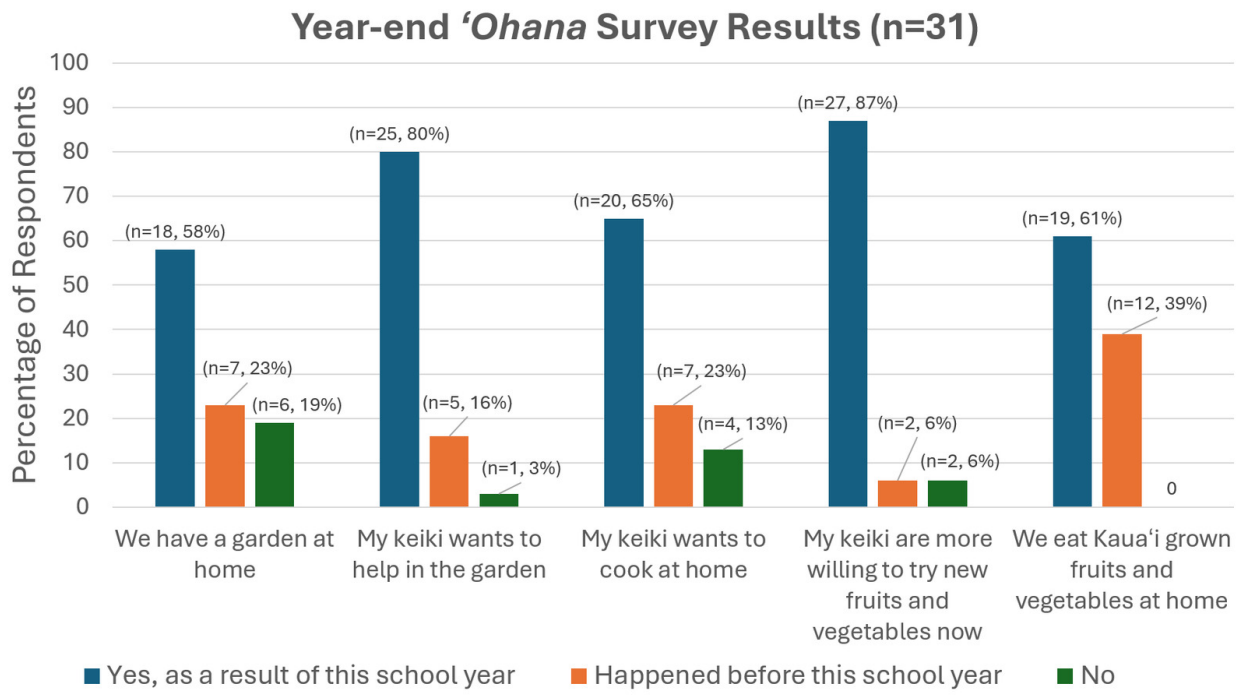

Figure 2. Year-end *'Ohana* Survey Results

important staple foods. **Table 5** provides the impacts of FTK on Hawaiian culture.

Benefits for Community

Participants described FTK as benefitting the local community by increasing demand for locally-grown produce, encouraging farming as a profession, and promoting sustainability through teaching children how to grow their own food. Additionally, FTK spent over $2,600 in 2022-2023 on local food that was purchased from area farmers and food hubs, thereby providing support for local growers. **Table 6** describes community benefits of FTK.

Discussion

While there is abundant literature on FTS programs, studies on the implementation and impact of these programs among Indigenous communities are scarce. Only 2 studies on FTS programs among Native people were identified,[10, 12] and none specifically with Native Hawaiians. This is the

Table 4. Benefits for *Kumu* Described in *Kumu* Focus Groups

Theme	How Demonstrated	Sample Quotes
Gardening	• Learned to garden • Started gardening at home	"To be given this gift of space and soil and time and education… we were literally learning alongside the kids… You can actually try it at home and you can help sustain your family as well." *(Kumu)*
New Knowledge	• Learned nutritional value of foods • Learned about new foods and new uses for plants	"I never heard of poha berry before Tiana introduced it… There's an edible flower up Kokeʻe and I never knew we could go and pick." *(Kumu)*
Eating Healthier	• Increased availability of fresh produce for *kumu* • Inspired to model healthy eating • Tried new foods	"I've been making healthier choices in what I eat around the students because I want to model actually eating vegetables." (*Kumu)*

Table 5. Benefits for Hawaiian Culture Described by Participants in *ʻOhana* Interviews and *Kumu* Focus Groups

Theme	How Demonstrated	Sample Quotes
Preservation of History and Stories	• Lessons about history, traditional uses, and *moʻolelo* (stories) about canoe plants.	"The flyers they sent home even had, like a cultural like story or history behind it. And so I thought that… benefited, you know, just the whole Hawaiian culture, as things have been lost over the years in our generations." *(Anahola mother)*
Perpetuation of Hawaiian Values	• *Malama ʻāina* • *Kuleana* • Sharing	"Yes, it's great to grow food, but it's also very important that we take care of the land that we're growing the food in because, optimally our health is connected to that component of it." *(Kumu)*
Promotion of Hawaiian Foods	• Keiki eating traditional foods • Parents and *keiki* learned how to grow *kalo* and make poi	"…especially kalo because it has the whole family analogy… My generation… we were just white rice every day was every meal… and we're paying the price for that. This is about shifting back, trying to rebalance that some…" *(Kaumakani father)*

Table 6. Benefits for the Community Described by Participants in *ʻOhana* Interviews and *Kumu* Focus Groups

Theme	How Demonstrated	Sample Quotes
Promoting Local Food	• Spent $2600 on local farmers and food hubs • Increased respect for farming	"I think the more we educate the younger generation about the importance of eating healthy… there'll be more demand for healthy options and maybe even it can go back to… agriculture as being our main source of economy." *(Kaumakani mother)*
Sustainability/ Resilience	• Promoting gardening at home helps families have access to food at home • Reduces dependence on imported food	"For keiki's future, self-sufficient is a big skill… so we don't rely on outsourcing too much." (*Anahola mother)*

first study of an FTS program that primarily serves Native Hawaiian students.

Many findings in this study align with and reinforce those of general FTS programs, particularly pertaining to the increased willingness to try new foods, increased produce intake, and increased nutritional knowledge.[13-17] However, there were some unique aspects of FTK, especially related to its impact on families and teachers and the inclusion of Hawaiian cultural elements in the curriculum.

Only 2 studies mention FTS impacts on families. Barnard et al note an unexpected finding in which a family member reported changes in their own eating habits due to their child sharing what they learned about healthy nutrition.[17] Sharma et al report that some parents described cooking and gardening with their children following the program.[13] The current study of FTK specifically sought to understand the impacts on families as well as the students, making this study unique among those reviewed. The combination of data from *kumu* and *ʻohana* paints a picture of a program that inspires families to eat healthier, grow food at home, spend time together cooking and gardening, and provides occasional free local produce. Some of these impacts were unexpected and will likely enrich the health and lives of the participants.

This study also examined impacts upon teachers, which was infrequently reported in the literature reviewed. Among studies that did include teachers, Bernard et al found that the FTS program increased the likelihood of

teachers eating in the school cafeteria, helped teachers make healthier food choices, and increased the number of fruits and vegetables consumed.[17] Dannefer et al found that educators reported aspects of teaching and promoting healthy eating to be rewarding.[18] The present study of FTK demonstrates the program helped teachers to eat healthier, learn or practice gardening skills, and expand their knowledge of local plants, foods, and healthier nutrition.

The most unique element of this study with FTK was its perceived promotion of Native Hawaiian culture. Although not a program objective, the use of traditional plants and foods, modeling of cultural values, and history lessons were described by participants as being important for the perpetuation of Hawaiian culture, and lessons about the canoe plants such as *kalo, ʻuala,* and *ʻulu* were commonly discussed by *kumu* and *ʻohana* as being important. Parents also identified the nutritional benefits of these plants and expressed a desire to see this generation eat more traditional plants. Intentionally taught or not, FTK participants saw the program as promoting traditional Hawaiian values like *mālama ʻāina*, *kuleana*, and sharing.

Finally, this study demonstrates that applied anthropology is well-suited to conducting program evaluations by empowering participants to describe their experiences, which can reveal unexpected information. In this study, quantitative tools like activity trackers and surveys provided data about the overall functioning of and satisfaction with the program, but this alone did not reveal the meaning of the program to participants. By interviewing and probing participants to explain how the program impacted them, participants unexpectedly revealed how it promoted Native Hawaiian culture and local community sustainability.

Limitations

This study had several limitations, including that the views of the *keiki* were not directly studied, inconsistent data collection, the relatively small sample size, possible self-selection bias, and potential recall bias. *Keiki* were not included in the research population to reduce potential risks, but their views were inferred from the adults around them. Data was collected inconsistently by *kumu;* however, their data was primarily intended for program evaluation rather than research. For example, some *kumu* did not use student identifiers when performing the pre- and post-test bingo cards, so paired samples t-tests could not be performed for about 14 students. The participants represented 12% of the total population of the 2 schools, and Anahola was overrepresented versus Kaumakani (23% vs. 6%). Since interviews were conducted with parents who volunteered to speak, it is plausible that people who had more positive experiences were more likely to volunteer. Lastly, participants recalled events from the year and could be at risk for recall bias.

Conclusion

Farm to Keiki helped *keiki*, their *ʻohana*, and their *kumu* learn about plants and nutrition and helped encourage them to make healthier dietary choices. Benefits like these have been described in previous literature, although few studies looked at these impacts on families and teachers. Beyond these expected findings, however, was the revelation that participants saw the perpetuation of Native Hawaiian culture through the inclusion of traditional Hawaiian foods and lessons about Native Hawaiian history and practices in the program. Quantitative data alone would have missed these findings. This underscores how anthropological theory and methods can be applied in program evaluation to gain a deeper understanding of program impacts on participants.

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Lee KE, Chen S, Altman MR, Fontenot HB, Loos JR. Advancing Health Equity: Reducing Maternal-Fetal Mortality in Hawai'i through Community-Academic Partnership. *Hawaii J Health Soc Welf*. 2025;84(12):303-306. doi:10.62547/GUJQ3103

Advancing Health Equity: Reducing Maternal-Fetal Mortality in Hawai'i through Community-Academic Partnership

Kyoung Eun Lee, PhD, APRN, WHNP-BC[1], Sunny Chen, BSN, RN[2], Molly R Altman, PhD, CNM, MPH, FACNM[1], Holly B Fontenot, PhD, APRN, WHNP-BC, FAAN[1], Joanne R Loos, PhD[1]

[1] School of Nursing and Dental Hygiene, University of Hawai'i at Mānoa, [2] Health Mothers Healthy Babies Coalition of Hawai'i

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The Spotlight on Nursing is a recurring column from the University of Hawai'i at Mānoa School of Nursing and Dental Hygiene (SONDH). It is edited by Holly B. Fontenot, PhD, APRN, WHNP-BC, FAAN, FNAP; Associate Dean for Research, Professor, and Frances A. Matsuda Chair in Women's Health for SONDH, and HJH&SW Contributing Editor; and Joanne R. Loos PhD, Science Writer for SONDH.

Abbreviations

HMHB – Healthy Mothers Healthy Babies Coalition of Hawai'i
SONDH – School of Nursing and Dental Hygiene

The Urgent Challenge: Maternal-Fetal Health Disparities in Hawai'i

Maternal-fetal health disparities in Hawai'i remain a pressing public health crisis, shaped by persistent racial, geographic, and economic inequities. Native Hawaiian, Pacific Islander, and other historically marginalized populations experience disproportionate burdens of maternal morbidity and mortality.[1] For example, from 2017 to 2019, Native Hawaiian and Pacific Islander women were significantly more likely to die from pregnancy-related causes than women of other racial or ethnic groups.[2,3] In 2020, 1 in 3 infants in Hawai'i were born to a woman receiving inadequate, late (after 2nd trimester), or no prenatal care.[4] According to the Office of Hawaiian Affairs (2022), only 59.5% of Native Hawaiian women receive prenatal care during the first trimester[5]—well below the national target of 80.5% set by Healthy People 2030.[5,6] Women living on rural neighbor island counties are doubly impacted, with reduced provider availability and increased travel distances to reach birthing facilities—averaging over 12 miles, compared to 8.8 miles on O'ahu.[1] Unlike other US regions where distance is measured in miles traversed on ground, patients in Hawai'i may be required to travel by air to another island to receive specialty care or deliver their babies. These inter-island travel requirements introduce significant barriers—including cost, scheduling, and transportation logistics—that disproportionately affect low-income and Medicaid populations. In many areas, especially Moloka'i, Lāna'i, and rural parts of Hawai'i Island, the scarcity of maternity providers and birthing facilities further intensifies disparities and delays in care. While the 2023 March of Dimes Maternity Care Desert Report (2023)[7] does not classify Hawai'i as having maternity care deserts, this designation overlooks the unique structural and geographic barriers that limit access. In practice, many communities across the state function as *de facto* maternity care deserts due to the unavailability of local services and the necessity of inter-island travel. These systemic limitations highlight the urgent need for mobile outreach, telehealth expansion, and community-rooted support networks across all islands.

Additional disparities manifest in mental and behavioral health outcomes. The prevalence of postpartum depressive symptoms in Hawai'i is estimated at 12% to 18%, depending on the population.[8] Native Hawaiian and Pacific Islander mothers are 1.5 to 2 times more likely to report depressive symptoms postpartum compared to White mothers, due to the limited access to mental health providers and cultural stigma remain barriers to care.[8] These disproportionate outcomes reflect entrenched disparities in chronic disease burden, limited access to timely and culturally appropriate care, and structural inequities embedded within the health care system.

Addressing these complex and layered disparities requires an integrated approach that merges academic knowledge with community wisdom. Therefore, a new partnership between the School of Nursing and Dental Hygiene (SONDH) at the University of Hawai'i at Mānoa and the Healthy Mothers Healthy Babies Coalition of Hawai'i (HMHB) has formed. This novel collaboration proposes an innovative and scalable framework to reduce maternal-fetal mortality, ensure early and sustained prenatal care, and improve overall birth experiences for all birthing people in Hawai'i.

Advancing Equity Through Community-Rooted Care: HMHB

HMHB is a nonprofit, community-rooted organization with a decades-long track record of serving the maternal and child health needs of Hawai'i's most vulnerable populations.[8] Founded over 30 years ago, HMHB continues to lead statewide efforts to reduce reproductive health inequities through integrated clinical services, education, peer support, and policy advocacy. Guided by core values of equity, autonomy, and innovation, HMHB's mission is to support and empower individuals and families across the reproductive lifespan—from preconception through pregnancy, postpartum, and early parenting.[9] Through a comprehensive model of wraparound care, HMHB addresses not only

clinical needs but also social determinants of health such as housing insecurity, food access, transportation, and systemic racism.

HMHB offers an array of services including birth control access, reproductive services, sexually transmitted infection testing and treatment, cervical cancer screening, and prenatal and post-partum care. These services are delivered through a mix of fixed-site clinics and mobile medical units that travel to remote and underserved communities across the islands.[10] Nurses, nurse practitioners, and midwives provide culturally grounded support to Native Hawaiian and Pacific Islander mothers living in remote areas with limited/no access to OB care through the Māna Mama and OG Mama programs. Māna Mama focuses on prenatal and postpartum care through traditional practices, and OG Mama offers peer-led outreach and guidance for women navigating substance use and recovery during pregnancy. The organization's Community-Based Doula program provides holistic childbirth and postpartum support rooted in cultural competence and lived experience. Their 'Piko Pals' initiative brings together new parents in peer-led groups that foster resilience, emotional well-being, and social connectedness. HMHB's expanded telehealth offerings, partnerships with shelters, and educational classes further extend their reach to individuals who otherwise might not have access to timely or quality care.

Through its multi-layered services, HMHB functions as both a health care provider and community advocate—an essential bridge between marginalized communities and the formal health care system. This uniquely positions HMHB as an indispensable partner for collaborative efforts to eliminate maternal-fetal disparities across the state.

Academic Excellence in Action: SONDH at the University of Hawai'i at Mānoa

An academic leader in advancing health equity through nursing education, research, and service, SONDH is rooted in a mission to improve the health of Hawai'i's diverse and geographically dispersed populations. The school has a mission to prepare culturally responsive clinicians and scholars who are trained to address health disparities across the lifespan.[11]

The faculty at SONDH conduct impactful research across maternal-child health, Indigenous wellness, population health, and rural care access. Their work is often transdisciplinary and community-engaged, with strong partnerships that translate evidence into action. Faculty initiatives focus on improving perinatal care delivery models, advancing equity in access to mental health care, and understanding the impact of social determinants on maternal outcomes.

The undergraduate and graduate education programs cultivate the next generation of health care clinicians and leaders equipped to deliver system-level change. These students engage in high-impact clinical training that integrates concepts of trauma-informed care, cultural humility, and interprofessional collaboration. SONDH's commitment to experiential learning places students in real-world settings, including community clinics, rural hospitals, and culturally focused health organizations, which allows them to apply theory and research to practice. The school's alignment with HMHB's mission and operational model creates a synergistic opportunity to both support and scale equitable maternal health interventions across the state.

A Shared Vision: Building a New Collaborative Infrastructure for Health Equity

The goals and values of SONDH and HMHB converge in their shared vision to eliminate maternal-fetal health disparities in Hawai'i. Together, these institutions form a new and powerful alliance to address the systemic barriers impacting maternal and infant health.

The new partnership will integrate SONDH students into HMHB's clinical programs, offering immersive training in prenatal, postpartum, and reproductive care. These clinical placements not only expand students' clinical and cultural competence but also increase HMHB's care capacity—particularly in underserved and neighbor island communities. Graduate students, in particular, will contribute to program improvement, service delivery, and practice-based research. In return, HMHB benefits from the scholarly engagement and workforce reinforcement provided by academic collaborators and future nursing leaders.

Beyond clinical training, the collaboration supports rigorous, community-informed evaluation of maternal health initiatives. The faculty, students, and HMHB team plan to co-develop new and assess outcomes for current clinical interventions such as mobile outreach, same-day reproductive services, peer-support groups like Piko Pals, and the Community-Based Doula Program. These existing initiatives aim to improve parenting confidence, reduce mental health burdens, and enhance equitable access to care—particularly for Native Hawaiian, Pacific Islander, and other Black, Indigenous, People of Color (BIPOC) birthing families; yet long term outcomes have yet to be explicated.

The new partnership is structured around bidirectional knowledge exchange: HMHB's on-the-ground expertise guides academic inquiry, while SONDH's research infrastructure supports service innovation. Community feedback will be integrated at every stage of any new program design and evaluation, ensuring that findings remain relevant, respectful, and impactful. The shared aim is to generate data-driven insights into the social and clinical drivers of maternal health inequities in Hawai'i. These insights will inform future interventions, guide best practices, help to generate programmatic revenue, and provide the knowledge needed to inform policy change.

The joint team is planning to pursue federal and foundation grant funding. Educational grant funding directly supports workforce development, training opportunities, and the expansion of clinical services that are culturally relevant and place-based. Research grant funding drives development and testing of innovation interventions necessary to guide services that will reduce health disparities and improve health outcomes for the communities served. Faculty and HMHB leader led continuing education, commu-

nity symposia, and policy engagement will also contribute to long-term systems change.

Ultimately, this collaborative infrastructure is more than a service network—it is a sustainable, equity-centered model grounded in Hawaiʻi's values of *aloha*, community, and *kuleana* (responsibility). By bridging academic excellence with community wisdom, the new SONDH-HMHB partnership offers a transformative blueprint for improving maternal and infant health outcomes statewide.

Conclusion: A Commitment to Equity and Generational Wellness

The collaboration between SONDH and HMHB represents a transformative model for improving maternal health outcomes across Hawaiʻi by centering equity, cultural responsiveness, and community empowerment. Through joint publications, community symposia, and continuing education workshops, the knowledge generated will be widely disseminated, ensuring research translates into real-world impact. Recognizing maternal-fetal mortality as a solvable crisis, this partnership emphasizes cross-sector collaboration, cultural insight, and structural investment to build a robust, research-informed model of care that serves Hawaiʻi's most vulnerable birthing populations. From peer support and mobile clinics to student training and data analysis, the shared infrastructure aims to close widening perinatal gaps and foster a maternal health system that leaves no family behind. This collaboration represents a hopeful and transformative response, one rooted in community, evidence, and *kuleana*.

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