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## Using Quantile Regression to Assess Disparities in Medication Adherence

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### Abstract

**Objective**—To examine racial/ethnic disparities in medication adherence between Asian and Pacific Islander Americans and Whites.

**Methods**—This retrospective data analysis included diabetes patients enrolled in a Hawaiian health plan (N = 43,445). For anti-diabetic, lipid-lowering, and anti-hypertensive medications, quantile regression was estimated at 25<sup>th</sup>, 50<sup>th</sup>, and 75<sup>th</sup> quantiles to examine the association with race and ethnicity, controlling for other patient characteristics.

**Results**—Consistently, Filipinos, Native Hawaiians, and other Pacific Islanders were significantly less adherent than Whites. The greatest disparities were found for other Pacific Islanders using lipid-lowering medications, with adjusted differences in medication adherence, with reductions relative to Whites of as much as 19% for lipid-lowering medications for the 25<sup>th</sup> quantile of adherence.

**Conclusion**—Whereas the large sample size undoubtedly contributed to the statistical significance, the large magnitude of the disparities, particularly for Filipinos, Native Hawaiians, and other Pacific Islanders, suggests that these are meaningful differences that need to be addressed. The largest disparities were found at the lowest quantile suggests that they may be occurring among the most vulnerable populations with potentially poor access to care.

A World Health Organization report called poor medication adherence a “worldwide problem of striking magnitude.”<sup>1</sup> Although it is well known that anti-diabetic, anti-hypertensive, and lipid-lowering therapies significantly reduce the risk of adverse cardiac events in patients with diabetes, adherence to recommended medication treatment regimens is known to be low,<sup>2-5</sup> particularly in certain racial or ethnic subgroups. Consistent results in prior studies show that African Americans and Latinos are less likely than Whites to adhere to medication regimens, regardless of medical condition, type of health insurance coverage, and way in which adherence is measured.<sup>6-38</sup>

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#### Conflict of Interest Statement

The authors have no financial or other conflicts of interest to disclose.

Despite the fact that Asian and Pacific Islander populations in the US are growing more rapidly than most other groups, few studies have examined the relationship between Asian and Pacific Islander ethnicity and medication adherence. The studies that do exist provide conflicting findings.<sup>39,40</sup> Our prior work has found significant disparities in medication adherence between Asian American and Pacific Islander subgroups and Whites.<sup>41-44</sup> In particular, Native Hawaiians and Filipinos tend to be less adherent to medications than Whites, Japanese, and Chinese. Existing disparities among subgroups highlight the importance of analyzing disparities in specific ethnic subgroups rather than combining all Asian and Pacific Islander groups into one category due to large variation in health-related behavior, quality of care, and health status among these ethnic subgroups.<sup>45,46</sup>

Most of these studies, as well as other medication adherence studies, however, define adherence as a possession ratio or percent of covered days greater than 80% and use logistic regression models to examine the relationship of predictor variables, including race and ethnicity, and the likelihood that a patient reaches that 80% threshold. This paper takes a different approach, using quantile regression to obtain a more comprehensive view of ethnic disparities in medication adherence. Quantile regression models the relationship between a set of predictor variables and specific quantiles (or quantiles) of the response variable.<sup>15,47,48</sup>

In our study, quantile regression is useful in that it provides a comprehensive view of the relationships between ethnicity and medication adherence and can bring to light differences in the tails as well as the center of the adherence distribution. For example, a 50<sup>th</sup> quantile regression of medication adherence specifies the differences in the median adherence related to ethnicity. However, ethnic disparities may vary substantially between quantiles and may only be statistically significant in specific quantiles of the adherence distribution. Hence, quantile regression might find that Native Hawaiians have lower adherence at the 25<sup>th</sup> quantile but have similar adherence at the 50<sup>th</sup> quantile, suggesting that special attention should be focused on those within that quantile. By focusing on mean adherence or dichotomous criteria (such as an 80% adherence rate), traditional linear and logistic regression models might miss these disparities. The objective of this study was to examine heterogeneous impacts of race and ethnicity at different quantiles of the adherence distribution as defined by percent of covered days.

When examining ethnic or racial disparities, issues of potential confounding need to be addressed. In our study, we control for age, sex, history of cardiovascular disease, and overall morbidity level; however, one limitation of the study is potential confounding by factors for which we were unable to adjust due to lack of data, including socioeconomic status and access to care.

## METHODS

### Study Sample

This retrospective claims analysis identified patients with diabetes enrolled in a large health plan in Hawaii from 1/1/2007 through 12/31/2010 (N = 116,726 observations for 45,047 patients).

Diabetes was identified using a disease management algorithm as either having 2 or more claims for type 2 diabetes in medical claims ([ICD-9-CM] codes 250.xx) or had at least one prescription for an oral hypoglycemic agent and/or insulin.

## Measures

Patient information including age, sex, history of cardiovascular disease, morbidity level, and year was obtained from administrative data. Patient morbidity level was determined by using *ICD-9-CM* codes according to the Johns Hopkins Adjusted Clinical Group methodology; levels of 4 or 5 on the 5-point scale were considered high morbidity.<sup>49</sup> The year variable was dichotomous and controlled for the year in which adherence was measured (2007–2010).

Data on ethnicity were available for 44% of patients from annual membership surveys. Members were asked to check all ethnicities that applied. Those who selected more than one ethnicity were classified as “mixed race” and excluded from the analyses (N = 1456). The exception was Native Hawaiians. In keeping with the approach used by the Hawai'i State Department of Health, we categorized as Hawaiian anyone who checked Hawaiian even if they checked more than one other ethnicity.<sup>50</sup> Ethnic categories for this study included the 6 largest groups: White, Filipino, Japanese, Chinese, Native Hawaiian, and other Pacific Islander. All other racial or ethnic groups were combined into an “other race” category.

Medication fill data including medication names, fill dates, and days of supply were obtained from pharmacy claims databases. Medication adherence was assessed for 3 types of medications: (1) anti-diabetic, (2) lipid-lowering, and (3) anti-hypertensive. To estimate medication adherence, we used the proportion of days covered (PDC), calculated as:

$$\frac{\text{\#of days in period}^{\text{covered}} \text{by medication}}{\text{number of days of drug enrollment}}$$

PDC is a well-validated and widely-used measure of medication adherence.<sup>51,52</sup> We determined the patient's measurement period as the index prescription date to the end of the calendar year or to the date of disenrollment. Within the measurement period, we counted the days the patient was covered by at least one drug for each type of medication based on the prescription fill date and days of supply. The number of covered days was divided by the number of days of drug coverage and multiplied this number by 100 to obtain the PDC (as a percentage) for each patient.

## Analysis Plan

Initially, we tabulated frequencies of the patient characteristics in year 2007 according to racial and ethnic groups and tested for statistical significance using analysis of variance for age and Pearson's chi-square test for categorical variables. To examine the relationship among race and ethnicity and medication adherence, quantile regression was estimated at 25<sup>th</sup>, 50<sup>th</sup>, and 75<sup>th</sup> quantiles.<sup>48</sup> Control variables included age, sex, region (Honolulu vs other), comorbidity level, history of coronary artery disease or congestive heart failure, and year. All analyses were conducted using Stata statistical software, Version 11.<sup>53</sup>

## RESULTS

### Patient Characteristics

All patient characteristics differed significantly by race and ethnicity (Table 1). Mean age ranged from 55 years old for other Pacific Islanders to 67 years old for Japanese and Chinese; percent female ranged from 45% for Whites to 57% for Filipinos. The percentage living in Honolulu varied significantly from 21% of Native Hawaiians to 66% of Chinese. High morbidity ranged from 47% for Whites to 30% for other Pacific Islanders. For coronary artery disease, percentages ranged from 21% for Pacific Islanders to 33% for

Chinese; for congestive heart failure, percentages ranged from 12% for Japanese, Chinese, and Filipinos to 18% for Native Hawaiians.

### Medication Adherence Related to Race and Ethnicity

The 3 figures display differences in medication adherence for each racial and ethnic group compared to Whites for the 3 types of medications: anti-diabetic, lipid-lowering, and anti-hypertensive. For anti-diabetic medications, the adherence of Chinese and Japanese did not differ significantly from Whites, except that Japanese had significantly higher adherence at the 75<sup>th</sup> quantile (Figure 1, Table 2). Filipinos, Native Hawaiians, and other Pacific Islanders were significantly less adherent than Whites for anti-diabetic medications at every quantile level examined. The greatest disparities were found for other Pacific Islanders at all 3 quantiles, with a difference relative to Whites of -11.4% at the 25<sup>th</sup>, -7.6% at 50<sup>th</sup>, and -4.0% for 75<sup>th</sup> quantiles. We found a similar trend, with larger disparities at lower quantile levels for Filipinos (-5.5% at 25<sup>th</sup>, -2.2% at the 50<sup>th</sup>, -1.3% at 75<sup>th</sup> quantile) and Native Hawaiians (-4.4% at the 25<sup>th</sup>, -3.5% at the 50<sup>th</sup>, -1.3% at the 75<sup>th</sup>).

Results for lipid-lowering medications were similar, except the magnitude of the differences between Asian and Pacific Islander sub-groups and Whites was larger and Chinese had lower adherence rates than Whites (Figure 2, Table 2). As with anti-diabetic medications, the largest disparities were found for other Pacific Islanders relative to Whites (-19.4% for 25<sup>th</sup>, -16.8% for 50<sup>th</sup>, -5.6% for 75<sup>th</sup>). Similarly, Filipino (-10.7% for 25<sup>th</sup>, -6.7% for 50<sup>th</sup> and -2.3% for 75<sup>th</sup>) and Native Hawaiian (-8.5% for 25<sup>th</sup>, -6.7% for 50<sup>th</sup>, -2.3% for 75<sup>th</sup>) disparities decreased for higher quantiles. For lipid-lowering medications, "other race" had lower adherence at all quantiles, whereas Chinese had lower adherence than Whites at the 25<sup>th</sup> quantile. Japanese were significantly more adherent than Whites at the 75<sup>th</sup> quantile but the magnitude of the difference was small.

For anti-hypertensive medications we found similar results regarding racial and ethnic disparities in medication adherence (Figure 3, Table 2). Other Pacific Islanders had significantly lower medication adherence than Whites at each quantile (-13.9% at the 25<sup>th</sup>, -7.4% at the 50<sup>th</sup>, and -3.0% at the 75<sup>th</sup>). Once again, Native Hawaiians and Filipinos also had significantly lower adherence than Whites at each quantile, with differences decreasing with increasing quantile. Chinese had significantly lower adherence rates than Whites at the 25<sup>th</sup> and 50<sup>th</sup> quantiles; however, the magnitude of the disparity was approximately half the size of that for Filipinos and Native Hawaiians. For antihypertensive medications, Other Race had significantly lower adherence at the 25<sup>th</sup> and 50<sup>th</sup> quantiles. Adherence rates of Japanese did not differ significantly from Whites.

### Medication Adherence and Other Patient Characteristics

Table 2 displays adjusted medication adherence rates, rather than differences in rates, for each type of medication at each quantile related to patient characteristics. For instance, for Whites, an individual at the 25<sup>th</sup> quantile of the distribution would be expected to have 56.9% adherence, an individual at the 50<sup>th</sup> quantile would be expected to have 79.6% adherence and an individual at the 75<sup>th</sup> quantile would be expected to have 92.4% adherence. For all 3 types of medications, antidiabetic, lipid-lowering, and anti-hypertensives, compared to being age 50 to 64, younger age was significantly associated with lower adherence at every quantile; older age was significantly related to higher adherence (Table 2). Large differences of 10% to 30% were consistently observed at the 25<sup>th</sup> and 50<sup>th</sup> quantiles, and differences of 4% to 16% at the 75<sup>th</sup> quantile. Female sex was significantly associated with reduced adherence for all 3 types of medication at each quantile, though differences tended to be lower at the 75<sup>th</sup> quantile (Table 2).

Living in Honolulu, relative to a rural area, was significantly and positively associated with medication adherence for each type of medication at each quantile, except for the 25<sup>th</sup> quantile of antihypertensive adherence ( $p = .06$ ); however, the magnitude of the differences was small, particularly at the 75<sup>th</sup> quantile, with 91% adherence among residents of Honolulu compared to 90.1% adherence in other regions. High morbidity was positively and significantly related to medication adherence for anti-diabetic and anti-hypertensive medications, but there were no significant difference in adherence to lipid-lowering medications.

Having a history of coronary artery disease or congestive heart failure was significantly associated with increased medication adherence for anti-hypertensive medications at each quantile (Table 2); however, the association between having a history of these conditions and other types of medications varied. Whereas coronary artery disease was not significantly associated with adherence to antidiabetic medications, congestive heart failure was associated with worse adherence to these medications at each quantile. Having a history of congestive heart failure was significantly associated with lower medication adherence to lipid-lowering medications at the 25<sup>th</sup> and 50<sup>th</sup> quantiles, whereas having coronary artery disease was positively associated with adherence to lipid-lowering medications at each quantile.

## DISCUSSION

Lack of adherence to medications in patients with diabetes has been associated with increased morbidity, mortality, and costs of care.<sup>54-57</sup> As medication adherence has been significantly shown to be higher in certain racial and ethnic groups relative to Whites, improving medication adherence in health disparity subgroups might be one means of reducing health inequalities associated with race and ethnicity. This study sought better understanding of the relationship between race and ethnicity and medication adherence for 3 types of medications (anti-diabetic, lipid-lowering, anti-hypertensives) in a predominantly Asian and Pacific Islander population enrolled in a large health plan in Hawaii ( $N > 43,000$ ).

We found that consistently across all 3 types of medications other Pacific Islanders (meaning non-Native Hawaiian Pacific Islanders) had the lowest medication adherence rates, followed by Native Hawaiians and Filipinos. Chinese had rates similar to Whites and Japanese had medication adherence rates greater than Whites. Our findings that Native Hawaiians and Filipinos had lower adherence than Whites are consistent with those of other studies.<sup>41-44</sup>

To our knowledge, however, our study is the first to document the large disparities found between other Pacific Islanders and Whites. The other Pacific Islander category includes Polynesians other than Native Hawaiians (eg, Samoan, Tongan), Micronesians (eg, Guamanian, Marshallese, Chuukese), and Melanesians (eg, Fijian). In Hawaii, the largest groups in the other Pacific Islander category are Samoans and Micronesians.

In addition, we discovered that the disparities, while present at each quantile (25<sup>th</sup>, 50<sup>th</sup>, 75<sup>th</sup>), tended to be most pronounced at the 25<sup>th</sup> quantile. Further research is needed to determine how best to improve medication adherence among this segment of the population with low adherence. The consistency of our findings across all 3 types of medications suggests that interventions should attempt to target all 3 types of medications (anti-diabetic, lipid-lowering, and anti-hypertensives) when addressing adherence issues among Pacific Islander and Filipinos populations.

Age differences in adherence were even greater than differences associated with race and ethnicity. Compared with patients aged 50 to 64, younger age was strongly associated with

lower adherence, whereas older age was significantly associated with higher adherence. Differences of 10% to 30% were consistently observed at the 25<sup>th</sup> and 50<sup>th</sup> quantiles, and differences of 4% to 16% at the 75<sup>th</sup> quantile. While the magnitude of the association was not as great, being female was significantly associated with worse medication adherence.

There are several limitations to this study. First, patients were enrolled in a large health plan in Hawaii so results may not be generalizable to uninsured populations, other regions, or other racial and ethnic groups not included in this study. Second, as medication compliance was determined from pharmacy claims, the actual consumption of medication was not assessed and the provision of free drug samples was not captured. Third, race and ethnicity information was only available for 44% of the study population. Even so, due to the large sample size, we were able to find significant racial and ethnic disparities in medication adherence. Fourth, we did not correct for multiple comparisons; however, as most of the p-values were < .001, we would likely retain the same conclusions.

Our study is the first to examine medication adherence using quantile regression analysis in an Asian and Pacific Islander population. Whereas the large sample size undoubtedly contributed to the statistical significance of the findings, the large magnitude of the disparities, particularly for Filipinos, Native Hawaiians, and Other Pacific Islanders at the 25<sup>th</sup> quantile, suggests that these are meaningful differences that need to be addressed. Further research is needed among other Pacific Islanders to determine which specific ethnic groups had lower adherence.

The fact that the largest disparities were found at the lowest quantile suggests that they may be occurring among the most vulnerable populations with potentially poor access to care. We need to identify effective means of improving adherence, particularly for those with the lowest levels of adherence, including other Pacific Islanders as well as Native Hawaiians and Filipinos in Hawaii. This is particularly important as the Native Hawaiian and other Pacific Islander population was one of the fastest growing ethnic groups between 2000 and 2010. Targeted interventions might also be needed to improve adherence in younger adults and women for all 3 types of medications.

### Human Subjects Statement

Our study involved retrospective secondary analysis of an existing dataset. Hence, the only risk to subjects would be related to privacy or confidentiality. Risks to subjects was minimized by conducting the analyses on a de-identified dataset. The University of Hawaii Committee on Human Studies approved this study as exempt.

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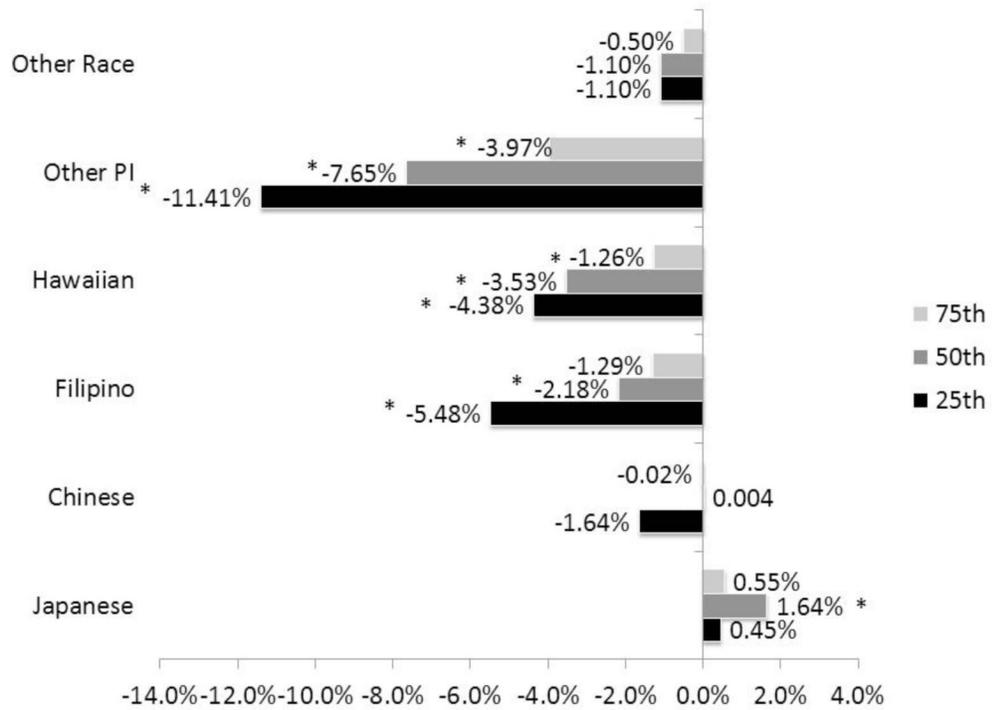
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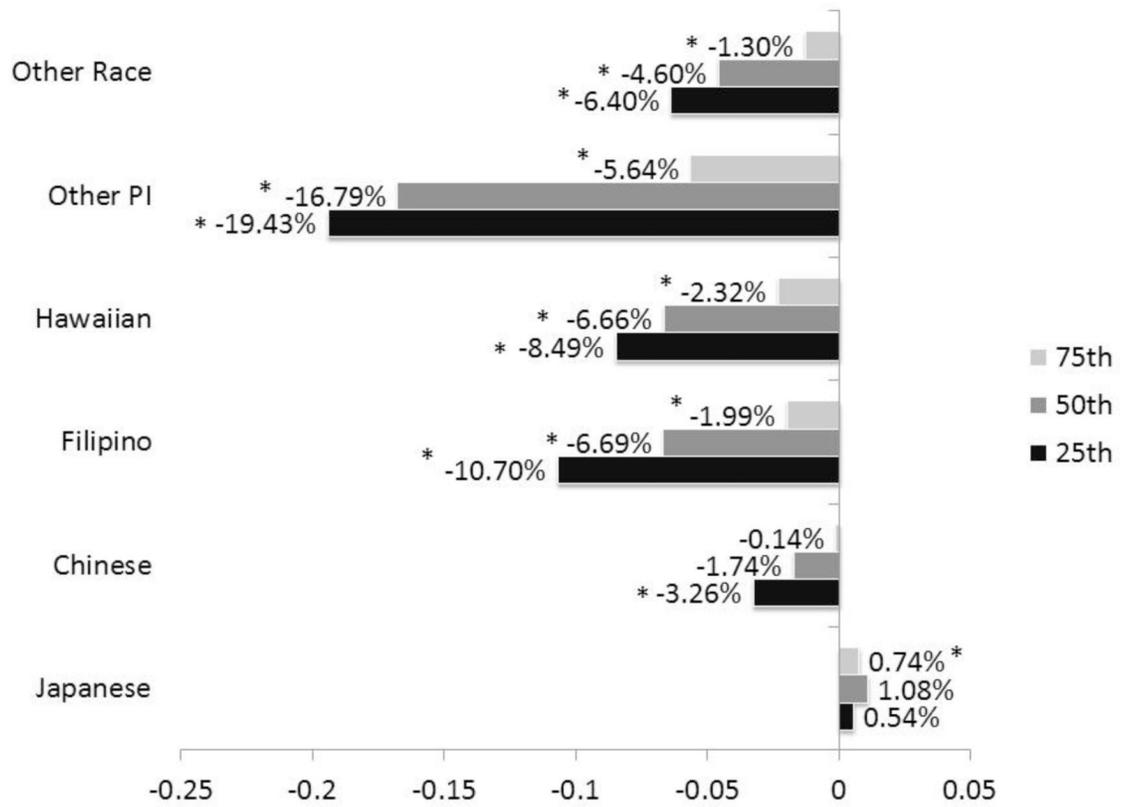


**Figure 1. Differences in Adherence to Anti-diabetes Medications Relative to Whites for each Ethnic Group by Quantile (Adjusted)**

\* = p < .05

Note.

Specific p-values can be found in Table 2. Adjusted for age, sex, living in Honolulu, high morbidity, history of coronary artery disease or congestive heart failure, and year.

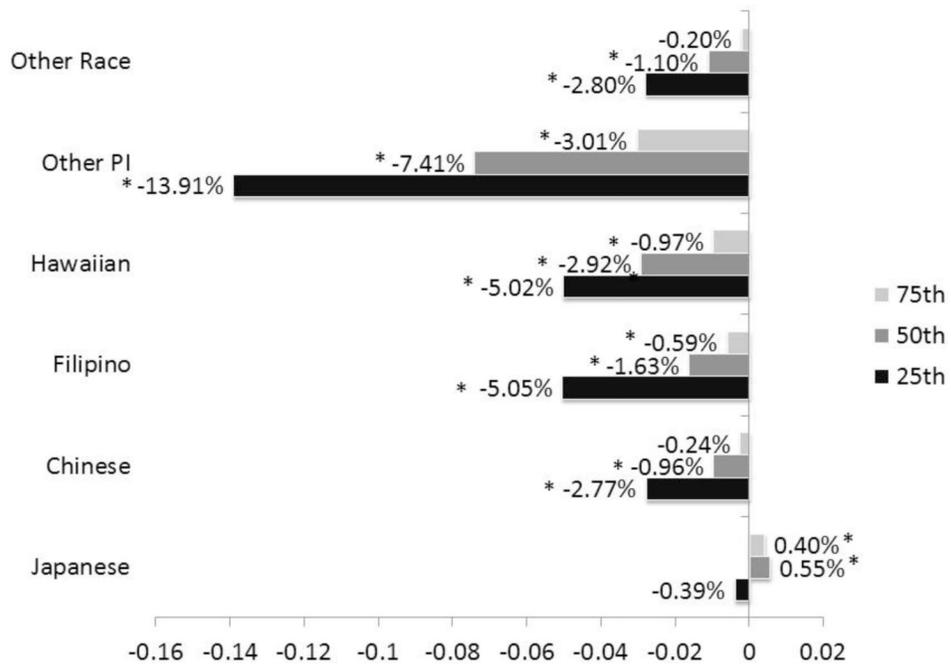


**Figure 2. Differences in Adherence to Lipid-lowering Medications Relative to Whites for Each Ethnic Group by Quantile (Adjusted)**

\* = p < .05

Note.

Specific p-values can be found in Table 2. Adjusted for age, sex, living in Honolulu, high morbidity, history of coronary artery disease or congestive heart failure, and year.



**Figure 3. Differences in Adherence to Anti-hypertensive Medications Relative to Whites for Each Ethnic Group by Quantile (Adjusted)**

\* = p < .05

Note.

Specific p-values can be found in Table 2. Adjusted for age, sex, living in Honolulu, high morbidity, history of coronary artery disease or congestive heart failure, and year.

**Table 1**  
**Patient Characteristics at Baseline According to Race and Ethnicity (N =43,445)**

	White (N = 1705)	Japanese (N = 7800)	Chinese (N = 1293)	Filipino (N = 2970)	Native Hawaiian (N = 3378)	Other Pacific Islander (N = 210)	Other race (N = 1206)	Race missing (N = 24,883)	p-value <sup>a</sup>
<b>Age</b> (mean, SD)	63.3 (11.3)	67.4 (11.6)	67.5 (12.0)	62.6 (12.3)	61.0 (12.3)	54.8 (12.4)	65.1 (12.1)	56.7 (13.9)	< .001
<b>Female (%)</b>	44.8%	53.6%	51.3%	57.1%	55.5%	48.1%	51.6%	44.6%	< .001
<b>Honolulu (%)</b>	27.3%	38.5%	66.0%	21.9%	21.0%	27.6%	33.1%	29.6%	< .001
<b>High Morbidity (%)</b>	46.9%	42.0%	40.7%	34.6%	40.2%	30.0%	44.9%	25.4%	< .001
<b>Coronary Artery Disease (%)</b>	29.0%	27.7%	32.6%	24.4%	29.7%	21.0%	32.6%	17.7%	< .001
<b>Congestive Heart Failure (%)</b>	14.0%	11.5%	12.1%	12.0%	18.2%	12.9%	15.6%	8.5%	< .001

**Note.**

<sup>a</sup> Analysis of variance was used to examine differences in age; Pearson's chi-squared test was used for categorical variables.

**Table 2**  
**Medication Adherence Estimates from Quantile Regression Models (Adjusted)\***

	25th		50th		75th	
	Adjusted	p-value	Adjusted	p-value	Adjusted	p-value
Age <35	22.9%	<.001	47.3%	<.001	75.3%	<.001
Age 35-49	36.6%	<.001	65.6%	<.001	86.9%	<.001
Age 50-64	52.6%	Ref	77.6%	Ref	91.6%	Ref
Age 65+	55.5%	<.001	79.3%	<.001	92.3%	<.001
Female	49.0%	<.001	73.9%	<.001	89.8%	<.001
Male	51.0%	Ref	76.1%	Ref	91.0%	Ref
Honolulu	51.8%	<.001	76.8%	<.001	91.0%	.02
Other regions	48.9%	Ref	74.3%	Ref	90.1%	Ref
High morbidity	50.6%	<.001	75.7%	<.001	90.7%	<.001
Low morbidity	49.5%	Ref	74.8%	Ref	90.3%	Ref
Coronary artery disease	53.1%	.4	77.3%	1.0	91.5%	.4
Congestive heart failure	50.4%	<.001	74.9%	<.001	90.6%	<.001
White	56.9%	Ref	79.6%	Ref	92.4%	Ref
Japanese	57.6%	.5	81.2%	<.001	92.9%	.07
Chinese	56.0%	.2	80.0%	1.0	92.4%	1.0
Filipino	50.7%	<.001	76.9%	<.001	90.8%	.002
Native Hawaiian	50.4%	<.001	74.1%	<.001	90.2%	<.001
Other Pacific Islander	42.0%	<.001	69.2%	<.001	90.2%	.001
Other race	55.7%	.2	78.3%	.1	91.8%	.2
Age <35	18.1%	<.001	38.8%	<.001	69.4%	<.001
Age 35-49	31.5%	<.001	60.1%	<.001	83.4%	<.001
Age 50-64	46.5%	Ref	72.9%	Ref	88.3%	Ref
Age 65+	50.1%	<.001	75.1%	<.001	89.8%	<.001
Female	42.3%	<.001	68.1%	<.001	86.4%	<.001
Male	45.9%	Ref	71.8%	Ref	88.1%	Ref
Honolulu	46.2%	<.001	72.2%	<.001	88.3%	<.001
Other regions	43.2%	Ref	69.1%	Ref	86.9%	Ref

Adherence to Anti-diabetic Medications (N = 112,897 observations for 43,445 patients)

Adherence to Lipid-Lowering Medications (N = 82,477 observations for 30,801 patients)

	25th		50th		75th	
	Adjusted	p-value	Adjusted	p-value	Adjusted	p-value
<b>High morbidity</b>	44.9%	.1	70.2%	.3	87.3%	.7
<b>Low morbidity</b>	43.9%	Ref	70.0%	Ref	87.3%	Ref
<b>Coronary artery disease</b>	48.3%	.02	73.6%	<.001	89.0%	.001
<b>Congestive heart failure</b>	45.7%	.005	70.8%	.003	88.1%	.03
<b>White</b>	53.7%	Ref	76.9%	Ref	89.7%	Ref
<b>Japanese</b>	54.4%	.5	77.9%	.09	90.5%	.008
<b>Chinese</b>	51.1%	.004	75.8%	.046	89.9%	.7
<b>Filipino</b>	42.1%	<.001	69.5%	<.001	87.4%	<.001
<b>Native Hawaiian</b>	43.1%	<.001	68.0%	<.001	86.4%	<.001
<b>Other Pacific Islander</b>	30.8%	<.001	57.0%	<.001	82.6%	.005
<b>Other race</b>	47.1%	<.001	72.2%	<.001	88.4%	.004
<b>Age &lt;35</b>	24.2%	<.001	48.2%	<.001	75.7%	<.001
<b>Age 35-49</b>	43.0%	<.001	71.6%	<.001	89.2%	<.001
<b>Age 50-64</b>	59.7%	Ref	82.0%	<.001	92.9%	<.001
<b>Age 65+</b>	64.3%	<.001	84.8%	<.001	94.5%	<.001
<b>Female</b>	56.4%	.002	79.3%	<.001	91.8%	<.001
<b>Male</b>	57.9%	Ref	80.6%	Ref	92.6%	Ref
<b>Honolulu</b>	58.7%	.06	81.1%	.008	92.7%	.04
<b>Other regions</b>	56.5%	Ref	79.4%	Ref	92.0%	Ref
<b>High morbidity</b>	58.7%	.01	81.0%	<.001	92.9%	<.001
<b>Low morbidity</b>	56.5%	Ref	79.5%	Ref	91.9%	Ref
<b>Coronary Artery Disease</b>	64.0%	<.001	84.5%	<.001	94.5%	<.001
<b>Congestive Heart Failure</b>	63.7%	<.001	84.3%	<.001	94.8%	<.001
<b>White</b>	64.9%	Ref	84.1%	Ref	93.8%	Ref
<b>Japanese</b>	64.6%	.7	84.7%	.09	94.3%	.008
<b>Chinese</b>	62.8%	.006	83.5%	.1	93.8%	.4
<b>Filipino</b>	59.2%	<.001	82.0%	.006	93.0%	.009
<b>Native Hawaiian</b>	57.7%	<.001	79.5%	<.001	92.2%	<.001
<b>Other Pacific Islander</b>	46.9%	.001	73.8%	<.001	89.5%	.01
<b>Other Race</b>	62.3%	.02	83.1%	.01	93.7%	.3

Adherence to Anti-hypertensive Medications (N =87,969 observations for 33,443 patients)

**Note.**

\* Adjusted for all other variables in the model and year (not shown).