PHYSICAL ACTIVITY AND THE BUILT ENVIRONMENT AMONG ADULTS ON O‘AHU

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Abstract

The benefits of physical activity have been well documented. It has shown to decrease risks of non-communicable diseases (NCDs) including diabetes, hypertension, and obesity. Native Hawaiians and other Pacific Islanders (NHPI) are among the populations most affected by non-communicable diseases (NCDs). Population studies have also reported that very few NHPIs meet physical activity recommendations of at least 150 minutes of physical activity per week.

This dissertation explored the physical activity status of NHPI in a rural community. By using a social ecological approach, this dissertation aimed to: 1) identify the physical activity status of NHPI and their perceptions of the active living environment, 2) assess physical features and amenities, community programs, and policies that promote physical activity, and 3) have community members identify perceptions of the built environment that influence physical activity behaviors.

The study in Chapter Two used the International Physical Activity Questionnaire and the Rural Active Living Perceived Environment Support Scale (RALPESS) to capture physical activity and community perceptions. Chapter Three objectively assessed the environment and examined amenities and facilities by performing an audit on 60 street segments. This study showed that Laʻie had the most sidewalks, crosswalks and bike lanes/path segments. The qualitative study in Chapter Four revealed community-specific barriers and facilitators to being physically active.

The data from this dissertation reported that a high proportion of NHPI meet physical activity recommendations and that future research should more closely examine the social environment of NHPI communities.

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Chapter 1: Introduction

Physical Activity and Health

The World Health Organization (WHO) defines physical activity as "any bodily movement produced by skeletal muscles that require energy expenditure" (WHO, 2016). Some activities that meet this definition are walking, bicycling, swimming and playing in sports. The four most common domains used to capture physical activity are occupational, transport, household and leisure (Craig et al., 2003; Bauman et al., 2009).

On December 2, 2010, Healthy People 2020 was launched with goals to:

- Attain longer disability and injury-free lives
- Improve the health of all groups by eliminating disparities
- Create social and physical environments that promote good health for all
- Promote quality of life, healthy development, and healthy behaviors across all life stages. (Healthy People 2020)

Leading Health Indicators (LHI) were created to track the country's progress in meeting these goals. Adult physical activity is one of the LHI with a target of 20.1% of adults meeting aerobic physical activity and muscle-strengthening for the year 2020 (Health and Human Services, 2010).

The health benefits from physical activity have been well documented (Warburton, Nicol & Bredin, 2006). Physical activiy can reduce the risk for several chronic disease and also reduce the risk for premature death (Warburton et al., 2006). These benefits are not restricted to one age group – several studies have shown these benefits are extended to all (Poitras, Gray, Borghese, & et al., 2016; Turner, Lira & Brum, 2017).

Native Hawaiians and other Pacific Islanders

Native Hawaiian and other Pacific Islanders (NHPI), as referred to by the US Office of Management and Budget, are those who have "origins in any of the original peoples of Hawai‘i,

Guam, Samoa, or other Pacific Islands" (Census, 2010). The term NHPI represents over 20 island nations scattered throughout the Pacific Ocean and are among the fastest growing racial group in the US (Census, 2010).

Over 356,000 Hawai'i residents identify as NHPI (alone or in combination of one or more additional races) – making it the most of any state in the country (Hixson, Helper & Kim, 2012). Other states that have significant NHPI populations are California, Washington, Texas, Utah, Florida, Nevada, New York, Oregon, and Arizona (Table 1). With Hawai'i also having the highest portion of the population that identify as NHPI (26%), it is important to identify opportunities for physical activity in their communities (Census, 2014).

Table 1. NHPI Population by State

State	NHPI Population
Hawaii	356,000
California	286,000
Washington	70,000
Texas	48,000
Florida	40,000
Utah	37,000
New York	36,000
Nevada	33,000
Oregon	26,000
Arizona	25,000

Physical Activity Status of Native Hawaiians and other Pacific Islanders

The Center for Disease Control and Prevention (CDC) recommends 150 minutes of moderate-intensity aerobic activity (i.e., brisk walking) every week and muscle-strengthening (activities that increases muscle strength, power, endurance or mass) activities on 2 or more days a week that work all major muscle groups (e.g., legs, chest, shoulders and arms; CDC, 2015).

Physical activity has been shown to reduce the risk of non-communicable diseases (NCDs) such as cardiovascular disease, diabetes, obesity and hypertension (Warburton et al.

2006; Janssen & LeBlanc, 2010). NHPI suffer from an extremely high prevalence of obesity, hypertension, and other NCDs (Hawley & McGarvey, 2015; Madan et al., 2012; Tuitama, Young-soo, Clark, Tukuitonga, & Beaglehole, 2014). Physical inactivity increases the risk NCDs and even death (Kohl, Craig, Lambert et al., 2012; Lee et al., 2012).

Previous studies have shown that very few NHPI meet physical activity recommendations (Moy, Sallis, Ice & Thompson, 2010; Moy, Sallis & David, 2010; Behrens, Moy, Dinger, Williams, & Harbour, 2011). Physical activity programs have been implemented throughout the Pacific to try and combat physical inactivity and prevent NCDs (Siefken et al., 2012). Even with the implementation of physical activity programs, progress towards improving health outcomes and increasing opportunities for physical activities among NHPI has been minimal (Hawley & McGarvey, 2015).

The Built Environment

Sallis et al. (2012) provides a definition for "built environment" as, "the totality of places built or designed by humans, including buildings, grounds around buildings, layout of communities, transportation infrastructure, and parks and trails." The built environment has always had significant impact on the public's health.

The Industrial Revolution was a trying period for people who flocked to urban areas in search for employment. Unfortunately, housing was limited, which led to overcrowding and horrible living conditions. Improvements to sanitation systems and housing reform came in response to infectious disease epidemics (Rosen & Imperato, 2015). Raw sewage dumped into dirt streets seeped into city water systems. To improve health, dirt streets turned paved, and sewers covered to prevent contaminating drinking water sources. In New York, legislation

passed to require proper air ventilation, lighting, and sewer systems for factories and living quarters (Krieger & Higgins, 2002).

As society moved away from farming and agriculture, physical activity related activities reduced. Technological advancements meant less physical activity in occupational areas where traditionally was labor-intensive. Cities began to grow and the concept of "urban sprawl" took form. Poor accessibility proved to be a negative outcome of this sprawl. Low density residential communities covered large areas of land, shopping centers were distinctly separated from housing and workplaces, there was no district town center, and massive roads were poorly connected (Ewing, Schmid, Killingsworth et al., 2003). This sprawl also led to a heavy dependency on vehicles for transportation (Frumkin, 2002). Urbanization, changes in diet and physical inactivity have all contributed to the increase in prevalence of NCDs (Kohl et al., 2012)

With an increase in NCDs and an increase in physical inactivity, there has been a recent movement to examine the relationship of the built environment and health (Handy, Boarnet, Ewing, & Killingsworth, 2002; Frank, Engelke, & Schmid, 2003; Jackson, 2003). Humans design and create the built environment. The built environment encompasses zoning, parks, buildings and transportation infrastructure (Sallis, Floyd, Rodriguez, & Saelens, 2012). Specific domains and characteristics in the built environment have been associated with NCDs and physical activity behaviors (Gordon-Larsen, Nelson, Page, & Popkin, 2006; Malambo et al., 2016). Studies have also looked to identify community perceptions of the built environment and its association with physical activity behavior (Bracy et al., 2014).

These studies reflect on the importance of the built environment and its influence on physical activity behavior. The majority of studies that examine the built environment have focused on urban areas (Ding & Gebel, 2012). Very few have looked at the environment in rural

communities (Hansen et al., 2015). Even fewer studies have focused on minority populations (Fields, Kaczynski, Bopp, & Fallon, 2013; Perry et al., 2015; Perez et al., 2016).

The built environment in rural areas can be very different from urban communities. The natural landscape in rural areas may provide recreational opportunities for physical activity. Such activities can include camping, hiking, swimming (lake or beach), mountain biking, and fishing. Open spaces in rural areas also provide occupational opportunities for physical activity – agricultural work, gardening, and outdoor tour guides (hiking, kayaking, and fishing tours).

There are also unique barriers to physical activity in rural communities. Some areas have limited facilities such as parks, and safety structures can be in poor condition (e.g., sidewalks and streetlights). Poor public transit policies and options, land use and zoning policies, and traveling distance all contribute to a heavy dependence on vehicle use which can be barriers to active living in rural areas (Shergold, Parkhurt, & Musselwhite, 2012; John, McCahan, & Gaulocher, 2012).

The term “rural” has different definitions across different US agencies (Umstattd, Moore, Abildso, & et al., 2017). For the purposes of this dissertation, “rural” is defined as a town having less than 10,000 residents, which is the same definition that has been used in similar studies assessing the rural environment (Frost, Goins, Hunter, Hooker & et al., 2010; Hartley, 2004; Seguin, Morgan, Connor, & et al., 2015).

Community and urban planning can both encourage or prohibit physical activity. As in the urban sprawl movement, towns have become dependent on motor vehicle transportation and have eliminated opportunities for physical activity. Proper planning policies can provide safe sidewalks and better connectivity for walking to work and school. Adequate planning and zoning

policies can also provide support for future construction to ensure that opportunities for physical activity will be implemented.

To combat physical inactivity, studies have been conducted to find the relationship between the environment and physical activity behavior (Handy et al., 2002; Frank, Engelke, & Schmid, 2003; Brownson et al., 2009; Ding & Gebel, 2012). The findings conclude that a combination of land use, active transportation systems, availability of recreational facilities and amenities, policies, and urban design all contribute to an environment that can promote physical activity (Handy et al., 2002; Sallis et al., 2016). These findings are promising; however, they were the majority of research has been conducted in urban areas. In a review by Ding & Gebel (2012), 36 papers reviewed the built environment and physical activity/obesity. Of the 36 reviews, one focused on African American adults, one focused on disadvantaged populations, and one reviewed studies done in rural areas (Casagrande et al., 2009; Lovasi et al., 2009; Frost et al., 2010). To date, no studies have examined the built environment and physical activity among NHPI.

Social Ecological model

The existing literature indicate that the individual, social, physical and policy environments are associated with levels of physical activity (Brownson et al., 2001; Gile-Corti & Donovan, Humpel et al., 2002). The social ecological model examines how those environments interact to influence an individual's behavior (Stokols, 1996). Those same environments can change to improve and support positive health behaviors (McLeroy et al., 1988). Sallis et al. (2006) adapted the social ecological model and framed it to how those environments can influence physical activity behaviors. A change in all environments can help sustain positive

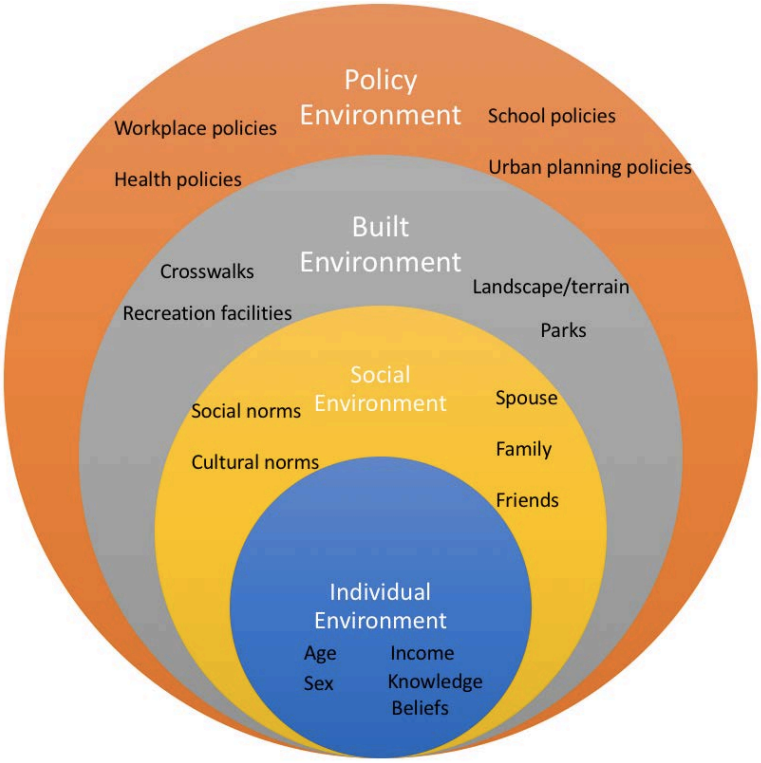
health behaviors; lacking support in any one environment may not produce intended results of any given health program or intervention.

One example of how this model was used is the current tobacco use policies. Studies have shown that smoke-free legislation has led to improved health outcomes and has also had economic benefits (Goodman, Haw, Kabir & et al., 2009; Hahn, 2010). Those tobacco policy changes also changed the built and physical environment. Smokers were no longer allowed to smoke indoor and also prohibited to smoke within a certain distance of building entrances. Social environments were influenced by using mass media and school and workplace initiatives to change individual smoking perceptions and behaviors (Durkin, Brennan, & Wakefield, 2012)

At the center of this theory is the individual environment (Figure 1. Social Ecological Model). Factors that may influence the individual at this level includes:

- Age
- Sex
- Income
- Knowledge
- Beliefs
- Skills, abilities or disabilities

Figure 1. Social ecological model



(Adapted from Sallis et al., 2006)

The social environment surrounds the individual environment. The social environment is important, as those around the individual can greatly influence the individual's behavior (Giles-Corti & Donovan, 2002; McNeill et al., 2006). An individual with a social network that supports physical activity is more likely to be physically active than someone who has a social network that is not supportive of physical activity (Bauman et al., 2012). The social environment includes:

- Social and cultural norms
- Social support groups (teammates, church and community groups, coworkers)
- Spouse
- Family
- Friends

Surrounding the social environment is the physical or built environment. Recreational amenities such as parks, exercise equipment, bike paths and swimming pools provide a

community with opportunities to be physically active. Studies have looked at the relationship between the built environment and physical activity, however, the most common setting is found in urban areas (McCormack & Shiell, 2011; Hansen et al., 2015). Very few examine the relationship in rural settings (Hansen et al., 2015). The physical environment includes:

- Parks
- Crosswalks
- Recreation facilities (YMCA, gym, swimming pool)
- Landscape/terrain
- Land usage

The policy environment encompasses all other environments. The policy environment can greatly influence physical activity behavior (Sallis et al., 2012). Policies that can promote physical activity may exist, and it is important that they be properly implemented to be successful. The implementation of such policies requires collaboration efforts and support across different agencies and organizations. The policy environment includes:

- Health policies
- Workplace policies
- School policies
- Urban planning policies
- Active transportation policies

The social ecological model has four principles: multiple factors influence behavior, environments are multidimensional and complex, human interactions can be described at varying levels, and interrelationships between people and their environment are dynamic (VCAA, 2015). This model properly aligns with the research questions for this dissertation by looking at all environments that influence an individual's physical activity behavior.

Literature regarding the built environment and physical activity in rural areas is very limited. The author did not find any studies that examined the rural environment of communities

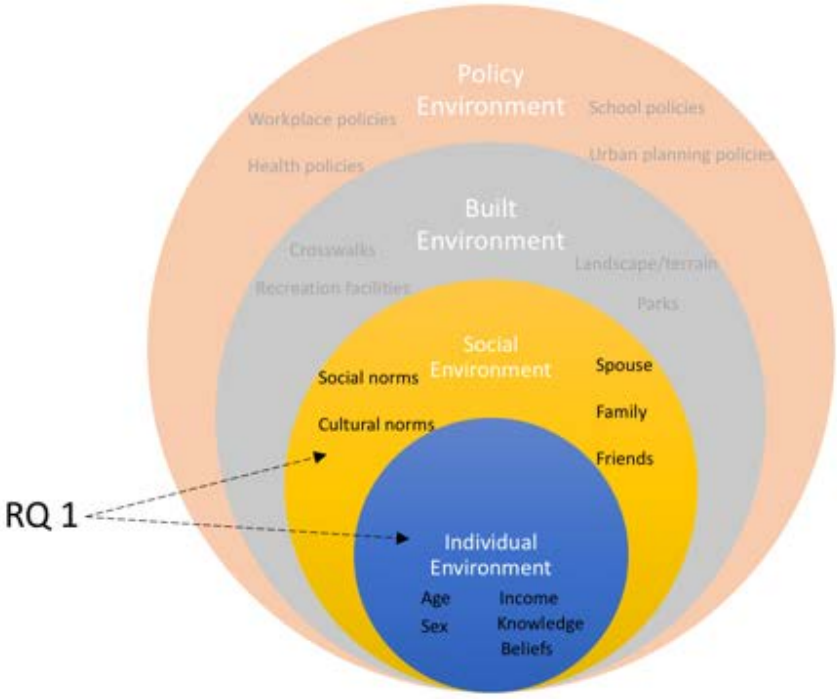
with high proportions of NHPI. To fill gaps in the literature, this study will answer three research questions:

1. What is the physical activity status of NHPIs in the observed community and what associations are found between perceptions of the built environment and physical activity among Native Hawaiian and Other Pacific Islanders in three rural Oahu communities? (RQ1)
2. What opportunities for physical activity are available for three rural, predominantly Native Hawaiian and other Pacific Islander communities? (RQ2)
3. What does the community perceive as barriers and/or facilitators to being physically active? (RQ3)

Research Question 1 (RQ1) will examine the social and individual environments of the adapted social ecological model (Figure 2). The International Physical Activity Questionnaire (IPAQ) long form was used to identify the physical activity status of NHPI across different domains (Craig et al., 2003). The Rural Active Living Perceived Environment Support Scale (RALPESS) was used to identify community perceptions of their active living environment (Umstattd et al., 2012). Both, the IPAQ and RALPESS have been used in previous studies to validate its appropriateness and accuracy (Craig et al., 2003; Umstattd et al., 2012; Doescher, Lee, Saelens et al., 2016). The IPAQ has a total of 27 items that identify physical activity behaviors in the last 7 days. The RALPESS has 33 items, which identify environment perceptions among participants. Included in the survey were 8 demographic questions – making the survey a total of 68 items.

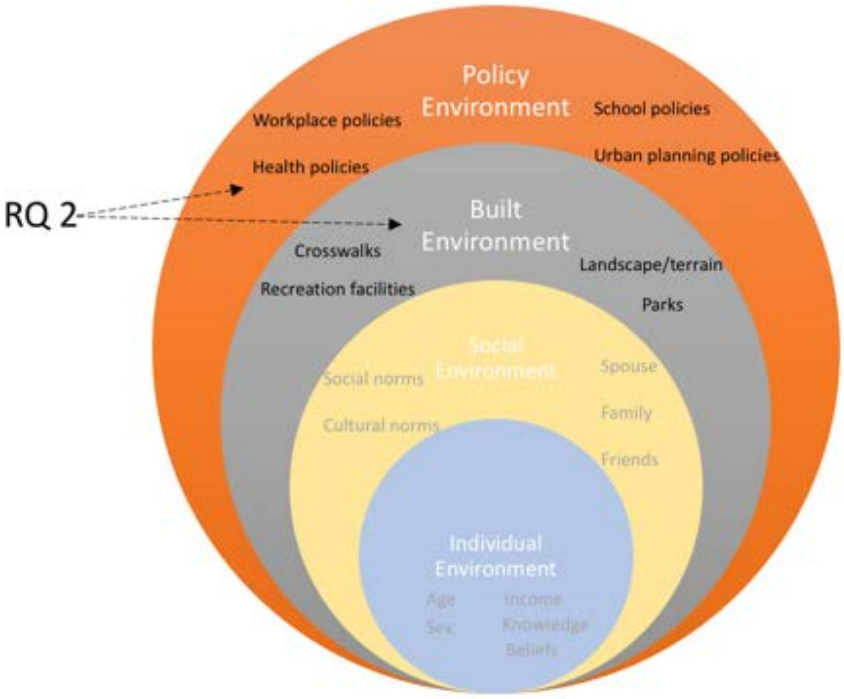
A total of 443 participants took the survey. After eliminating erroneous responses (e.g. responding more than 25 hours in a day) and incomplete surveys, 311 responses completed over 95% of the survey and were used in the data analysis. Data from the IPAQ and RALPESS were analyzed using SPSS (Version 24).

Figure 2. RQ1 will focus on the Social and Individual Environments of this model



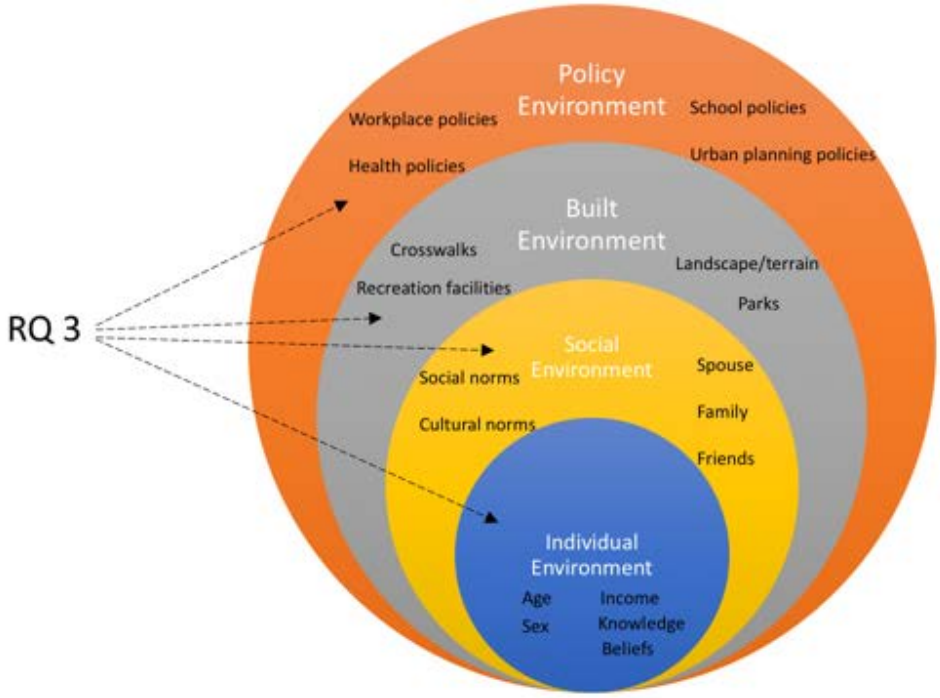
Research Question 2 (RQ2) will assess the built and policy environments (Figure 3) by using an objective tool – the Rural Active Living Assessment (RALA) tools. The RALA tools has three separate assessments – the Town-wide Assessment (TWA), the Policies and Programs Assessment (PPA) and the Street Segment Assessment (SSA). One TWA and PPA were completed for each of the three towns. The least possible score for each assessment (TWA and PPA) was 0 points and the highest possible score was 100 points. Twenty street segments were randomly selected from each town (60 total segments) to complete the SSA. Data from the RALA were analyzed using SPSS; frequencies and Fisher's exact tests were completed to compare the three towns.

Figure 3. RQ2 will focus on the Policy and Built Environments of this model



Community members will address RQ3 to identify barriers and facilitators to being physically active in all environments of the social ecological model (Figure 4). The Photovoice method was used (Wang & Burris, 1997). Photovoice is a community participatory research method that can be used as a needs assessment and a health promotion strategy (Wang & Burris, 1997; Wang, Yi, Tao, & Carovano, 1998). Similar studies have used this method to identify barriers and facilitators to physical activity Kowitt, Wood-Jaeger, Lomas, Taggert, et. Al, 2015; Belon, Nieuwendyk, Valliantos & Nykiforuk, 2016; Ross & Francis, 2016)

Figure 4. All the environments in social ecological model will be examined in RQ3



A total of 13 participants were recruited for the Photovoice project. Participants were asked to take photographs of barriers or facilitators that could influence being physically active during daily activities.

Three sessions were conducted to complete the Photovoice project. Session One was used to explain the purpose of the project and what the collected data can be used for. After Session One, participants were given a week to take photographs in their community and environment. Session Two provided an opportunity for participants to discuss their photographs and why they thought it was a barrier or facilitator to being physically active. Audio from this session was recorded and then transcribed verbatim by the student researcher. Also, in Session Two, participants were asked to select up to three photographs and why they thought it best described

their feelings toward being (or not being) physically active. Themes were then selected by the participants and then combined with photographs. Session Three was an opportunity for any clarifications of themes or additional thoughts, questions, and comments on any photographs. Any changes were discussed as a group and made upon agreement by everyone in the group.

Chapter 2: Physical Activity Status of Native Hawaiian and other Pacific Islanders and Their Perceptions of the Environment

BENEFITS OF PHYSICAL ACTIVITY

Benefits of being physically active have long been documented and studied. Studies have shown short and long-term benefits of physical activity in children, adolescents, adults and older aged adults (Hallal, Victora, Azevedo, & Wells, 2006; Warburton, Nicol, & Bredin, 2006; Reiner, Niermann, Jekauc, & Wall, 2013). There is a reduced risk for type 2 diabetes, specific cancers (breast and colon cancer), cardiovascular-related diseases, and osteoperosis (Warburton et al., 2006; Reinder et al., 2013). The prevalence of obesity, diabetes, stroke and pulmonary disorders have also been found to be much lower in populations that are physically active (Booth, Roberts & Laye, 2012; Dustine, Gordon, Wang & et al., 2013)

Physical activity has also been shown to have mental health benefits. Studies have expressed that any type of physical activity and any duration (even less than the recommended 150 minutes per week) are beneficial (Penedo & Dahn, 2005; Saxena, Van Ommeren, Tang, & et al., 2005).

PHYSICAL ACTIVITY IN RURAL COMMUNITIES

Residents in rural areas have been shown to suffer from NCDs at rates that are much higher than their urban counterparts (Phillips & McLeroy, 2004; Hartley, 2004). Rural residents are also less likely to meet physical activity recommendations than residents living in urban areas (Hartley, 2004; Kegler, Swan, Alcantara & et al., 2014; Meyer, Perry, Sumrall & et al., 2016). Limited social and physical resources are shown to possibly contribute to the low levels of physical activity in rural areas (Frost, Goins, Hunter, & et al., 2010; Parks, Housemann, & Brownson, 2003).

PHYSICAL ACTIVITY AMONG NHPI

Several studies have examined physical activity levels among NHPI using subjective and objective measures. National surveillance data, such as that gathered by the Behavioral Risk Factor Surveillance System (BRFSS) may not adequately represent the physical activity status among NHPI. For example, the BRFSS data from Utah reported that 23.5% of NHPIs are physically inactive (as defined by Healthy People 2020). However, the sample size of NHPI was only 16. A study by Behrens et al. (2011) among 30 Tongans in Salt Lake City used accelerometers to capture physical activity data. The results showed men were more active than females, and that only 20% of the participants met physical activity recommendations. Moy et al. (2010) also looked at physical activity levels with NHPI and used questionnaires such as the International Physical Acitivity Questionnaire. The findings from that study were the opposite of what Behrens et al. (2011) reported – females in the study were more than twice as active as the men (Moy et al., 2010). The differences in previous studies may be partly due to the types of instruments used to collect physical activity data, and the types of physical activity the questionnaire items seeked to identify (e.g. leisure physical activity and job-related physical activity).

Albright et al. (2017) reported that there were mixed results when examining population-based data (such as BRFSS) and smaller data sets, such as those reported by Behrens (2011) and Moy (2010). Although they suffer from physical activity-related diseases (obesity, diabetes and pre-diabetes) at higher rates than other ethnic/minority populations, NHPI physical activity levels were comparable to Whites (Albright, Mau, Choy & et al., 2017). Albright et al. (2017) recommended that more studies look into the amount, types, and duration of physical activity NHPIs would need to engage in to improve their health.

PHYSICAL ACTIVITY RECOMMENDATIONS

Current recommendations for adults are (CDC, 2011):

- 150 minutes of *moderate-intensity aerobic activity* (Table 2) **and** *muscle-strengthening activities* (Table2) on 2 or more days a week that work all major muscle groups (legs, hip, back, chest, shoulders, abdomen, arms)

  OR

- 75 minutes of *vigorous-intensity aerobic activity* (Table 2) every week **and** *muscle-strengthening activities* on 2 or more days a week that work all major muscle groups.

  OR

- An equivalent of *moderate-* and *vigorous-intensity aerobic activity* **and** *muscle-strengthening activities* on 2 or more days a week that work all major muscle groups.

Table 2. Aerobic and strengthening activities

Moderate-intensity aerobic activities	-Walking fast -Water aerobics -Riding a bike on level ground or with few hills -Playing tennis (doubles) -Pushing a lawn mower
Vigorous-intensity aerobic activities	-Jogging or running -Swimming laps -Riding a bike fast or on hills -Playing tennis (singles) -Playing basketball
Muscle-strengthening activities	-Lifting weights -Working with resistance bands -Doing exercises that use your body weight for resistance (i.e., pushups, sit ups) -Heavy gardening (i.e., digging shoveling) -Yoga

Source: CDC, 2011.

Self-report Tools for Physical Activity

Physical activity data can be collected by using questionnaires, activity logs or activity diaries (Sallis & Baelen, 2000). Self-report tools to capture physical activity is the most commonly used in large-scale studies for numerous reasons. The goal of collecting such data is to identify the frequency, intensity, duration and type of behavior in a given time (Ainsworth,

Cahalin, Buman, & Ross, 2015). The self-report questionnaires are the cheapest method used in collecting data from large population studies (Helmerhorst, Barge, Warren, & et al., 2012). These self-report questionnaires can differ in capturing the type physical activity, the duration, and the domain in which one is being physically active (Bandmann, 2008; van Poppel, Chinapaw, Mokkink, & et al., 2010). For example, the Minnesota Leisure Time Physical Activity Questionnaire has 63 items and asks to recall physical activity in the last 12 months whereas the Stanford Brief Activity Survey only has two items.

Physical activity logs and diaries are another form of self-reporting physical activity behavior. These self-report tools ask participants to identify physical activity bouts over a predetermined time. Some tools require participants to log their physical activity every 15 minutes, and others may ask to recall physical activities from the past 24 hours (Ainsworth, Bassett, Strath, & et al., 2000; Bangmann, 2008). These logs also often require to be 3 or 7-days long (Bangmann, 2008). For example, the Bouchard Physical Activity Record asks to record physical activity behaviors in 15-minute intervals over three days (Bouchard, Tremblay, Leblanc, & et al., 1983). Ainsworth et al. (2000) used a 48-item log with participants who were asked to complete one log at the end of each day for 21 days. The completed self-report logs can provide very detailed data and can help reduce recall biases.

Perceptions of the Built Environment

Understanding participant perceptions of the environment are measured using self-report tools. Existing research has shown that perception of the environment can influence physical activity behaviors (Cerin, Cain, Conway, Van Dyck, & et al., 2014; Ding & Gebel, 2012; Bauma, Reis, Sallis, & et al., 2012; Ding, Adam, Sallis, & et al., 2013). Tools used to capture participant perception can include questions on the perceived built environment, political

environment and social environment (Brownson, Hoehner, Day, Forsyth & et al., 2009). For example, the Neighborhood Enviornment Walkability Scale (NEWS; Saelens, Sallis, Black, & Chen, 2003) is a 78-item survey that attempts to capture perceptions of the neighborhood, access to amenities, safety and aesthetics.

Study Design

Sample

Participants were selected from three towns in Hawaii that have a high proportion of NHPI – Kahuku, Laʻie and Hauʻula. According to the 2010 Census, nearly 60% of residents in Kahuku self-identified as NHPI, over 56% and 70% of residents in Laʻie and Hauʻula respectively also self-identified as NHPI (Table 3).

Table 3. Community Demographics

	Kahuku	Laʻie	Hauʻula	State of Hawaii
Population, N	3,292	6,419	5,555	1,360,301
Native Hawaiian or other Pacific Islander, % (n)	59.5 (1,960)	56.8 (3,292)	70.2 (3,904)	25.7 (350,288)
High school graduate or higher, %(n)	87.4 (2,285)	97.9 (6,009)	87.4 (3,625)	90.7 (1,233,793)
Median household income, dollars	61,250	86,731	65,625	68,201
Persons below poverty level, % (n)	14.9 (490)	13.2 (847)	12.9 (716)	11.2 (152,353)

Table 4. Participant Demographics

Gender % (n)	
Male	41.8 (130)
Female	58.2 (181)
Age (years)	
18 – 29	12.5 (39)
30 – 39	50.5 (157)
40 – 49	23.2 (72)
50 – 59	11.6 (36)
60 and over	2.3 (7)
Town	
Kahuku	39.9 (124)
Laʻie	37.9 (118)
Hauʻula	22.2 (69)

Race	
Chamorro	0.3 (1)
Fijian	1.6 (5)
Maori	3.5 (11)
Native Hawaiian	36.0 (112)
Samoan	25.7 (80)
Tongan	43.1 (134)
*Participants were able to select multiple races they identified with	
Highest level of education attained	
Grade 9 – 11 (some high school)	0.3 (1)
Grade 12 or GED (high school graduate)	22.2 (69)
College 1 – 3 years (some college or technical school)	23.2 (72)
College 4 years or more (college graduate)	54.3 (169)
Employed	
For wages	75.9 (236)
Self-employed	9.0 (28)
Unemployed	
Less than 1 year	0.6 (2)
More than 1 year	1.0 (3)
Homemaker	9.6 (30)
Student	2.6 (8)
Retired	1.3 (4)
Born in the US	
Yes	74.6 (232)
No	25.4 (79)
Mean years living in US	24.7
Survey type	
Paper	11.9 (37)
Electronic	88.1 (274)
Date completed	
Oct – Dec 2016	63.0 (196)
Jan – Mar 2017	37.0 (115)

A total of 311 adults (41.8% male, 58.2% female) participated in the survey (Table 4). There were more female participants (58.2%) than male participants (41.8%). Slightly more than half of the participants (50.5%) were between the ages of 30-39 at the time they completed the survey. The next age group with the second highest proportion of participants were between 40 – 49 years old (23.2%), followed by 18 – 29 (12.5%) and 50-59 (11.6%), with 3.2% of participants in the 60 and older age group. Nearly 40% of the study participants reside in Kahuku, another

37% live in Laʻie, and the remaining 22% of participants live in Hauʻula. Participants were asked to select the race(s) they self-identified as – 43.1% (n=134) self-identified as Tongan, 36.0% (n=112) as Native Hawaiian, 25.7 % (n=80) as Samoan, 3.5% (n-11) as Maori, 1.6% (n=5) as Fijian, and 0.3% (n=1) as Chamorro. Nearly all of the participants in this study graduated from high school or received a diploma equivalent (99.7%); 54.3% graduated from a 4-year college or higher, 23.2% graduated from a technical school or received some college education (1 – 3 years), and 22.2% received a high school diploma or its equivalent. Over three-quarters of study participants were employed (75.9%) and another 9% were self-employed. Homemakers made up 9.6% of the study sample, 2.6% were students, 1.3% were retired, and 1.6% were unemployed. Over one-quarter of the participants were born outside of the US (25.4%), with years of living in the US ranging from less than 1 to 47.

Recruiting of Participants

Churches play a significant role in NHPI communities. Among Samoans, the church is viewed as a prominent institution that emphasizes relationship between the family and the spiritual realm (Aitaoto, Braun, Dang, & Soa, 2007). The vast majority of Tongans attend some type of religious institution, making meetinghouses accessible for collecting data and conducting interventions (Fotu, Moodie, Mavoa, Pomana & et al., 2011; Simons, Voyle, Fou, Feo & et al., 2004; Evans, Sinclair, Fusimalohi & Liavaa, 2001). Churches have also served as intervention sites for rural dwelling Native Hawaiians (Kaopua, 2008; Kaʻopua, Park, Ward & Braun, 2011). Participants were recruited by visiting local churches.

Purposive sampling was done to recruit participants that self-identify as NHPI (Oyeyemi, Sallis, Deforche & et al., 2013; Oyeyemi, Bello, Philemon, & et al., 2014). To assist with the

recruitment of participants, pedometers were provided to those who completed the survey. The student researcher has also been a longtime member of the community that is being observed.

Churches

Three congregations were visited to recruit participants in October and November. Churches were visited during weekday activities which were held in the evenings at meetinghouses. The Tongan congregation from The Church of Jesus Christ of Latter-Day Saints (LDS) in Kahuku was visited twice during the first week of data collection. Surveys were distributed and collected after each visit. Table 5 shows the churches that were visited, the number of times they were visited, and the number of surveys collected at each location.

Table 5. Participant recruitment at churches

Town	Church name	# of visit	Completed surveys
Kahuku	LDS (Tongan)	3	12
Laʻie	LDS (Samoan)	2	10
Hauʻula	LDS (Tongan)	2	7

Three non-LDS congregations (two in Kahuku and one in Hauʻula) were also contacted to participate in the survey. They requested that an electronic version so that it could be completed at a more convenient time. It was also recommended that an electronic version of the survey be created to reach congregation members who did not regularly attend weekly services. A modification to this project's IRB was submitted and approved prior to creating the online survey. The consent form and every question in the paper survey was transferred into Qualtrics (Provo, UT) without any alterations.

Community members who agreed to complete online survey were provided with an anonymous link via email or Facebook. The purposive sampling method changed into a snowballing method, as participants who completed the survey recruited other NHPIs in their church, work place, and neighborhood by sharing the anonymous link on personal Facebook

pages, community Facebook pages, and via email (Brusko, 2010; Dusek, Yurova & Ruppel, 2015; Fenner, Garland, Moore & et al., 2012; Kosinski, Matz, Gosling & et al., 2015; Wilson, Gosling & Graham, 2012). The link was shared 9 times with the potential to reach over of 6,000 online participants. To prevent participants from completing more than one survey, only one survey per IP address was accepted – one online survey per electronic device. Individuals who heard of the survey but did not have an electronic device were provided a paper survey. Other participants who did not have an electronic device but could use a family member or friend's device was sent an individual link to complete the survey.

Incentives

Pedometers were used as incentives for participants completing the surveys. The pedometers were purchased online from Pedometers USA. The funding used to purchase the incentives came from Kagan Foundation Award which was received during the Fall 2016 semester. Pedometers were distributed at church meetinghouses and delivered to participant residences if they were unable to meet at specific church locations. To ensure that participants completed the survey only one time, participants were asked to electronically sign a spreadsheet after receiving their pedometer.

Surveys were administered (paper and electronically) between October 2016 and March 2017.

International Physical Activity Questionnaire (IPAQ)

The International Physical Activity Questionnaire (IPAQ) has a short form and a long form. The short form is made of 7 questions that asks participants to recall the type (vigorous or moderate) and duration (hours and minutes) of physical activity done in the last 7 days as well as time walking. The long form has a total of 27 items (Appendix II) that are used to identify

physical activity behaviors in the past 7 days. Frequency (days), type (vigorous or moderate) and duration (hours and minutes) across four domains and walking are self-reported. The four domains are: 1) job-related physical activity (7 items), 2) transportation physical activity (6 items), 3) housework, house maintenance and caring for family (6 items) and 4) leisure (6 items). There are also two items that ask about the amount of time sitting on weekends and weekdays.

The IPAQ long form was selected for this study for a number of reasons. First, the IPAQ was feasible and the main monetary cost was printing fees for the paper survey. Second, the IPAQ has been used in over 70 countries and has been proven to be a valid and reliable instrument to collect physical activity data (Craig, Marshall, Sjostrom, & et al., 2003). The low participant burden and being a non-invasive tool were also considered when selecting the IPAQ.

The IPAQ offers two ways to express physical activity levels. One way is to categorize levels of physical activity as low, moderate, and high levels. The second way is express physical activity levels as metabolic equivalents (MET) energy expenditure per activity.

Perceived Environment

The Rural Active Living Perceived Environment Support Scale (RALPESS) was used to assess community perceptions of the environment (Appendix II). The student researcher selected the RALPESS for many reasons. First, it is a validated tool that has been used among rural areas in the southeastern region of the US (Umstattd, Baller, Hennessy, & Hartley, et al., 2012). Second, the tool was specifically made for small towns with a total population of less than 10,000 residents. Third, the RALPESS was created to capture physical activity amenities that are more commonly found in rural areas, such as playgrounds and equipment on school or church property.

The RALPESS has a total of 33 items that are answered on a 4-point Likert scale (Strongly Disagree, Disagree, Agree, Strongly Agree). The 33 items are divided into five categories: 1) Indoor areas (6 items), 2) Outdoor areas (3 items), 3) Town center (9 items), 4) Schools (3 items), 5) Churches (7 items), and 6) Areas around the home (5 items).

Survey Tool

The 27-item IPAQ long form and the 33-item RALPESS were combined to produce one survey. An additional 8 items were added at the end of the survey for demographic purposes. The completed survey tool consisted of 68 total items and required an estimated 15 minutes to complete.

ANALYSIS

All paper surveys were entered manually into SPSS. Any surveys completed online were stored in Qualtrics, then exported into SPSS and combined with data from the paper surveys. Prior to cleaning any missing data, there were a total of 443 participants who began and/or fully completed the survey.

Data Cleaning

The IPAQ Scoring Protocol was followed to clean the data. Each row (participant survey) was individually reviewed for any missing, incomplete, or inaccurate (e.g. totaling more than 24 hours in a day or scored <1 or >5 in the RALPESS portion or responded >7 for any item asking for 'days') data. Any surveys with at least 5% missing data (more than three items) were removed. Only values of 10 or more minutes of activity were included in the IPAQ domain scores. Any values with '15', '30', '45', '60', or '90' in the hours column was converted to the minutes column, as they were most likely entered in by mistake into the hours column. There

were no variables missing more than 1.6% of data (Church Exercise Activities variable). After removing ineligible surveys, 311 were analyzed for this study.

The Scoring Protocol provides two options to score results: as categorical or continuous variables. There are three levels in the categorical scoring: low, medium, and high. Table 6 shows how scoring the three levels of physical activity according to the Scoring Protocol.

Table 6. IPAQ Categorical Scoring

Category 1: Low Any individuals who do not meet the criteria for Categories 2 or 3
Category 2: Moderate Any of the following: • 3 or more days of vigorous activity of at least 20 minutes per day • 5 or more days of moderate-intensity activity or walking of at least 30 minutes per day • 5 or more days of any combination of walking, moderate-intensity or vigorous intensity activities achieving a minimum of at least 600 MET-min/week
Category 3: High Any of the following: • Vigorous-intensity activity on at least 3 days and accumulating at least 1500 MET-minutes/week • 7 or more days of any combination of walking, moderate-intensity or vigorous intensity activities achieving a minimum of at least 3000 MET-minutes/week

The second option recommended by the Scoring Protocol for scoring the IPAQ was as continuous variables. This requires converting scores into metabolic equivalent (MET) per minute of each activity.

Several studies which used the IPAQ, used a third method to score physical activity dichotomously. Total physical activity minutes, or domain-specific physical activity minutes were combined and the recommended physical activity time (150 minutes) was used as cut-off points for, “meets physical activity recommendations” (≥150 minutes of physical activity per week,) and “does not meet physical activity recommendations” (<150 minutes of physical activity per week) (Florindo, Guimaraes, Cesar & et al., 2009; Florindo, Salvador & Reis, 2013;

Hallal, Reis, Parra & et al., 2010; Kavanagh, Goller, King & et al., 2005; Zwald, Hipp, Corseuil & et al., 2014).

The SPSS Version 25 for Mac was used for all analyses. To begin the analysis, recoding of some variables was necessary. Any "hours" from the IPAQ were converted into "minutes" and then totaled as "Total Minutes" per domain.

To express the IPAQ results as categorical, it was first necessary to convert them into MET-minutes/week, which was done by following the Scoring Protocol. They were also scored dichotomously as "Meets physical activity recommendations" and "Does not meet physical activity recommendation".

Dependent and Independent Variables

The dependent variable was dichotomized into ≥ 150 minutes, as "Meets physical activity recommendations" and < 150 minutes as "Does not meet physical activity recommendations" (Hallal et al., 2010; Oyeyemi et al., 2013; Taylor, Leslie, Plotnikoff & et al., 2008; Zhou, Li, Umezaki & et al., 2013).

Independent variables were the perceptions of the environment captured by the RALPESS items. Responses for the RALPESS were dichotomized – "Strongly disagree" and "Disagree" were combined to form "Disagree"; "Strongly agree" and "Agree" were combined to form "Agree" (Hallal et al., 2010; Rech, Reis, Hino, & et al., 2014). To ensure internal consistency with the RALPESS, Cronbach's Alpha was measured (0.903, n=33).

All variables were analyzed descriptively. A table of frequencies and percentages for each of the RALPESS and IPAQ items are found in Tables 7 and 12 respectively. Chi-square tests were performed to identify any differences in physical activity between males and females across all physical activity domains and between towns. Chi-square tests were also performed to

identify any differences between demographic variables. The survey was available from October 2016 to March 2017. Since it is common to set goals to improve healthy behaviors at the beginning of a new year, a Chi-square test was performed to identify any differences in physical activity behaviors. Completion dates were dichotomized into "2016" and "2017" participants. Age was dichotomized as <40 and ≥40. Following the descriptive analysis, bivariate summary statistics were examined, and bivariate logistic regression was conducted Independent variables that expressed a p-value <.20 were included in the final models, which were examined by domain.

RESULTS

IPAQ

Over 87% of parcipants (n=271) met physical activity recommendations; 86.2% (n=156) of females and 88.5% (n=115) of males (Table 7). Over 55% of participants who met physical activity recommendations were under the age of 40. All variables in Table 7 expressed a 95% Confidence Interval that included "1" and all p-values greater than .05.

Table 7. IPAQ Demographic Variables

	PA ≥ 150 minutes			
	Yes (n, %)	No (n, %)	Crude OR (95%CI)	p-value
Sex Female	86.2 (156)	13.8 (25)	Ref	
Male	88.5 (115)	11.5 (15)	1.223 (.620, 2.435)	.555
Age ≥40 years	84.3 (97)	15.7(18)	Ref	
<40 years	88.8 (174)	11.2 (22)	1.468 (.751, 2.870)	.262
Town Hauʻula	88.4 (61)	11.6 (8)	Ref	
Kahuku	87.1 (108)	12.9 (16)	.885 (.358, 2.188)	.792
Laʻie	86.4 (102)	13.6 (16)	.836 (.338, 2.069)	.699
Work Employed	87.1 (230)	12.9 (23)	Ref	
Unemployed	87.2 (41)	12.8 (6)	1.010 (.399, 2.558)	.983
School Some college	86.7 (209)	13.3 (32)	Ref	
HS diploma	88.6 (62)	11.4 (8)	1.187 (.520, 2.708)	.684
Birth Other	83.5 (66)	16.5 (13)	Ref	
USA	88.4 (205)	11.6 (27)	1.496 (.730, 3.065)	.272
Year 2017	82.6 (95)	17.4 (20)	Ref	

2016	89.8 (176)	10.2 (20)	1.853 (.950, 3.614)	.070

Table 8 includes frequencies and percentages of participants who said they did some form of physical activity in a specific domain, average days per week, and average minutes per day. Participants achieved the most physical activity days (2.8) doing moderate physical activity inside the home (e.g. sweeping and doing laundry). Nearly half of the participants (49.2%, n=153) achieved an average of 41.7 minutes of moderate physical activity as part of their work. The area where participants achieved the least physical activity was traveling by bicycle with an average of less than one day per week (.22 days per week, .39 minutes per day).

Physical Activity at Work

Nearly half of the participants walked as part of their work (49.8%, n=155) for 25 minutes on two of the last seven days (Table 8); 49.2% (n=153) participants achieved 41 minutes of moderate physical activity on nearly two of the past seven days; 39.5% (n=123) participants achieved 34 minutes of vigorous physical activity on one day in the past week.

Acive Transportation

Nearly 86% of participants (n=267) recorded traveling by motor vehicle on an average of 54 minutes per day on four of the seven days (Table 8). Only 19% (n=59) of participants reported traveling by bicycle in the past seven days, and 31.5% (n=98) of participants reported walking to places such as work, the grocery store, or to school.

Physical Activity Around the House and Yard Work

Over half of the participants (50.5%, n=157) reported an average of 16 minutes per day of moderate physical activity in the garden on one day within the past week; 70.4% (n=219) reported an average of over 28 minutes of moderate physical activity inside the home on two of the past seven days.

Leisure

Participants reported walking during their leisure time more frequently (average of 1.1 days in the last week) than moderate and vigorous activity in the past seven days (Table 8). Just under 32% (n=99) of participants reported an average of 18 minutes of vigorous physical activity on an average of less than one day (.93) within the past seven days; 34.7% (n=108) averaged 12 minutes of moderate physical activity on .72 days in the past week.

Sitting

The sitting times during the week and on the weekend were nearly identical with an average of 310.8 and 310.6 minutes per day respectively.

Table 8. Physical Activity by Domain

DOMAIN	% (n)	Mean (days)	Mean (min/day)	Mean (min/wk)
Work				458.6
Vigorous PA as part of your work	39.5 (123)	1.39	34.60	
Moderate PA as part of your work	49.2 (153)	1.97	41.70	
Walk as part of your work	49.8 (155)	2.06	25.08	
Transportation				39.8
Travel in motor vehicle	85.9 (267)	4.2	54.4	
Travel by bicycling	19.0 (59)	.22	.39	
Travel by walking	31.5 (98)	1.1	5.4	
House and Yard Work				288.5
Vigorous PA in the garden	35.0 (109)	.95	15.8	
Moderate PA in the garden	50.5 (157)	1.6	16.0	
Moderate PA inside your home	70.4 (219)	2.8	28.4	
Leisure				147.1
Vigorous PA in your leisure time	31.8 (99)	.93	18.33	
Moderate PA in your leisure time	34.7 (108)	.72	12.93	
Walk in your leisure time	38.3 (192)	1.1	11.0	
Sitting				
Weekday	100.0 (311)		310.8	
Weekend	100.0 (311)		310.6	

Table 9 shows differences between male and females who met physical activity recommendations. There were differences in physical activity prevalence between the two sexes

across all domains. The only items which did not express a difference were travel by bicycling, moderate physical activity in the garden, and vigorous and moderate physical activity during their leisure time.

Table 9. Physical activity by sex and Chi-square if physical activity differs by sex (male=130, female=181)

DOMAIN	Male % (n)	Female % (n)	p-value
Work			
Vigorous PA as part of your work	52.3 (68)	30.4 (55)	<.001
Moderate PA as part of your work	59.2 (77)	42.0 (76)	.010
Walk as part of your work	56.9 (74)	44.8 (81)	<.001
Transportation			
Travel in motor vehicle	93.1 (121)	80.7 (146)	.002
Travel by bicycling	13.8 (18)	22.7 (41)	.051
Travel by walking	17.7 (23)	41.4 (75)	<.001
House and Yard Work			
Vigorous PA in the garden	24.6 (32)	42.5 (77)	.001
Moderate PA in the garden	37.7 (49)	59.7 (108)	.161
Moderate PA inside your home	43.8 (57)	89.5 (162)	<.001
Leisure			
Vigorous PA in your leisure time	26.9 (35)	35.4 (64)	.115
Moderate PA in your leisure time	33.1 (43)	35.9 (65)	.605
Walk in your leisure time	26.9 (35)	46.4 (84)	<.001

Chi-square tests was also performed to identify any differences in physical activity between the three observed towns (Table 10). The only difference was observed in in moderate PA during leisure time.

Table 10. Participant physical activity by town and Chi-square if PA differs by town

DOMAIN	Kahuku (n=124)	Laʻie (n=118)	Hauʻula (n=69)	p-value
Work				
Vigorous PA as part of your work	41.9 (52)	38.1 (45)	37.7 (26)	.762
Moderate PA as part of your work	50.0 (62)	48.3 (57)	49.3 (34)	.324
Walk as part of your work	50.8 (63))	50.0 (59)	47.8 (33)	.342
Transportation				
Travel in motor vehicle	86.3 (107)	81.4 (96)	92.8 (64)	.096
Travel by bicycling	12.9 (16)	26.3 (31)	17.4 (12)	.028
Travel by walking	26.6 (33)	39.0 (46))	27.5 (29))	.085
House and Yard Work				
Vigorous PA in the garden	33.9 (42)	39.8 (47)	29.0 (20)	.305

Moderate PA in the garden	45.2 (56)	55.9 (66)	50.7 (35)	.246
Moderate PA inside your home	62.9 (78)	74.6 (88)	76.8 (53)	.058
Leisure				
Vigorous PA in your leisure time	25.0 (31)	33.9 (40)	40.6 (28)	.070
Moderate PA in your leisure time	27.4 (34)	36.4 (43)	44.9 (31)	.044
Walk in your leisure time	33.1 (41)	42.4 (50)	40.6 (28)	.298

RALPESS

Responses from the RALPESS portion of the survey are expressed dichotomously (Disagree and Agree) in Table 11.

Indoor Areas

Just over 22% of participants agreed that their town has a private indoor exercise area; 27% agreed that the indoor exercise areas are not to use and well kept; 31.4% agreed that indoor exercise areas are generally safe; nearly 42% agreed that their town offers indoor exercise activities; 22% agreed that there is equipment for physical activity or exerise at the indoor are, and that there are choices for physical activity in the indoor exercise area in their town.

Outdoor Areas

A high percentage of participants (80.9%) agreed that outdoor exercise areas in their town have available restrooms; 81% agreed that their outdoor exercise are has water fountains. Just over half of the participants agreed (52.1%) that there is sufficient police presence where people could be physically active.

Table 11. RALPESS frequencies

INDOOR	Agree % (n)	Disagree % (n)
1. Private exercise areas	22.9 (71)	77.1 (239)
2. Nice and well kept	27.7 (83)	72.3 (217)
3. Generally safe	31.4 (95)	68.6 (208)
4. Offer activities	41.9 (126)	58.1 (175)
5. PA equipment	22.4 (68)	77.6 (235)

6. Choices for PA or exercise	22.0 (67)	78.0 (237)
OUTDOOR AREAS	Agree % (n)	Disagree % (n)
7. Restrooms	80.9 (250)	19.1 (59)
8. Water fountains	81.2 (251)	18.8 (58)
9.Sufficient police	52.1 (162)	47.9 (149)
TOWN CENTER	Agree % (n)	Disagree % (n)
10. Places to eat	97.4 (303)	2.6 (8)
11. Sidewalks	55.9 (174)	44.1 (137)
12. Sidewalk is shaded and no trash	50.0 (155)	50.0 (155)
13. Sidewalk is even	48.7 (151)	51.3 (159)
14. Crosswalks	81.0 (252)	19.0 (59)
15. Streetlights	83.6 (260)	16.4 (51)
16. Indoor equipment	24.3 (73)	75.7 (227)
17. Outdoor equipment	58.9 (182)	41.1 (127)
18. Choices for PA or exercise	39.2 (121)	60.8 (188)
SCHOOL GROUNDS	Agree % (n)	Disagree % (n)
19. Playground equipment	94.8 (294)	5.2 (16)
20. PA equipment	87.4 (270)	12.6 (39)
21. Choices for PA or exercise	84.1 (260)	15.9 (49)
CHURCHES	Agree % (n)	Disagree % (n)
22. Public indoor facilities	25.6 (79)	74.4 (229)
23. Public outdoor facilities	12.9 (40)	87.1 (271)
24. Can use indoor area for PA or exercise	66.4 (202)	33.6 (102)
25. Can use outdoor area for PA or exercise	36.4 (112)	63.6 (196)
26. Offer PA programing/activities	19.3 (59)	80.7 (247)
27. Public playground equipment	4.2 (13)	95.8 (298)
28. Encourage being physically active	89.6 (275)	10.4 (32)
AROUND YOUR HOME/NEIGHBORHOOD	Agree % (n)	Disagree % (n)
29. Crosswalks	54.0 (168)	46.0 (143)
30. Bike lane, bike path, shoulder	42.4 (132)	57.6 (179)
31. Good lighting	69.8 (217)	30.2 (94)
32. Sidewalks on most of the roads	40.8 (127)	59.2 (184)
33. Sidewalk connectivity	21.1 (131)	57.9 (180)

Town Center

Nearly all of the participants agreed that there are shopping areas and places to eat in the town center (97.4%). Just over 44% disagreed that there were any sidewalks in the town center, and half of the participants (48.7%) agreed that the sidewalks in the town center are nice to use. Almost half of the study participants agreed that sidewalks were well kept and not uneven; 81% of participants agreed that crosswalks were marked in the town center. Over 75% disagreed that there is equipment for exercise of physical activity at indoor places in the town center.

School Grounds

A vast majority of participants agreed to the statements in the School Ground portion of the RALPESS. Over 94% agreed that schools in their town have a playground with equipment; 87.4% agree that there is equipment for physical activity or exercise at the school; 84% agree that there are choices of activities for physical activity or exercise at the schools in their town.

Church Areas

The majority of participants indicated that their church does not have indoor recreational facilities that are open to the public (Table 11; 74.4%). Even more participants did not agree that their church has outdoor recreational areas for exercise open to the public (87.1%). Although the church facilities were not available to the public, 66.4% of participants agreed that they could use the indoor church areas for physical activity or exercise; 36.4% agreed that they could use outdoor areas for physical activity or exercise. Only 4.2% of participants agreed that the churches in their town have public playgrounds with equipment. Nearly 90% of participants agreed the churches in their town encourage exercise or being physically active, however, only 19.3% of participants agreed that the churches in their town offer exercise or physical activity programming or activities.

Around Your Home and Neighborhood

Of the participants who completed the survey, 54% agreed that there are crosswalks in the area around their home (Table 11); 42.5% agree that the roads around their home have a place to walk or ride a bike next to the road. Nearly 70% agree that the roads around their home have good lighting; 59.2% disagree when asked to rate" there are sidewalks on most of the roads in the area around my home". Only 21.1% of participants agreed that they are sidewalks around their home that connect to places such as a grocery store or post office.

Agreement by Sex

Table 12 identified any differences in "agreement" (agree and disagree) to the RALPESS. Of the 33 items, there were differences in 12 items. No differences were found across male and female participants in any of the Indoor items (six items). Two out of three Outdoor Area items expressed differences between male and females. More males than females agreed that there were available restrooms in outdoor areas (89.2% [n=116] and 74.4% [n=134] respectively, p=.001), and that the outdoor exercise areas have water fountains (92.3% [n=120] and 73.5% [n=133], p<.001).

Four of the six RALPESS items in the Town Center expressed differences between male and female participants. All male participants (100%, n=130) agreed that their town center had shopping areas and places to eat. More females agreed that there were sidewalks to use (60.8%, n=110), while less than half of the males felt the same way (49.2%, n=64). There was a difference in male and female participants who agreed that their town center outdoor equipment for physical activity or exercise (69.2%, n=90 and 51.4%, n=93 respectively), and choices for physical activity or exercise (46.2%, n=60 and 34.8% (n=63 respectively).

Table 12. Agreement by sex

	Participants who agree		
INDOOR	Male % (n)	Female % (n)	p-value
1. Private exercise areas	20.0 (26)	25.0 (45)	.301
2. Nice and well kept	25.4 (33)	28.9 (52)	.495
3. Generally safe	26.2 (34)	35.4 (64)	.085
4. Offer activities	42.3 (55)	40.0 (72)	.683
5. PA equipment	22.3 (29)	24.3 (44)	.681
6. Choices for PA or exercise	17.7 (23)	26.0 (47)	.085
OUTDOOR AREAS	Male % (n)	Female % (n)	
7. Restrooms	89.2 (116)	74.4 (134)	.001
8. Water fountains	92.3 (120)	73.5 (133)	<.001
9.Sufficient police	54.6 (71)	50.3 (91)	.450
TOWN CENTER	Male % (n)	Female % (n)	
10. Places to eat	100.0 (130)	95.6 (173)	.015
11. Sidewalks	49.2 (64)	60.8 (110)	.043
12. Sidewalk is shaded and no trash	46.2 (60)	52.5 (95)	.271
13. Sidewalk is even	46.2 (60)	50.6 (91)	.444

14. Crosswalks	83.1 (108)	79.6 (144)	.435
15. Streetlights	86.9 (113)	81.2 (147)	.180
16. Indoor equipment	29.2 (38)	22.7 (41)	.189
17. Outdoor equipment	69.2 (90)	51.4 (93)	.002
18. Choices for PA or exercise	46.2 (60)	34.8 (63)	.044
SCHOOL GROUNDS	Male % (n)	Female % (n)	
19. Playground equipment	97.7 (127)	92.8 (168)	.055
20. PA equipment	94.6 (123)	82.1 (147)	.001
21. Choices for PA or exercise	90.0 (117)	79.9 (143)	.016
CHURCHES	Male % (n)	Female % (n)	
22. Public indoor facilities	14.6 (19)	33.5 (60)	<.001
23. Public outdoor facilities	8.5 (11)	16.0 (29)	.049
24. Can use indoor area for PA or exercise	71.5 (93)	62.4 (113)	.094
25. Can use outdoor area for PA or exercise	33.8 (44)	38.2 (68)	.433
26. Offer PA programing/activities	7.7 (10)	27.8 (49)	<.001
27. Public playground equipment	2.3 (3	5.5 (10)	.162
28. Encourage being physically active	93.1 (121)	87.0 (154)	.085
AROUND YOUR HOME/NEIGHBORHOOD	Male % (n)	Female % (n)	
29. Crosswalks	48.5 (63)	58.0 (105)	.096
30. Bike lane, bike path, shoulder	41.5 (54)	43.1 (78)	.784
31. Good lighting	76.2 (99)	65.2 (118)	.038
32. Sidewalks on most of the roads	40.8 (53)	40.9 (74)	.984
33. Sidewalk connectivity	40.0 (52)	43.6 (79)	.521

Two out of the three items in School Grounds expressed being different between male and female participants; 94.6% (n=123) of males agreed that there is equipment for physical activity or exercise on school ground, while 82.1% (n=147) of females agree with p=.001.; 90.0% (n=117) of males agreed that there are choices for exercise of physical activity at the school, and only 79.9% (n=143) of females agreed (p=.016) to that statement.

Less than half of the items in Churches expressed differences between male and female participants. Only 14.6% (n=19) of males agreed that the churches in the town have indoor recreational facilities for exercise that are open to the public; more females agreed to that statement (33.5% [n=60], p=<.001). A difference was also observed when participants were asked if their town has churches with outdoor recreational areas that are open to the public (8.5% [n=11] of males, 16.0% [n=29] of females, p=.049) and if the churches offer exercise or physical activity programs.

There was a difference in the number of males and females who agreed that the roads around their home have good lighting; 76.2% (n=99) and 65.2% (n=118) respectively with p=.038.

Agreement by Town

Agreement to the RALPESS items were also observed by town, with 21 items expressing differences between towns (Table 13).

Table 13. Frequency of participants who "Agree"

INDOOR	Kahuku %(n)	La'ie %(n)	Hau'ula %(n)	p-value
1. Private exercise areas	33.3 (41)	22.0 (26)	5.8 (4)	<.001
2. Nice and well kept	36.6 (45)	26.3 (31)	13.0 (9)	.002
3. Generally safe	36.3 (45)	33.9 (40)	18.8 (13)	.034
4. Offer activities	53.2 (66)	33.3 (39)	31.9 (22)	.002
5. PA equipment	33.1 (41)	21.2 (25)	10.1 (7)	.001
6. Choices for PA or exercise	26.6 (33)	21.2 (25)	17.4 (12)	.309
OUTDOOR AREAS	Kahuku	La'ie	Hau'ula	
7. Restrooms	90.3 (112)	69.2 (81)	82.6 (57)	<.001
8. Water fountains	87.9 (109)	72.9 (86)	84.1 (58)	.009
9.Sufficient police	48.4 (60)	60.2 (71)	44.9 (31)	.075
TOWN CENTER	Kahuku	La'ie	Hau'ula	
10. Places to eat	97.6 (121)	98.3 (116)	95.7 (66)	.537
11. Sidewalks	30.6 (38)	94.9 (112)	34.8 (24)	<.001
12. Sidewalk is shaded and no trash	22.6 (28)	89.0 (105)	31.9 (22)	
13. Sidewalk is even	21.1 (26)	88.1 (104)	30.4 (21)	<.001
14. Crosswalks	78.2 (97)	92.4 (109)	66.7 (46)	<.001
15. Streetlights	79.8 (99)	94.9 (112)	71.0 (49)	<.001
16. Indoor equipment	24.2 (30)	39.0 (46)	4.3 (3)	<.001
17. Outdoor equipment	58.1 (72)	61.9 (73)	55.1 (38)	.644
18. Choices for PA or exercise	30.6 (38)	50.8 (60)	36.2 (25)	.005
SCHOOL GROUNDS	Kahuku	La'ie	Hau'ula	
19. Playground equipment	95.2 (118)	93.2 (110)	97.1 (67)	.501
20. PA equipment	86.3 (107)	86.2 (100)	91.3 (63)	.537
21. Choices for PA or exercise	85.5 (106)	87.1 (101)	76.8 (53)	.158
CHURCHES	Kahuku	La'ie	Hau'ula	
22. Public indoor facilities	19.5 (24)	33.9 (40)	22.1 (15)	.029
23. Public outdoor facilities	7.3 (9)	22.9 (27)	5.8 (4)	<.001
24. Can use indoor area for PA or exercise	68.5 (85)	70.3 (83)	55.1 (38)	.081

25. Can use outdoor area for PA or exercise	28.1 (34)	51.7 (61)	24.6 (17)	<.001
26. Offer PA programing/activities	18.3 (22)	22.2 (26)	15.9 (11)	.545
27. Public playground equipment	2.4 (3)	6.8 (8)	2.9 (2)	.199
28. Encourage being physically active	89.4 (110)	89.7 (105)	89.6 (60)	.997
AROUND YOUR HOME	Kahuku	La‘ie	Hau‘ula	
29. Crosswalks	36.3 (45)	82.2 (97)	37.7 (26)	<.001
30. Bike lane, bike path, shoulder	19.4 (24)	80.5 (95)	18.8 (13)	<.001
31. Good lighting	71.0 (88)	78.8 (93)	52.2 (36)	.001
32. Sidewalks on most of the roads	15.3 (19)	77.1 (91)	24.6 (17)	<.001
33. Sidewalk connectivity	13.7 (17)	81.4 (96)	26.1 (18)	<.001

The prevalence of how participants who met physical activity recommendations perceived the RALPESS items are shown in Table 14.

Table 14. Bivariate Summary Statistics (Meets PA Recommendations)

RALPESS Items	Meets Physical Activity Recommendations			
INDOOR	Agree %(n)	Disagree %(n)	Crude OR (95% CI)	p-value
1. Private exercise areas	24.8 (67)	75.2 (203)	.337 (.116, .981)	0.046
2. Nice and well kept	30.0 (81)	70.0 (189)	.259 (.089, .752)	0.013
3. Generally safe	35.1 (95)	64.9 (176)	.150 (.045, .500)	0.002
4. Offer activities	43.0 (116)	57.0 (154)	.504 (.242, 1.050)	0.067
5. PA equipment	25.1 (68)	74.9 (203)	.426 (.161, 1.132)	0.087
6. Choices for PA or exercise	24.4 (66)	75.6 (205)	.345 (.118, 1.006)	0.051
OUTDOOR AREAS	Agree %(n)	Disagree %(n)	OR (95% CI)	p-value
7. Restrooms	78.9 (213)	21.1 (57)	3.300 (.982, 11.094)	0.054
8. Water fountains	79.3 (215)	20.7 (56)	4.94 (1.159, 21.140)	.031
9.Sufficient police	50.2 (136)	49.8 (135)	1.84 (.923, 3.683)	0.083
TOWN CENTER	Agree %(n)	Disagree %(n)	OR (95% CI)	p-value
10. Places to eat	97.8 (265)	2.2 (6)	.430 (.804, 2.209)	0.312

11. Sidewalks	57.6 (156)	42.4 (115)	.603 (.309, 1.176)	0.138
12. Sidewalk is shaded and no trash	50.9 (138)	49.1 (133)	.712 (.364, 1.393)	0.322
13. Sidewalk is even	50.0 (135)	50.0 (135)	.667 (.339, 1.311)	0.240
14. Crosswalks	83.0 (225)	17.0 (46)	.425 (.204, .884)	0.022
15. Streetlights	85.6 (232)	14.4 (39)	.392 (.184, .836)	0.015
16. Indoor equipment	24.4 (66)	75.6 (205)	1.496 (.730, 3.065)	0.272
17. Outdoor equipment	56.5 (153)	43.5 (118)	2.314 (1.088, 4.922)	0.029
18. Choices for PA or exercise	40.2 (109)	59.8 (162)	.800 (.400, 1.601)	0.529
SCHOOL GROUNDS	Agree %(n)	Disagree %(n)	OR (95% CI)	p-value
19. Playground equipment	94.8 (257)	5.2 (14)	1.035 (.226, 4.734)	0.965
20. PA equipment	86.2 (232)	13.8 (37)	3.030 (.701, 13.095)	0.138
21. Choices for PA or exercise	83.6 (225)	16.4 (44)	1.369 (.508, 3.688)	0.535
CHURCHES	Agree %(n)	Disagree %(n)	OR (95% CI)	p-value
22. Public indoor facilities	28.6 (77)	71.4 (192)	.131 (.031, .557)	0.006
23. Public outdoor facilities	14.8 (40)	85.2 (231)	279735 (.000, .)	0.998
24. Can use indoor area for PA or exercise	67.2 (182)	32.8 (89)	.734 (.371, 1.450)	0.373
25. Can use outdoor area for PA or exercise	40.7 (109)	59.3 (159)	.118 (.036, .393)	<0.001
26. Offer PA programing/activities	21.8 (58)	78.2 (208)	.092 (.012, .684)	0.020
27. Public playground equipment	4.4 (12)	95.6 (259)	.553 (.070, 4.375)	0.575
28. Encourage being physically active	90.3 (241)	9.7 (26)	.611 (.235, 1.593)	0.314
AROUND YOUR HOME/NEIGHBORHOOD	Agree %(n)	Disagree %(n)	OR (95% CI)	p-value
29. Crosswalks	55.7 (151)	44.3 (120)	.587 (.300, 1.149)	0.120
30. Bike lane, bike path, shoulder	43.2 (117)	56.8 (154)	.790 (.399, 1.565)	0.499
31. Good lighting	70.8 (192)	29.2 (79)	.686 (.343, 1.369)	0.285
32. Sidewalks on most of the roads	41.3 (112)	58.7 (159)	.852 (.430, 1.689)	0.646
33. Sidewalk connectivity	41.3 (112)	58.7 (159)	1.284 (.660, 2.500)	0.461

Multiple Logistic Regression Models

Multiple logistic models were created by domain. Items that expressed a p-value of <0.20 from the bivariate analysis (Table 14) were placed into a multiple logistic regression model by

domain (Table 15). The models were adjusted by gender and town since Chi-square tests expressed at least one difference across all domains (Table 13).

The odds of those who "Met physical activity recommendations" for those who "Agree" that there was available physical activity equipment in the town's Indoor Areas is 2.76 (95% CI= .319, 23.890) times more than those who disagreed. Participants had an odds of more than two times (OR = 2.762, 95% CI = .319, 23.890) of meeting physical activity recommendations if they "Agree" that there were available physical activity equipment in the town's Indoor Areas than those who disagreed. The odds of "Met physical activity recommendations" for those who agreed that there were available water fountains is 3.71(95% CI = .675, 20.402) times than those who disagreed. The odds of "Met physical activity recommendations" for those who agree that there were restrooms was 1.756 (95% CI [.723, 3.031]) than those who disagreed, and odds of 1.481s (95% CI = .421, 7.329]) for those who agreed that there was sufficient police presence in the town's Outdoor Areas than those who disagreed. The odds of "Met physical activity recommendations" for those who agreed that there was outdoor equipment for physical activity or exercise in the Town Center was nearly three times (OR=2.982, 95% CI = 1.292, 6.882) those who disagreed. Participants also had three times more odds of meeting physical activity recommendations if they agreed that there was physical activity equipment on School Grounds (OR=3.392, 95% CI = .773, 14.893]) than those who disagreed. Items around Church and around the neighborhood showed very little effect on the regression models (Table 7) with very low odds ratios (<.20) and/or p-values that were greater than .05. Although several RALPESS items expressed higher odds of meeting physical activity recommendations, the findings should be interepreted with caution, as p-values did not express significance on several items, and several odds ratios included "1" in the 95% Confidence Interval.

Table 15. Multiple Logistic Regression Models

Indoor	Adjusted OR (95% CI)	p-value
Private exercise areas	.478 (.079, 2.881)	.421
Nice and well kept	.635 (.110, 3.673)	.612
Generally safe	.181 (.043, .769)	.021
Offer activities	.840 (.341, 2.069)	.704
PA equipment	2.762 (.319, 23.890)	.356
Choices for PA or exercise	.791 (.128, 4.872)	.801
Outdoor	OR (95%CI)	p-value
Restrooms	1.756 (.421, 7.329)	.440
Water fountains	3.712 (.675, 20.402)	.131
Sufficient police	1.481 (.723, 3.031)	.283
Town Center	OR (95%CI)	p-value
Sidewalks	.598 (.198, 1.802)	.361
Crosswalks	.553 (.180, 1.699)	.301
Streetlights	.413 (.131, 1.303)	.131
Outdoor equipment	2.982 (1.292, 6.882)	.010
School Grounds	OR (95% CI)	p-value
PA equipment	3.394 (.773, 14.893)	.105
Churches	OR (95%CI)	p-value
Public indoor facilities	.216 (.047, .991)	.049
Can use outdoor area for PA or exercise	.142 (.041, .494)	.002
Offer PA programing/activities	.210 (.025, 1.734)	.210
Around your neighborhood	OR (95% CI)	p-value
Crosswalks	.470 (.218, 1.012)	.054

DISCUSSION

The purpose of this study was to identify the current physical activity status of NHPIs in a rural community. To the researcher's knowledge, this is the only study that examined this specific population in a rural setting.

Over 87% of participants met physical activity recommendations. Previous studies that have examined physical activity levels among NHPIs have reported much lower percentages of participants meeting recommendations. Moy and colleagues (2010) reported that only 20% of study participants engaged in sufficient physical activity. Chiem et al. (2006) reported that only 33% of Chamorros engaged in at least 150 minutes of physical activity per week. Population

surveys such as the BRFSS have previously reported that over 50% of NHPI in Hawaii meet physical activity recommendations (Albright et al., 2017).

The findings from this study have identified domains in which NHPI are physically active and other domains where efforts for interventions can be focused. Participants in this study achieved the most physical activity minutes as part of their work (458 minutes of physical activity per week). Participants also achieved almost twice as many minutes being physically active doing work around the house and yard than in their leisure time (288.5 minutes per week and 147.1 minutes per week respectively). The domain in which participants achieved the least minutes of physical activity was Active Transportation (walking and bicycling to places).

Men reported more physical activity across all three items in the Work domain (vigorous physical activity, moderate physical activity, and walking as part of your work) than women. However, women were reported more physically active minutes across the three other IPAQ domains (Transportation, House and Yard Work, and Leisure). Women reported more physical activity walking (to places such as work), vigorous physical activity in the garden, moderate physical activity inside the home, and walking during their leisure time. These findings are domain-specific, unlike previous studies that only identify walking, moderate physical activity, and vigorous physical activity (Moy et al., 2010). Previous studies have also reported women being less physically active than men (Behrens et al., 2011; Kruger, Ham, Kohl, & et al., 2004).

The RALPESS captured the community's perceptions of their activing living environment indoors, outdoors, at school, at church, and around their neighborhood. Nearly one-third of the RALPESS items (21 out of 33) expressed a difference when responses were analyzed by town. Although the three observed towns are next to each other and close in distance, they are perceived differently by the residents. This difference between resident perceptions highlight the

need to address rural active living environments individually. For example, a high proportion of residents in La‘ie reported agreeing to items that asked about the are Around Your Home and Neighborhood compared to residents in Kahuku and Hau‘ula. The La‘ie residents responded they “Agree” that the area around their home has crosswalks, good lighting, bike lanes/path, sidewalks, and sidewalks that connect to other parts of the town.

As with previous studies, this study had its limitations. One limitation was that the physical activity was self-reported instead of using an objective measure. Another limitation may have been the lack of culturally-specific domains for physical activity. The survey tool did not ask to capture physical activity that may have resulted from outdoor cooking (underground ovens) for weddings, holidays, birthdays or other special occasions. Cultivating root crops is very common among NHPI communities, and questions attempting to capture physical activity should be modified to include domains that are culture-specific. Since the student researcher is from the observed community, there was also a potential for participant bias and desire to make them (and their town) look better than how they actually are. Another limitation was that the researcher was unable to identify participants who had limited English skills. However, since almost 80% of participants indicated that they received at least some college education, it was assumed that understanding the IPAQ was not an issue.

One notable strength to this study was that the tools used to capture physical activity levels and community perceptions are instruments that have been validated by previous studies. Another strength is that the student researcher was from the community and was seen as an “insider” rather than an outsider researcher attempting to collect data.

Different reasons could contribute to the high levels of physical activity in the observed community. First, data reporting physical activity among NHPI may not include work-related

physical activity (Hawaii Behavioral Risk Factor Surveillance System) – the IPAQ specifically asks for physical activity across four domains including work-related physical activity. Another factor that may explain the high levels of physical activity is the social cohesiveness of the community. The close-knit community may influence physical activity behaviors in the community. Previous studies have shown that social cohesiveness and support, and even the perception of social support were positively associated with an increased level of physical activity (Carron, Widmeyer & Brawley, 1988; Sallis, Owen & Fisher, 2015). The LDS church has a strong influence in La‘ie, and its influence can also be felt in Kahuku and Hau‘ula. There are also several other churches that can be found in the observed community. Previous research has shown that church attendance are associaed with greater physical activity (Shapiro, 2018)

CONCLUSION

The findings from this study highlight the high rates of physical activity among NHPI in this community. Although not all community perceptions were favorable among all RALPESS items, NHPIs are still very physically active. One of the items where a high proportion of participants agreed was if their church encouraged physical activity or exercise (93.1% for men and 87% for women). Other RALPESS items with similarly high scores were more about amenities (crosswalks, playgrounds, and exercise equipment). Asking participants about if their church encourage physical activity is not an amenity, but rather an item asking about their church’s principles or guidelines to being physically active.

Religious institutions are very important among NHPI cultures, and it is especially important in the community that was observed. Some of the churches in the community include Methodist, Catholic, Jehovah’s Witness, New Hope, and the LDS. Previous studies have

specifically targeted faith-based institutions as intervention sites (Ka‘opua et al., 2011; Tristao Parra, Porfirio, Arredondo & et al., 2017). Nearly half of the participants in this study reported being physically active at work. There were also a high proportion of participants who reported doing some form of physical activity at home or in the garden. It is very common for NHPI in the observed community to lease or own a plot of land to cultivate root crops (yams, sweet potatoes, and taro). Future research should examine how much physical activity is achieved when cooking outdoors and working in their plantations – the word “garden” referred to in the IPAQ is understood by most community members as the area around the house where flowers are planted – the “farm” is referred to when speaking about their crops.

After time at home and time at work, the next most likely place they will spend a significant amount of time during the week is with their social groups or churches (Palmer, Lee, Sablan-Santos & et al., 2013; Wiltin & Lavin, 2012;). After examining the differences between male and female agreement of the RALPESS items, three items in the “Churches” were different according to the Chi-square tests. Female agreement were higher for item numbers 22 (indoor facilities can be used by the public for physical activity or exercise), 23 (outdoor facilities can be used by the public for physical activity or exercise), and 26 (churches in your town offer physical activity programing or activities). After further investigation it was noted that the community has existing women-led groups that meet at church facilities specifically for physical activity programs (e.g. Zumba). These classes are free to the public and are advertised via social media (e.g. community Facebook pages) and target women within the community. This may be part of the reason why female agreement to the three mentioned RALPESS items are at least twice, and up to almost four times the proportion of agreement by men for those same items.

Physical activity behaviors are influenced by different enviornments as promoted by the social ecological model (Gile-Corti & Donovan, 2002; Sallis et al., 2015). Results show a high proportion of NHPIs in the community are meeting physical activity recommendations, however, there are still gaps that could be strengthened. The lowest amounts of physical activity were noted in Active Transportation – very few participants reported walking and bicycling to places. Being that the observed community is in a rural area, funding for infrastructure changes may not realistic. Thus, improvements to the social environment with a focus on churches in NHPI communities can be a step towards increasing physical activity behaviors across all physical activity domains.

Chapter 3: An Assessment of the Built Environment

PURPOSE OF STUDY

Very few studies have assessed the built environment for physical activity in rural settings (Hansen et al., 2015). Even fewer have reported on minority populations (Sanderson, B., Littleton, M., & Pulley, L.V., 2002; Thompson et al., 2002; Robinson, Carson, Johnson & et al., 2014; Perry, Nagel, Ko & et al., 2015). Unfortunately, no studies have reported data on the built environment in rural areas where there is a high proportion of Native Hawaiians and other Pacific Islander (NHPI). This study seeks to fill gaps in the literature and provide information to help reduce physical activity disparities that exist between urban and rural communities.

The purpose of this study is to answer an important question when looking at the populations in rural areas: what opportunities for physical activity are available for three predominantly NHPI communities in Hawai‘i? This chapter will use validated measures and tools to identify factors in the built and policy environments that may influence physical activity behaviors.

METHODS

Measurement Tool

Rural areas have facilitators and barriers to physical activity that are different than those in urban areas (Sandercock, Angus, & Barton, 2010; Frost et al., 2010; Forsyth, Oakes, Lee & Schmitz, 2009; Seguin, Connor, Nelson & et al., 2014). Access to physical activity facilities may be a barrier in rural communities. Commercial health and fitness facilities are not commonly found in rural areas. There is also an unequal distribution of accessible parks and green spaces according to regional characteristics (Dai, 2011; Gordon-Larsen, Nelson, Page, & Popkin, 2006; Moore, Diez Roux, Evanson, & et al., 2008). Time may be a factor for some populations where

they do not have to spend so much time traveling to and from work. These are some examples that reflect the importance of filling gaps in the literature to include assessments of the built environment in rural areas.

Many studies have assessed the built environment for physical activity using different measurement and audit tools (Brownson,R.C., Hoehner, C.M., Day, K., & et al., 2009). The majority of tools have been created to examine the environment in urban settings (Brownson et al., 2009). Differences in the urban and rural environment also make it necessary to use assessment tools that have been validated in rural settings, as findings from studies in urban areas may not be generalizable to rural areas (Yousefian et al., 2010). In a systematic review by Feng et al. (2010), results indicated a lack of studies conducted in rural areas.

The Rural Pedestrain Environmental Audit Instruct was created to produce a walkability summary score in rural settings by modifying the Pedestrian Environmental Data Scan (PEDS) instrument (Fisher, Richardson & Hosler, 2010). One of the limitations of the rural instrument modification was it could only be used in good weather conditions. Rain or snow could make rural roads hazardous for pedestrians. Another instrument that was used to measure the rural active living environment is the iCHART (Seguin, Lo, Sririam & et al., 2017). The iCHART was created so that an individual observer could complete the audit in a single visit. One challenge identified from the iCHART is that the audit has a total of 191 items, which could contribute to tester fatigue and inconsistent scoring (Seguin et al., 2017). Another tool that was also created for rural areas is the Stanford Healthy Neighborhood Discovery Tool, which uses a mobile device to capture photographs, community narratives, and walking routes (Seguin, Morgan, Connor & et al., 2015)

The Rural Active Living Assessment (RALA) tools were developed by Yousefian et al. (2010) because of a need to provide an assessment tool for rural areas. This tool was selected for several reasons. First, it was created specifically for rural areas. Second, the RALA tools were made to assess different domains that are more likely to be found in rural areas (Yousefian A., Ziller A., Swartz J., Hartley D., 2009). Another reason the RALA was used for this study is because it is an objective measurement tool and has been validated in previous studies (Hege, Christiana, Battista & et al., 2017; Perry et al., 2015; Robinson et al., 2014)

The RALA consists of three assessment tools. The Street Segment Assessment (SSA) examines selected street segments within the town boundaries. The SSA has a total of 28 questions that identify walkability (available sidewalk, buffers, and shoulder conditions), safety, road features and land use. The Town Wide Assessment (TWA) tool uses 33 questions to identify town demographics, school location, biking/hiking trails, public parks and playgrounds, and other recreational facilities. The third tool in the RALA is the Policy and Program Assessment (PPA) tool, which has 20 questions to identify existing programs and policies, in the town and schools, that promote physical activity.

Unlike the TWA and PPA, the SSA is not scored by domain and does not have an overall score. Characteristics of the assessed segments are displayed in Table 4. Fisher's exact test was conducted to see if there were any differences between the characteristics in each town. P-values were significant at $p \leq 0.05$.

Selected areas and segments

The observed towns were selected because they have a high proportion of NHPI resident, they are located in a rural area, and the student researcher has been a lifelong member of the community. Kahuku, La'ie and Hau'ula are located along the North and Northeast shores of

Oahu Island, Hawai‘i and are described in Table 17. By population, Kahuku is the smallest of the three towns with 3,292 residents and La‘ie is the largest of with 6,419 residents. Hau‘ula has the highest proportion of residents who self-identify as NHPI 70.2% of total residents. Although La‘ie has the lowest proportion of NHPI residents, the proportion is still more than half of the current residents (51.1%). Income levels in Kahuku ($61,250) and Hau‘ula ($65,265) are lower than the state median ($68,201), and residents in La‘ie have the highest median income ($86,731) of the observed towns. All three towns have a higher percentage of people living under the poverty level than the state (11.2%).

Table 16. Population description

	Kahuku	La‘ie	Hau‘ula	State of Hawai‘i
Population, N	3,292	6,419	5,555	1,360,301
Native Hawaiian or other Pacific Islander, % (n)	59.5 (1,960)	56.8 (3,292)	70.2 (3,904)	25.7 (350,288)
High school graduate or higher, %(n)	87.4 (2,285)	97.9 (6,009)	87.4 (3,625)	90.7 (1,233,793)
Median household income, dollars	61,250	86,731	65,625	68,201
Persons below poverty level, % (n)	14.9 (490)	13.2 (847)	12.9 (716)	11.2 (152,353)

Source: factfinder.census.gov

Procedures

Prior to collecting any data, an application was submitted, and approval was granted by the University of Hawai‘i at Mānoa Institute Review Board (Protocol ID 2016-30515).
One community member was trained by the student researcher on how to use the SSA portion of the RALA tools. Two meetings were held to go over the SSA. The first meeting was to review the SSA items and to do a practice audit with 4 selected segments. Two segments were residential, and two other segments were in non-residential areas. Prior to conducting the audits, the SSA items were entered into Qualtrics. The student researcher and community member conducted each SSA separately. All SSAs were completed electronically and stored in Qualtrics.

The four segments were audited on two weekdays between the hours of 10:00 am and 1:00 pm. Following the first meeting, the data from the SSAs were transferred and uploaded to SPSS (Version 24). The second meeting was held to review the practice audits and inter-rater reliability of the SSA scores.

One TWA was completed for each town. Much of the information needed for this portion is publicly available (e.g., town population, total town area, public school location, and public parks) and can be found on local government agency websites (Hawai‘i census, Honolulu City & County). One PPA per town was completed by working with recreation and school officials to confirm existing policies and programs.

There are no designated “town-centers” for any of the three towns in this study. It was necessary to find a “town-center” that would be available in all three towns. After a review of the existing literature, and consulting with committee members and RALA authors, the public elementary schools in each town were used as the “town-center” for this study (Carver, Panter, Jones, & et al., 2014; Jones, Jones, van Slujis, & et al., 2010). Previous studies have indicated that community residents are likely to walk to certain destinations (e.g. grocery store and restaurants) within a half-mile radius of where they live (Agrawal, Schlossberg & Irvin, 2008; Scott, Evenson, Cohen & et al., 2007; Lee & Moudon, 2006; Nagel, Carlson, Bosworth & et al., 2008). Consistent with the existing literature, a half-mile radius was created around each town-center. This was created using Google Maps. A total of 60 street segments were randomly selected from within the half-mile areas to be assessed – 20 from each town (Figures 5-7). Each segment began at an intersection and ended at the nearest intersection or cross street within that segment. Some streets were divided into multiple segments because of its length – four streets in Kahuku had to be broken into smaller segments, three in La‘ie, and four in Hau‘ula. The

segments were divided by using any cross streets that connected to observed segment (Clifton, Smith & Rodriguez, 2007). All selected segments for the SSA were assessed in May 2017, on a non-holiday weekday between the hours of 8 am and 5 pm.

The TWA, PPA and SSA were completed and then scored according to the RALA Codebook (Hartley, 2010). Domains were scored individually for the TWA and PPA, and then combined to produce a grand total.

Figure 5. Selected Kahuku segments for SSA.

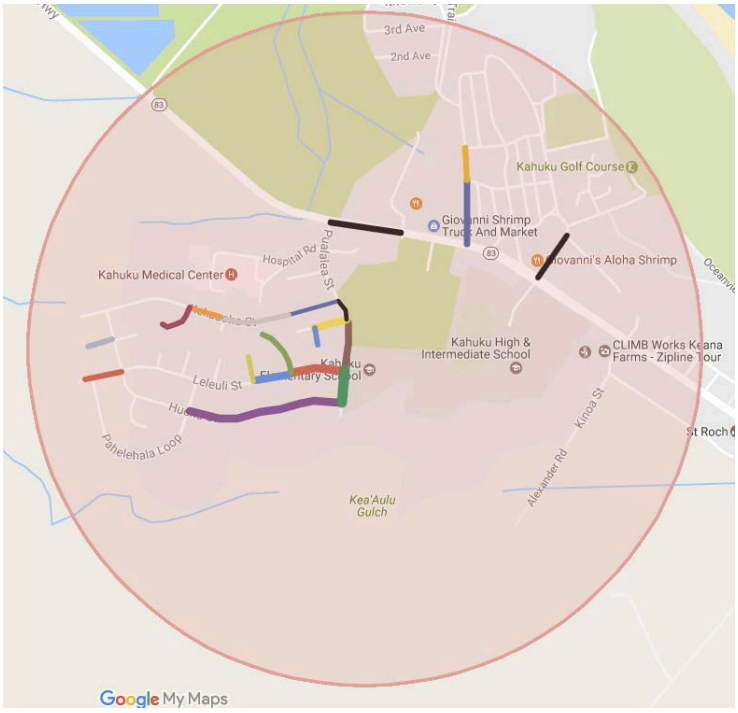


Figure 6. Selected La‘ie segments for SSA

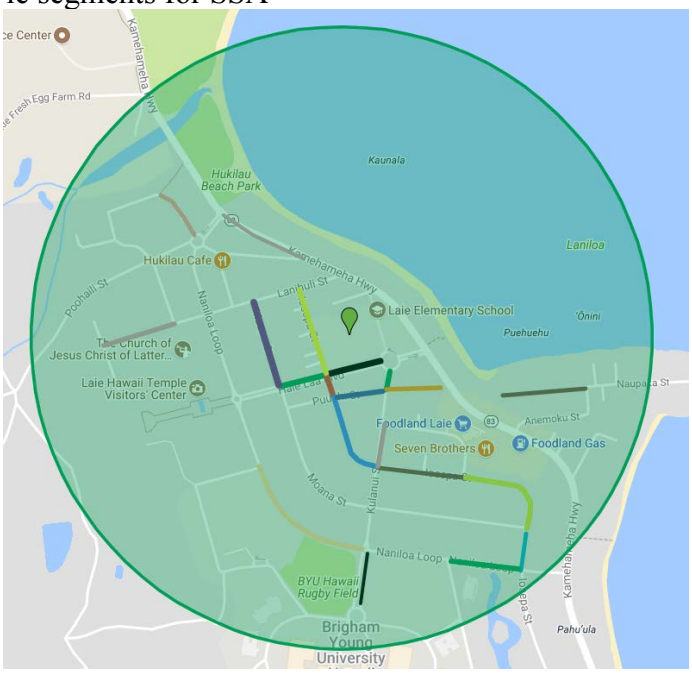


Figure 7. Selected Hau‘ula segments for SSA

RESULTS

Town-Wide Assessment

The TWA scores individual domains in the town and provides and overall score for available physical activity amenities (Table 18). Most data needed to complete the TWA are publicly available and can be found on state and Honolulu City & County government websites. Other data (e.g., availability of private fitness facility) not found on government websites can be found by asking local community members. The student researcher, a resident in the observed community for year 20 years, was able to complete the TWA alone. The lowest possible score is a zero and the highest possible score for the TWA is 100 points. The total scores for the TWA ranged from a low of 61 (Hauʻula and Laʻie) to high of 83 (Kahuku).

Table 17. TWA Scores

Domain (max score)	Kahuku	Laʻie	Hauʻula	Overall Mean (SD)	Median
School location (15)	15	6	6	9 (5.1)	6
Trails (20)	20	20	20	20 (0.0)	20
Parks and playgrounds (25)	25	17	23	24.3 (1.1)	25
Water activities (10)	5	5	5	5 (0.0)	5
Recreation facilities (30)	18	13	7	12.6 (5.5)	13
Total (100)	83	61	61	71 (11.1)	13

In the School Location domain three items were scored (see Appendix III). All three towns had an elementary school that children can walk to. The only middle/intermediate and high school in the area is located in Kahuku, which makes it unwalkable for children in Laʻie and Hauʻula.

All three towns scored the maximum 20 points in the Trails domain. Each town has at least one hiking or walking trail within 5 miles of the town center (Table 19), each town center is within 5 miles of a bike path and have other hiking or walking trials used for physical activity.

Table 18. TWA Trails

Kahuku	Cross Hill Kahuku Loop Trail Kahuku Point Trail
La‘ie	Wailele Falls La‘ie Summit Trail
Hau‘ula	Hau‘ula Loop Trail Kaipapa’u Makai

Four items were used to score Parks and Playgrounds in the TWA. Two towns (Kahuku and Hau‘ula) have a public park (Kahuku District Park and Hau‘ula Community Park) operated by the city and county government, and one town (La‘ie) has a private park maintained by private land owners (commonly known as La‘ie Park). La‘ie Park was placed as “Other” and scored two points under Parks and Playgrounds. All three towns also have elementary school playground fields that are open to the public. All three parks have functioning water fountains and available restrooms, as well as playground equipment and basketball courts.

Water Activities were scored with 4 items. Each town has access to several public beaches. There are also rivers that offer access for canoeing, kayaking and stand-up paddle boarding, within 15 miles of each town center. High scores are highlighted in Table 18.

Only five of the items to score Recreational Facilities were applicable for this setting (Appendix III). Kahuku has two private fitness facilities (Crossfit Ko‘olau and Turtle Bay Fitness Room). Crossfit Ko‘olau is located within a half-mile of the town center and the Turtle Bay Fitness Room is nearly 4 miles from the town center at the Turtle Bay Resort. La‘ie and

Hauʻula do not have any private fitness centers. All three towns have public playing fields or courts within their town center. Kahuku also has a small skate area in their district park.

Policy and Program Assessment

The PPA was assessed and scored for each town by domain, and then combined to produce a total PPA score (Table 20). The lowest possible score is a zero and the highest possible score for the PPA is 100 points. There was a high of 72 (Laʻie) and a low of 43 (Hauʻula).

Table 19. PPA Scores

Domain (max score)	Kahuku	Laʻie	Hauʻula	Mean (SD)	Median
Town policies (10)	10	10	10	10	10
Town programs (30)	26	22	18	22.0 (4)	22
School policies (30)	15	15	15	15.0 (0)	15
School programs (30)	0	25	0	8.3 (144)	0
Total (100)	51	72	43	55.3 (14.9)	12.5

Each town scored a 10 in the Town Policies domain. High scores of the PPA are highlighted. There were two items to score Town Policies, however, only one was applicable to the town – existing policy requiring bikeways/pedestrian walkways in new public infrastructure project. The second item was about the town regularly clearing snow from sidewalks. The RALA tools scored the first Town Policies item (existing bikeway/pedestrian walkways policies for new infrastructure) as a possible "10" if the town did not snow; the same item was only scored as a possible "7" if it did snow in the town. The three towns in this study do not have their individual city/town government and fall under the jurisdiction of Honolulu City & County government, which covers the entire island.

Six items were used to score the Towns Programs for each town. All three towns have a public recreation department that is managed by the Honolulu City & County Department of Parks and Recreation. Each town also offers physical activity programs for youth. Sliding fees for lower income residents are provided for some sporting organizations, which also include no fee if a parent or guardian volunteers to coach a team for that season. For School Policies, two items were used to score School Policies. The three elementary schools and one high school within this community allow public access to their recreation facilities (basketball court, school playground, and playing fields) after school hours. Three items were used to score School Programs. A bike education course if offered for one elementary school, and a Junior Police Officer program encourages pedestrian safety and motor vehicle awareness to students walking to/from school.

Street Segment Assessment

To examine inter-rater reliability, kappa scores were identified using crosstabs. Kappa scores from the four SSAs can be found in Table 20.

Table 20. Inter-rater reliability scores

Town – segment type	Kappa	p-value
Kahuku – residential	0.805	<0.001
La‘ie – commercial	0.601	<0.001
La‘ie – residential	0.847	<0.001
Hau‘ula – residential	0.778	<0.001

According to McHugh (2012), the raters scored “almost perfect agreement” (0.81 – 1.00) on two SSAs, one SSA was considered “substantial agreement” (0.61 – 0.80) and one SSA was scored as “moderate agreement” (0.41 – 0.60). There was a concern with the rating of the La‘ie – commercial segment, as it had the lowest inter-rater reliability kappa score (0.601). It was determined that one rater mistakenly identified the presence of a post office, a medical office, a

gas station, and a movie theater, which are all located in the La‘ie Shopping Center. The shopping center parking lot has several entrances, and although you can enter the parking lot through an entrance in the segment that was being observed, the raters mutually decided that the four items selected during the “practice run” should not have been scored “present” in the SSA – but would have been “present” if the connecting segment was being observed.

A total of 60 SSA were completed; 20 from each town in the study. Unlike the TWA and PPA, there is no scoring guide for the SSA, which only asks for frequencies (Table 21).

Table 21. Characteristics of segments in the SSA

N(%)	Kahuku (n=20)	La‘ie (n=20)	Hau‘ula (n=20)	p-value
Commercial features	4 (20%)	2 (10%)	2 (10%)	0.56
Public/civic features	11 (55%)	5 (25%)	8 (40%)	0.17
Public playground	3 (15%)	2 (10%)	1 (5%)	0.57
Sidewalks (both sides of street)	0 (0%)	6 (30%)	2 (10%)	0.06
Sidewalk (one side of street)	3 (15%)	3 (15%)	1 (5%)	0.27
Sidewalk shoulder/buffers	1 (5%)	9 (45%)	2 (10%)	0.00
Safety features (street lights)	18 (90%)	19 (95%)	20 (100%)	0.76
Crossing signals	1 (5%)	1 (5%)	0 (0%)	0.59
Crosswalks	7 (35%)	13 (65%)	2 (10%)	0.00
Connectivity	2 (10%)	8 (40%)	3 (15%)	0.04

The SSA identified La‘ie as having the most sidewalk shoulders and buffers, crosswalks, and segment connectivity.

Chi-square test were performed to identify any differences in segment characteristics between the three towns. There were difference in the three towns in shoulders and buffers, crosswalks, and segment connectivity frequencies (Table 21). Of the 60 segments assessed in the

SSA, only three segments did not have any safety features (traffic light, stop sign, school flashing light, speed bump, or public lighting). The SSA indicated that the segments selected in Kahuku had more public/civic features (athletic field/court, fire station, police station, post office, church etc.) and commercial features (restaurant, bar, gas station, convenience store, medical office, theater, etc.) than the segments assessed in La‘ie and Hau‘ula.

DISCUSSION

RALA Scores

The findings from the RALA clearly identifies built environment barriers to being physically active in Kahuku, La‘ie and Hau‘ula. The TWA revealed that there are town-wide barriers in all three towns, specifically in the domain of Recreational Facilities. There are existing playing field or courts, but there are no town-owned recreational centers or YMCA in La‘ie and Hau‘ula. Kahuku has two pay-for-use recreation facilities – Crossfit Ko‘olau and Turtle Bay Fitness Center. These two facilities were included when scoring the TWA in Kahuku. Crossfit Ko‘olau open during certain hours of the day; 5:00 am – 9:00 am and 5:00 pm – 7:00 pm Monday to Friday and 8:00 am – 9:00 am on Saturday, and the membership cost may not be affordable for all residents ($70 to $120 per month). The Turtle Bay Fitness Center also has limited hours for instructor-led classes, and a fee of $120 per month. Public beaches are accessible in all three towns and a bike path (on private property) connecting La‘ie and Kahuku is accessible for public use. These public areas may provide an opportunity for physical activity but a facility such as Gold’s Gym or Curves may provide a sense of safety for community members.

These findings support previous studies which identify the availability of recreational facilities as a barrier to physical activity (Babey et al., 2008). Moore et al. (2008) noted that

minority neighborhoods were less likely to have recreational facilities than white neighborhoods. A review by Meyer et al. (2016) identified barriers across several domains (home/neighborhood, workplace, transportation and school) which may prevent rural residents from being just as physically active as their urban counterparts.

The PPA scores indicate that existing policies are a barrier to physical activity in these three towns. The scores were similar to that of previous studies that have used the RALA tools Robinson et al., 2014; Perry et al., 2015). According to the PPA scores, all three towns scored a "10" in the Town Policy domain. Two items are used to score the Town Policies; 1) Town has policy requiring bikeways/pedestrian walkways in new public infrastructure projects and 2) Town regularly clears snow from sidewalks (if applicable). Only the first item was used to score the Town Policy since it does not snow in the three towns, and the RALA adjusts the scores to a possible "10" for the first item instead of a "7". All three towns do not have their own individual town/city governments – only a county government (Honolulu County). All three towns fall under the jurisdiction of the Honolulu City & County government, leaving policies requiring bikeways/pedestrian walkways to fall on the responsibility of elected officials whose offices are in Honolulu. To address this issue, the state of Hawai‘i passed legislation in 2009 requiring all counties to adopt a Complete Streets policy.

Two towns have public programs that are offered to community member. Kahuku district park and Hau‘ula community park offer recreational programs (dance, craft, sport, and music) throughout the year for all ages. These programs fall under the Honolulu City & County's Parks and Recreation programs. Almost all public programs at these two sites are only offered for young children and youth (Table 22).

Table 22. Parks and Recreation programs

Kahuku		La‘ie		Hau‘ula	
Program	**Age (yrs)**	**Program**	**Age**	**Program**	**Age (yrs)**
Archery	9-12	Archery	8 – 12	Active Seniors	55 and up
Arts and Crafts	Any	Crafts	5 – 12	Archery 2-3 Gr	7 – 9
Karate	6 – 18	Dance	5 – 12	Archery 4 – 6 Gr	9 – 12
Open gym	Any	Hula	5 – 12	Basketball	7 – 10
Summer Fun	5 – 12	Hula	12 and up	Hula	4 – 10
Summer Teen Program	12 – 18	Polynesian dance	5 – 12	Jr Lifeguard	9 – 12
Senior Social	55 and up	Lei making	5 – 12	Kitchen Creation	7 – 12
Teen Club	12 – 18			Senior Club	55 and up
				Tennis & Pickle Ball	7 – 12
				Ukulele	12 – 18
				Ukulele adults	18 – 80
				Volleyball	7 – 12

(www.parks.honolulu.gov)

The American Youth Soccer Organization (AYSO) Region 358 (Kahuku, La‘ie, Hau‘ula, Punalu‘u, Ka‘a‘awa) offers youth soccer. The Police Activities League (PAL) also offers youth basketball in La‘ie, for residents in La‘ie and surrounding towns during the winter and spring months. Also available for youth in the area, are Pop Warner and Big Boys football leagues, and rugby leagues. All of the mentioned organizations and programs for youth require a fee which ranges from $0 (free) to $230. For some sports (PAL basketball) a fee will be waived if a parent of a child-participant volunteers to coach a team. The fees may not be affordable for everyone in these communities. Organizations and sponsors who provide these programs should consider a sliding-scale fees (Sallis & Glanz, 2006; Kohl III & Cook, 2013).

The lack of policies in these three towns are also reflective of similar studies that report local policies as a barrier to physical activity (Yousefian et al., 2009).

Of the 20 segments assessed in each town, La‘ie had the highest number of sidewalks, sidewalk buffers and shoulders, crosswalks, and route connections. La‘ie had the highest score for PPA but had the lowest score for the TWA. With sidewalks being more available in La‘ie,

the elementary school may be more likely to implement policies and programs that promote walking and biking to school – La‘ie also has designated bike lanes, thus explaining a high PPA score. La‘ie’s low score for the TWA may be explained due to the fact that the La‘ie Park is not a public park. It is privately owned and maintained, but is accessible by the public, and is used for recreational programs such as PAL basketball and Big Boys League football (both youth programs). It should be noted that La‘ie also has the highest median income of the three towns by more than 30%.

Kahuku scored the highest in the TWA (a score of 77). The Kahuku district park is used for youth sports such as AYSO soccer and rugby. The district park also has a baseball field, basketball courts and a facility for skateboarding. Kahuku had the highest score for the School domain in the TWA (20 points) which may be due to the fact that there is a public elementary school, middle school (intermediate school), and high school in Kahuku – Kahuku Intermediate & High School is the only high school in the area that accommodates students from 7^{th} to 12^{th} grade.

Strengths

The RALA tools is a comprehensive measurement tool that assesses both the built environment and the policy environment of the social ecological model. To the author’s knowledge, this is the first study to look at the built environment of rural towns with high proportions of NHPI residents. The results from this study can be used to provide policy makers with a “baseline” in hopes that future modifications and improvements can be done to the policy and built environments of Kahuku, La‘ie and Hau‘ula to better promote physical activity.

Limitations

One limitation of the RALA is that is specifically asks for public parks, and scores it higher than private spaces. In Laʻie, the main park used for recreation is privately-owned (unlike Kahuku and Hauʻula district parks operated by Honolulu City & County) but is used by the public and for PAL activities. Although the scores may reflect a barrier in the community, in reality Laʻie park is considered a strength to the community because it functions as a public park. Scores could be improved if private parks that are available for public use (such as Laʻie Park), were scored as equal to public parks.

Another limitation was found in the PPA. Two items are used to score the Town Policies. However, only one item was applicable (the second item asked for about snow removal). Future assessments of the town policies may consider using another tool with more items to score the town policies.

Since the three observed towns are located along a coastline, the half-mile buffer around each town-center also covered into the ocean. A large part within the buffers in Laʻie and Hauʻula covered the ocean, as their town-centers are located on Kamehameha Highway and directly across from the beach. Kahuku is situated far enough inland that he half-mile radius from the town-center did not cover any ocean, however, the buffer did include land that is currently zoned for agricultural use.

CONCLUSION

In 2009 the State of Hawaiʻi adopted Complete Streets, and in 2012 the Honolulu City & County adopted a Complete Streets policy and ordinance. Although the City & County "is taking aggressive steps to implement Complete streets," none of the 16 study sites on Oahu are in small rural towns (Department of Transportation Services, City & County of Honolulu). In 2014 a protected bike lane was created on King Street, Honolulu. Another bike lane was completed in

2017 (South Street). The Hawai‘i Bike Share (Biki) program has also launched in urban Honolulu. In 2017 there were over 360,000 rides logged with Biki. Though these policy implementations can be applauded, rural areas should also be a point of focus when implementing Complete Streets policies. Figure 8 is a map of current Complete Streets projects. It is heavily focused in urban Honolulu, and there are no current projects in any areas of the north or Leeward side of the island.

Figure 8. Current Complete Streets Projects

(Source: www.honolulu.gov/compeltestreets)

Though the Complete Streets policies remain the same throughout the county, implementation will look different in rural and disparate communities. For example, no Complete Streets projects were identified to have been completed in Wai‘anae. Although Wai‘anae is not considered “rural” by the definition used in this dissertation, the community has one of the highest proportion of NHPI residents and ranks the highest in the state for risk of socio-economic and chronic disease indicators (State of Hawai‘i, 2016). Ko‘olauloa (of which Kahuku, La‘ie and Hau‘ula are a part) also did not have any Complete Streets projects completed

or currently underway, and also suffers from chronic disease rates much higher than the rest of the state (State of Hawai‘i, 2016).

Current rural needs may only require painted lines and crosswalks to better connect the town. Other rural communities may need improvements to road conditions to improve walking and bicycling opportunities. Findings from this study could be used to alert policymakers that there are existing policy barriers that prevent disparate populations from being physically active in their neighborhoods.

For the specific communities in this study, seeking a joint use agreement with schools in the area would be beneficial. Brigham Young University – Hawai‘i, located in La‘ie, has facilities available only for students and staff/faculty members (outdoor swimming pool, indoor basketball/volleyball gym, outdoor tennis courts, and weight room). A joint use agreement with Brigham Young University-Hawai‘i would be extremely beneficial to the surrounding community members (Young, Spengler, Frost & et al., 2013).

The results from this study can be used as a “baseline” measurement for policy makers. The assessment identifies needs in the built and policy environments that should be modified and/or improved to promote physical activity in Kahuku, La‘ie and Hau‘ula. The RALA can be easily conducted and more studies should be conducted in rural areas with high proportions of NHPI and other minority groups because of the higher risk they pose for preventable diseases (e.g. heart disease, stroke, type 2 diabetes, and obesity).

By using the RALA tools, the student researcher was able to gain a comprehensive outlook of the environments that influence active living. However, there were still gaps in assessing the active living environment that were not captured with the selected instrument.

For example, private land owners may allow the community to use their land as a public, as is the case with La‘ie Park. Instead of an item for “availability”, the item should be asked about “public usage”. Although the RALA scores indicate that there were no bike paths in the town centers of Kahuku and Hau‘ula, it may still be possible that residents used bicycles if they owned one to make short trips in the area. Individual household audits should be considered when assessing the environment in a rural community. For the observed NHPI communities, a household audit tool would include identifying any home gym equipment (which is commonly shared within the observed community, see Chapter 1 Figure ##) and any farm or planation tools – which could indicate that an individual in the household has a plot of land that is tended.

Root crops are an integral part of NHPI cultures and identities (De La Pena, 1996; Onwueme, 1999; Vakalahi & Davis, 2014). It is recommended that future studies identify ways to integrate measurement tools that examine the availability and use of privately owned agriculture plots of land. For example, in the observed community, it is very common for families to own or lease a plot of land where they cultivate root crops commonly found throughout the Pacific (yam, taro, sweet potato, yucca, etc.).

Future research among NHPI should examine more closely the social environment and social norms of the community – existing measurement tools may need to be modified to accurately capture opportunities for physical activity. Outdoor kitchens and underground ovens are common among the observed community. An outdoor oven can be identified as an opportunity for physical activity, as preparing the oven and foods to be cooked in it can be very laborious. Such tools have been used in other populations, and should be adapted for NHPI populations (McNeill, Kreuter, & Subramanian, 2006; Giles-Corti & Donovan, 2002).

Research will not be enough to promote active living in rural areas. It is important translate that research into practice in these communities. Previous studies have shown that planners were more likely to work with diverse organizations in rural areas than in urban areas (Coghill, Valaitis, & Eyles, 2015). In order to create a healthy policy and built environment for physical activity, supportive partnerships must be established across different sectors and organizations – policy makers, school officials, local leaders, and community members. Evaluating any programs or interventions to improve physical activity in rural settings is also important, being that some interventions have been evaluated "informally or not at all" (Coghill et al., 2015).

The findings from this study will serve as a guide to improve or modify existing conditions that influence physical activity behaviors. Recommendations from this study can help policy makers and community members guide future research and policy changes. Although some of the recommendations may not be relevant or for all NHPI communities, investing adequate funds and time to improving the built environment and existing policies will ensure that the community has opportunities to be physically active.

Chapter 4: Community perceptions of barriers and facilitators to being physically active

Existing literature report that perceptions of the environment can influence physical activity (Lamit, Majid, Shafaghat & et al., 2012; McGinn, Evenson, Herring & et al., 2007; Troped, Tamura, Whitcomb & et al., 2011). Previous studies have used qualitative research methods in different settings to understand barriers and facilitators to being physically active (Cleland, Hughest, Thornton & et al., 2015; Ferrer, Ruiz & Mars, 2015; Hume, Salmon & Ball, 2014; Rader, Byrd, Fountain & et al., 2015). The results from these studies have identified community needs and strengths that may not have otherwise been identified if quantitative methods had been used.

RESEARCHER POSITIONALITY

In qualitative research, the positionality of the researcher is critical when working with indigenous and minority populations (Absolon, 2011; Denzin & Lincoln, 2008). Positionality must be considered, as it can influence data collection, analysis, and interpreting the data. In order for an audience to understand or validate any conclusions from qualitative research, researchers must "acknowledge, describe, and 'bracket' his or her values" (Ponterotto, 2005).

As a Tongan-American, I am especially interested in physical activity behaviors among Native Hawaiians and other Pacific Islanders (NHPI). This interest has led me to identify specific areas in the existing literature regarding NHPIs that need to be filled. The research questions that are examined in this dissertation, are a result of my resolve to increase opportunities for physical activity in my hometown.

As a longtime member of the observed community, I consider myself an "insider" and was already accepted into the community. I acknowledge that my desires to improve the built environment in this community and increase opportunities for physical activity, are what have

led me to pursue this study. There are advantages and challenges of being an "insider". First, the relationship between the participants and myself was understood as equalized – I was viewed as a community member first, then as a researcher by the participants. Another benefit as an "insider" was that I was able to understand any historical references, social taboos and current happenings in the community. I was also able to detect actual behaviors and hidden behaviors "versus their performed selves" (Chavez, 2008). I understand my biases may have shaped some of the discussions in this study and influenced participants in their identification of facilitators and barriers to being physically active.

PURPOSE OF STUDY

The purpose of this study was to answer an important question that could be used to increase opportunities for physical activity: what do Native Hawaiian and other Pacific Islanders (NHPI) perceive as barriers and facilitators to being physically active in their rural community? This qualitative study employs the Photovoice method to identify barriers and facilitators to being physically active through the lens of community members.

METHODS

Observed Communities

Kahuku, Laʻie, and Hauʻula are rural towns located on the north and northeast shores of the island of Oʻahu. They were selected for the study because all three communities have a proportion of NHPI residents that are higher than that of the state's (Table 23). Parts of Hauʻula serve as home to Native Hawaiian families that participate in the Hawaiian homelands program for homesteads. This program allows Native Hawaiians (at least 50% Hawaiian) to lease a homestead for 99 years, at $1 per year for residential, agricultural or pastoral purposes (DHLL, 2017). Laʻie is home to the Brigham Young University-Hawaiʻi campus and the Polynesian

Cultural Center; both are among the main employers in the area. Other major employers in the area include the Department of Education (Kahuku, La‘ie, and Hau‘ula Elementary Schools, and Kahuku High & Intermediate) and Turtle Bay Resort. The only high school that serves the area is located in Kahuku. Until 1971, Kahuku was a “plantation town”, and operated a sugar cane mill.

According to the Census (2015, Table 23), La‘ie is the most populated of the three towns (6,419) and Kahuku is the smallest by population (3,292). Median incomes in Kahuku and Hau‘ula are both below the state’s median income ($61,250 and $65,625 respectively). The median income for La‘ie residents is well over the state’s median income, at $86,731, and they also have the lowest proportion of NHPI residents (Table 23).

Table 23. Observed Community

	Kahuku	La‘ie	Hau‘ula	State of Hawai‘i
Population, N	3,292	6,419	5,555	1,360,301
Native Hawaiian or other Pacific Islander, % (n)	59.5 (1,960)	56.8 (3,292)	70.2 (3,904)	25.7 (350,288)
High school graduate or higher, % (n)	87.4 (2,285)	97.9 (6,009)	87.4 (3,625)	90.7 (1,233,793)
Median household income, dollars	61,250	86,731	65,625	68,201
Persons below poverty level, % (n)	14.9 (490)	13.2 (847)	12.9 (716)	11.2 (152,353)

Factfinder (Census)

Participants

Participants were purposefully selected from the observed community. The student researcher identified potential participants that had lived in the community for several years, are aware of (or use) recreational facilities in the area and are actively engaged in community activities (e.g. school or religious activities) (Palinkas, Horwitz, Green & et al., 2015; Patton, 2002). The participants were also selected because they have intentions of remaining in the community for several more years – they would be able to use the findings from this study to inform changes to improve physical activity behavior.

Catalani & Minkler (2010) examined 37 Photovoice studies. Participant sizes ranged from 4 to 122 with a median of 13. For this study, 15 community members agreed to participate. However, two were unable to attend any meetings due to scheduling conflicts, which then resulted in a total of 13 adults participants. The mean age of participants was 32 years (range was 29 to 49 years). Participant eligibility depended on: 1) self-identify as a Native Hawaiian or other Pacific Islander, 2) live within any of the observed communities, 3) age 18 and over, 4) able to communicate in English, and 5) willing to complete a survey as part of a larger project by the lead researcher. All of the participants received at least a high school diploma, with four participants attaining a graduate degree. Table 23 provides selected characteristics of the observed community and the state of Hawai‘i. The participant demographics can be found in Table 24.

Table 24. Photovoice Participant Demographics

Town (n)	Kahuku (n=4)	La‘ie (n=7)	Hau‘ula (n=2)	Total (n=13)
Gender % (n)				
Male	25.0 (1)	42.8 (3)	50.0 (1)	38.5 (5)
Female	75.0 (3)	57.2 (4)	50.0 (1)	61.5 (8)
Education % (n)				
HS diploma	25.0 (1)	-	50.0 (1)	15.3 (2)
4 yr degree	25.0 (1)	71.4 (5)	50.0 (1)	53.8 (7)
Graduate degree	50.0 (2)	28.6 (2)	-	30.7 (4)
Marital status % (n)				
Single (never married)	-	-	-	-
Married/Common law	100 (4)	100 (7)	100 (2)	100 (13)
Separated/divorce	-	-	-	
Widow	-	-	-	
Employed				
Part-time	75.0 (3)	57.2 (4)	-	53.8 (7)
Full-time	25.0 (1)	42.8 (3)	100 (2)	46.1 (6)
Self-employed	-	-	-	-
Unemployed	-	-	-	-
**Ethnicity				
Native Hawaiian		28.5 (2)		15.3 (2)
Maori		28.5 (2)		15.3 (2)
Samoan		28.5 (2)		15.3 (2)

Tahitian		14.2 (1)		7.6 (1)
Tongan	100 (4)	28.5 (2)	100 (2)	61.5 (8)

** n > 13, as some participants self-identified with more than one ethnicity.

Photovoice Theoretical Framework

Three theories provide the basis for the Photovoice method, as described by Wang (1999). The first comes from the social concept of critical consciousness (Freire, 1973). Photovoice, in relationship to the environment and physical activity behaviors, uses Freire's (1973) concept to initiate critical reflection of an individual or community's surroundings, with the intention of promoting positive changes (Carlson, Engebretson & Chamberlain, 2006). The second theory that helped form Photovoice, is the feminist theory (Wang, 1999). This theory examines the inequality between genders and the need to understand the importance of viewing issues through the lens of the female population (Im, Lee, Chee, & et al., 2011). The third area that helped create the Photovoice method was photography documentary – using visual images to explore the realities of a political or social environment (Wang & Burris, 1994).

Photovoice Method

The Photovoice method was created to help researchers gain a better understanding of a specific issue by having community members take photographs and share the story behind their photographs (Nykiforuk, Valliantos & Nieuwendyk, 2011; Wang & Burris, 1994 & 1997). Photovoice allows participants to become the experts of the issues that are important in their community, and how those issues can be addressed or changed. The three main goals of the Photovoice method, as outlined by Wang and Burris (1997), are: "1) to enable people to record and reflect their community's strengths and concerns, 2) to promote critical dialogue and knowledge about important issues through large and small group discussion of photographs, and

3) to reach policymakers." One of the main strengths of the Photovoice method is its value to raise awareness and create social change (Simmonds, Roux & Avest, 2015). Another strength of Photovoice is that is attempts to "narrows the researcher-participant dichotomy by enabling participants to take photographs and analyze the data" (Sitter, 2017).

This qualitative participatory approach has been used across different disciplines and fields (Catalani & Minkler, 2010; Simmonds et al., 2015; Belon, Nieuwendyk, Vallianatos & et al., 2016). It has been used to address issues with mental health, disability, social justice, and other disciplines (Catalani & Minkler, 2010; Hans & Oliffe, 2016; Mabry, Farris, Forro & et al., 2016; Sanon, Evans-Agnew & Boutain, 2014). This method has also been used among different age groups and underserved populations (Hennessey, Kraak, Hyatt & et al. 2010; Mahmood, Chaudhury, Michael & et al., 2012; Yousefian, Ziller, Swartz & et al., 2009). Researchers have also used Photovoice among NHPIs to capture attitudes on drug prevention, disaster reduction strategies and tobacco control (Crabtree & Braun, 2015; Helm, Lee, Hanakahi & et al., 2015; Helm, Davis & Haumana, 2017; Tanjasiri, Lew, Kuratani & et al., 2011; Tanjasiri, Lew, Mouttapa & et al., 2013). Searches were performed in PubMed and Google Scholar to identify existing literature on NHPI perceptions of physical activity barriers and facilitators in their community, which produced only one result. A dissertation study by Ng-Osorio (2014) was identified as using the Photovoice method among Native Hawaiian youth to identify perceived supports and challenges to physical activity and healthy eating in their school and neighborhood. Gaining greater insight of community perceptions by using qualitative methods can be beneficial in identifying specific needs for that population, however, this was identified as a gap in the literature/research for NHPI communities in the area of physical activity (Brown, 2003; Krenichyn, 2006; Scammell, 2010).

Studies among NHPIs have shown that qualitative methods have been useful in building a "foundation to support the selection of relevant and meaningful strategies to address community-defined needs" (Chung-Do, Look, Mabellow & et al., 2016; Kwon, Rideout, Patel & et al., 2015). As a result, it was important that a qualitative method be used to capture NHPI strengths and needs in their community. The Photovoice method will also shed light on how behaviors are influenced by different environments, as displayed by the social ecological model, and identify community-specific interventions (Nykiforuk et al., 2011).

Participatory Action Research

Traditional research consisted of an "expert" or "outsider" entering a community to conduct research, and then interpreting the collected data. This practice has been critiqued and was missing a crucial part – participation from members within the community that was being observed (Brydon-Miller, Greenwood, & Maguire, 2003). Purposeful sampling allowed the student researcher to remain consistent with key principles of participatory action research (Lingard, Albert, & Levinson, 2008).

This method also allows the researched population to be the experts in their community, and to become researchers themselves. The selected population were also involved in providing the context of their research, and how that research should be acted upon (Baum, MacDougall, Smith & et al., 2006). Participants reported that they had intended to remain as residents in the community for several more years. This will allow them to use the findings from this study to reach policymakers and "actions to improve health and reduce health inequities through involving the people who, in turn, take actions to improve their own health" (Baum et al., 2006).

PROCEDURES

Approval from the University of Hawai‘i’s Institutional Review Board was received prior to initiating the study.

Participants were asked to attend three sessions between April and May 2017 to complete the project. As an incentive for attendance, dinner was provided at each session. Eleven participants attended all three sessions. Two participants were unable to attend Session Three, so they met at a different scheduled time. All three sessions were held in a private room at the Brigham Young University-Hawai‘i campus and were less than 90 minutes each.

The consent form was reviewed at the beginning of Session One. The consent form explained that the risks to participating in this study were very minimal – participants were not asked to modify or change their daily routines. Participants were also informed of possible benefits that may result from this study – information that could be used to inform elected officials and community members of facilitators and barriers to being physically active in the community. All the participants signed the consent form before continuing with the first session.

Field notes were recorded by the student researcher throughout (before, during and immediately after) the three Photovoice sessions to provide context and inform the analysis of the discussions (Carlson et al., 2006; Phillippi & Lauderdale, 2017). The notes were used to capture any side comments and non-verbal cues (facial expressions and body language) of the participants.

The purpose of the study and the Photovoice method was explained in Session One. Although digital cameras were offered for the study, participants requested that they use their personal cell-phone to capture photographs, which has also been used in previous Photovoice studies (Alcazar, Raber, Lopez, Markham & et al., 2017; Williams, Shore, Sineath, & et al.,

2013). All cell-phones were checked to see if they had camera capabilities, text messaging, and email services. Participants were not allowed to photograph images, portraits, or people who could be easily identified. Any photographs with identifiable faces or body features (piercing or tattoos) would not be accepted and would be deleted immediately by the researcher.

Participants were instructed to take photographs that served as a barrier or facilitator to them being physically active. A "barrier" was described as something (physical, social, economic, or perceived) that prevented them from being physically active. A "facilitator" was described as something (physical, social, economic, or perceived) that allowed them to be physically active. "Physical activity" was defined as any movement that was done for leisure or transportation (Mahmood et al., 2012). They were instructed to take pictures of things they would do or see on a normal day. Participants were provided with examples from a Photovoice assignment that the student researcher completed for a qualitative methods course. There were no minimum requirements or upper limit to the number of photographs they could take. Participants were given one week to take photographs (Cahill & Suarez-Balcazar, 2012; D'Alonzo & Sharma, 2010; Mmari, Lantos, Bhrambhatt & et al., 2014). Photographs were emailed or texted to the lead researcher continually throughout the week, who compiled the photographs by each participant.

All the photographs were printed by the researcher at the end of the one-week period and then distributed to each participant at the start of Session Two. The purpose of Session Two was to discuss their photographs and generate themes. Participants were asked to select up to three of their photographs that could best describe barriers and facilitators to physical activity. Before beginning the discussion, participants gave consent to be audio-recorded. To initiate the discussion, the mnemonic questions, SHOWeD, were written on a whiteboard:

S: What do you See here?
H: What is really Happening here?
O: How does this relate to Our lives?
W: Why does this situation, concern, or strength exist? and,
D: What can we Do to improve the situation, or to enhance these strengths?
(Wang, Morrel-Samuels, Hutchison & et al., 2004)

Each participant began by answering the SHOWeD questions. After each participant's description of their photograph, the entire group was encouraged to share their thoughts on the image. The group was allowed to comment or ask any follow up questions to the individual describing their photograph. The group decided to move on to the next photograph if they felt the answers to the SHOWeD questions and discussion sufficiently described what the participant intended to describe. The audio recording from Session Two was transcribed verbatim and participants were identified alphanumerically. The audio file and transcript were securely stored on a flash drive that was only accessible by the primary student researcher.

Session Three was used to review the audio transcription, and collaboratively identify themes and categories from Session Two. Consistent with the Photovoice procedures, all themes were participant-driven rather than investigator-driven (Hennessy et al., 2010).

DATA ANALYSIS

Demographic data was analyzed using SPSS (Version 25.0. Armonk, NY: IBM Corp.). An inductive thematic analysis of the qualitative data was a multi-step and collaborative process (Braun & Clark, 2006; Lardeau, Healey, & Ford, 2011; Murray, Mohamed, Dawson & et al., 2015; Nykiforuk et al, 2011). First, the audio recording from the Session Two was transcribed verbatim and then distributed to participants during Session Three which also included the field notes. As a group, the photographs from Session Two were then paired with segments in the transcript that described the photograph. After pairing the photographs that were used in the discussion, they were placed into three possible categories: barriers, facilitators, and photographs

that expressed to be both a barrier and facilitator to being physically active. Sub-categories were then created for any photographs or transcript sections had similar working or meaning. Any section of the transcript that described barriers and facilitators, but was not paired with a photograph, were also categorized according to the interpretation of the participant who made the comments. Repeated phrases [e.g. "it's not safe to walk around…" and "I don't think it's safe…"] were automatically grouped into a common theme and category (Ryan & Bernard, 2003). Comments that may not have been repeated but were related to an existing theme was also grouped into the same theme (e.g. "I've seen a lot of cars swerve onto the side [*of the bike path*]). Any disagreements in the themes were discussed, and any changes to the themes were made when a consensus was achieved (Belon et al., 2016; Murray et al., 2015).

RESULTS

A total of 81 photographs were taken and submitted (range 1 to 23 per person). Of that total, 27 photographs (range 1 to 3 per person) were selected for discussion. Themes were divided into three categories: barriers, facilitators, and themes that were perceived as both barriers and facilitators. A sample of categories and themes are found in Table 25.

Table 25. Sample Themes

Category	Themes	
	Facilitator	Barriers
Available facilities	Turtle Bay Fitness Room is where I go – they have a lot of classes which is why I really like it The *(Malaekahana)* bike path is a good option for us People in the community use the *(Kahuku High School)* track for walking	We don't have any gyms here in La'ie We have to drive to Kahuku or Turtle Bay to attend organized classes End up having to go to these expensive classes if we want to get a good work out

	We have all these other options that are not free, but this *(BYU-H Fitness Center)* is free if you're faculty, staff or student To me the most biggest facilitator that, what I heard from people *(in this group)* was the bike path. That was the biggest thing and that was put in a few years ago and you drive by and you always see it. You know there's people on there, even if it's super hot. Things that have been done, that we see results, that's probably the main one, the bike path.	It prohibits me from going out with my kids as often as I would if we had sidewalks There are available resources to me but I just choose to not be physically active. I just want to return to the house to the AC (air condition) in the room after work.
Category	Directional perceptions	
Safety perceptions	My second picture was of the bike path but instead of focusing on how dark – I'm not afraid of the dark.	It's not safe to walk around in my community I don't think that is safe to begin with because there isn't any guard rail I've seen a lot of cars swerve onto the side *(of bike path)* When I'm on the bike path and have my headphones on, I always leave one off because once I hear the slightest bit of brake, I'm always looking Yesterday there were dogs on the loose and bit some kids. So that's scary, but I don't even walk in Kahuku. I've seen tourists driving on the bike path.

		If an oncoming car comes and one of those cars that are parked on the side of the road is block them from seeing you, that could be really dangerous.
Street amenities (i.e. sidewalk, defined shoulder, bike lane or crosswalk)	I think promoting awareness with the City and County so we can have sidewalks to walk safely…and if they (City and County) could put lines up. It's cool that we have bike lanes and sometimes I'll ride with my kids and I'll go in the bike lane.	There's no solid line or dotted lines for driving lanes or shoulders. If you want to exercise or walk with your family or run with your stroller there's really not anywhere safe. I didn't take any pictures at night, but even at night the street lights are really dim. Some lights don't even work. There's no sidewalk on the main road up at the Point. We're constantly fighting traffic, and the grass that we're supposed to be walking on, to say off the road, isn't always mowed. Like right now, it's up to your knees so then it forces you to walk on the road… There are no sidewalks that go up the main road to my house
Economic factors	If we have a rec center it may not be as expensive *(as existing pay-for-use facilities)*	We end up having to go to these expensive places if we want to have a good workout in an organized setting in a class, with teachers. It's expensive to work out at these places

Cultural facilitator	I have drums *(Tahitian and Samoan drums)* that I can use to stay physically active. I practice in a group or by myself.	
Social norms	People in our community are still creative in how they are able to be physically active	This is a picture of my car. I work at *[employer omitted]*- basically my backyard, but I drive my car to work even though I live so close. I don't know anyone who doesn't have a car. It's out mode of transportation. It takes us where we need to go, faster. I drive to the bike path so I can walk on the bike path.

Barriers to Physical Activity

A total of three major themes (safety, availability, and accessibility) emerged that were related to barriers to physical activity. Additional barrier themes included hygiene, social norms, and natural elements. The most common theme among barriers was perceived safety. The findings were consistent with results from other studies that identified physical activity barriers for rural communities. Seguin et al. (2014) found that residents felt unsafe to be physically active in their neighborhood because of poor street safety features. This was also the case with some participants in this Photovoice study:

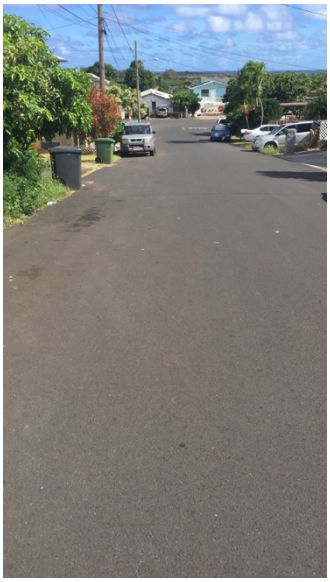
Figure 9. Tall Weeds on Street Shoulder

"There's no sidewalk on the main road up at the Point. We're constantly fighting traffic, and the grass that we're supposed to be walking on, to say off the road, isn't always mowed. Like right now, it's up to your knees so then it forces you to walk on the road and causes a safety hazard."-Female

Another participant noted that:

> *"Getting to the bike path is an issue for me. I drive to the bike path so then I can walk on the bike path. I mean, that's two separate things to get to the bike path. I drive to get to the bike path, to walk on the bike path." -Male*

Figures 9-16 depict a variety of safety barriers that prevent participants from physical activity. The street in Figure 1 normally turns into a single-lane road when cars are parked on both sides of the road, making it extremely unsafe for pedestrians. Although there are marked bike lanes on some streets, vehicles can often be found parked in the bike lane (Figure 2), obstructing views for bicyclists and drivers who may be exiting their driveway. This forces bicyclists to ride in the road or on the sidewalk. Similarly, when vehicles obstruct sidewalks, pedestrians are forced to walk in the bike lane or on the road.

Figure 10. Cars parked on road	Figure 11. Obstructed bike lane
	
"If you want to exercise or walk with your family or run with your stroller, there's really not any safety. If an oncoming car comes and one of those cars that are parked on the side of the road is blocking them from seeing you that could be really dangerous. So that was my issue. Just feeling safe taking a walk in your own community would be the issue."-Female	*"They're constantly parking in the bike lane. And your car either goes on the sidewalk or it goes in the bike lane. So it gets a little tricky, at least in the morning, everyone's aware because there are kids out so everyone's looking out. So that kind of concerns me." -Female*

The lack of existing crosswalks, crosswalks, and the poor condition of existing amenities was well documented by the participants. One participant, who works at the local high school, photographed the existing track around the football field (Figure 12) to show potential safety hazards from using the facility. It is a dirt track, unlike tracks at other Department of Education high schools that are typically made of all-weather synthetic materials. The track is used by community members, but the participant who took the photograph stated that it was unsafe because it was not level – full of potholes, which was a safety concern.

Figure 12. Kahuku High School & Intermediate track

"I see this every day. I see a lot of student running it, I see parents, people from the community also walking on this dirt track. Students practice (track) on it. I see this as a huge barrier because of all the potholes and rocks that are on this track field."-Male

With limited options for recreational physical activity, some residents and high school athletic teams use the Malaekahana Bike Path (Figure 13), or the shoulder of Kamehameha Highway. One participant recalled how dangerous it is to run along a highway where the speed limit is 35 miles per hour.

> *"We used to run on the shoulder of Kam Highway for volley and one of the girls was waving to somebody driving, a friend. And that caused a car accident because the car stopped."-Female*

There are several public beaches in the community (Malaekahana, Hukilau, Kakela, La'ie Beach Park, Kokololio, and Hau'ula Beach Park). However, the parking lots at these beaches are prime locations for theft. Figure 14 was selected because the participant always worries about someone breaking into his vehicle when he goes to the beach. He would go to the beach more often if he could feel safe after leaving his vehicle in the parking lot.

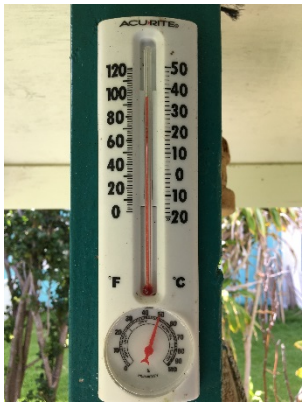
Figure 13. Malaekahana Bike Path – no guard rail	Figure 14. Beach theft safety sign
	
"The issue was the lack of a guardrail. There's not a guardrail that runs along that would protect the bike path. I've seen a lot of cars swerve off to the side. So I thought that was a huge barrier for me running on the bike path" -Male	*"The first sign is just the rules of the park and the second one is "prevent theft and break-ins". Especially over there, I never leave my car because I feel it can get broken into. That's what I feel like, just the thought of leaving my car that far away." -Male*

Figure 15 depicts how the participant was limited from walking to the grocery store because there was no direct access point to cross Kamehameha Highway. The participant who took the photograph noted that their area does not have sidewalks or crosswalks that lead directly to Foodland, even though it would take less than three minutes to walk there from their house. The lack of sidewalks and crosswalks, and no direct access point, forces the participant to drive to the grocery store. Figure 16 was selected because the participant wanted to show that streets in the neighborhood do not have sidewalks for residents to use. Similar to Figure 9, the street in Figure 16 does not have marked shoulders and is a safety concern when vehicles are parked on both sides of the road, not allowing any space for pedestrians or bicyclists.

The weather – specifically, the temperature and humidity, was also identified as a barrier (Figure 17). Participants compared the one-mile Malaekahana Bike Path to the roughly four-mile bike path in Sunset, which in some areas, is shaded by trees. Participants suggested that trees could be planted along the bike path and along sidewalks to provide shade for pedestrians and bicyclists.

Figure 15. No direct access to Foodland	Figure 16. No sidewalks
	
"Foodland is literally 10 steps from our house if we walk down the stairs, but since we're up on the Point and Foodland is down there, we feel the need to drive down to Foodland. So 90% of the time we need to go down to the shopping center we'll always drive." -Female	*"I took a picture of the road and part of the problem is all the cars. If I want to work out in the morning, it would be at like 6:00 AM and all the cars are lined on the side of the road." -Female*

Figure 17. Outdoor thermometer



"It gets so hot and humid that, that's like a big deterrent. I'll try and wait until it gets cooler in the evenings, but by then life just gets busy and it never happens. So having options, like facilities where we're not as worried about the weather." -Female

One participant, who works in a building that has multiple floors, always opts to take the elevators instead of the stairs (Figure 18). Taking the elevator up one floor is acceptable and "is considered normal, at work." It is also socially accepted for someone in the community to drive to work, even though it may only be a few blocks away. Driving, even short distances, has been normalized in this community (Figure 19).

Figure 18. Lobby elevator

"This picture is at work. I face this every morning when I walk into the lobby. I always take the elevator just to get up to the second floor."-Female

"What contributes to use not being more physically active is like, we tend to turn towards what's more convenient. Like turning to an elevator, it's something that makes it more convenient, instead of using options that would be better for our health." -Female

Figure 19. Vehicle to drive to work

"This is a picture of my car. I work at [employer omitted]- basically my backyard, but I drive my car to work even though I live so close. I don't know anyone who doesn't have a car. It's out mode of transportation. It takes us where we need to go, faster." -Female

One participant suggested that an empty lot that is not allowed for public use, was a barrier to being physically active (Figure 20). She also expresses that membership fees at local facilities may not be affordable for all residents.

Figure 20. Empty lot

"To me this is a barrier. Not being able to use this open area, and not having a rec(reactional) center to be physically active because there's nowhere else to workout at in a facility (in La'ie). We end up having to go to expensive places if we want to have a good workout in an organized setting or in a class." – Female

Facilitators and Supports to Physical Activity

Major themes that emerged as facilitators to physical activity were: availability of outdoor amenities, and accessibility. There were also recreational facilities in the area that

participants identified as facilitators to being physically active (Figures 21 and 22). The fitness center at Turtle Bay (Figure 21) is open from 6 am – 10 pm and requires a 24-hour fitness card to access it after regular hours. Spin classes, yoga, and aerobics are offered at Turtle Bay for a $120 per month membership fee. Free weights, stationary bicycles, and machines are also available in the fitness room. The facility is also an indoor and air-conditioned facility, unlike Koʻolau CrossFit in Kahuku.

Figure 21. Turtle Bay Resort fitness room

"I took a picture of the fitness room at Turtle Bay. It's a place that I work out at and they have a lot of organized classes, which is why I really like it." – Female

Figure 22. BYU-H Fitness Center bulletin board

"I took a picture of the BYU-H Fitness Center bulletin board because there are announcements for classes and it's free (for faculty, staff and students). It's nice because there are treadmills, free weights, and machines to use." – Female

A participant who is employed at BYU-H photographed a bulletin board of activity announcements outside of the fitness center (Figure 22). The BYU-H fitness center hours vary by semester. Since it is the only fitness center on campus, the schedule changes to accommodate physical education classes during the school semester. The Turtle Bay Resort fitness room and the BYU-H fitness center are both indoor and air-conditioned facilities.

According to an environmental assessment of the three towns observed, Laʻie had the highest amount of street segments with sidewalks and bike lanes (Hafoka, 2017). One participant in Laʻie has a sidewalk in front of their house and uses it to daily for walking to places (Figure

23). This sidewalk also connects with other sidewalks and crosswalks throughout the town. Walking among participants was facilitated by the availability and accessibility to sidewalks along with the connectivity of those sidewalks to parks, grocery stores, and other destinations.

Figure 23. Sidewalk outside of participant's house	Figure 24. Park and playground
	
"We live on one of the few streets that do have sidewalks. So, we really enjoy that. My kids ride their bikes to school. They ride on the sidewalk, then when they get on Kulanui Street, it depends. If it's busy on the sidewalk they on in the bike lane." – Female	*"This is a playground by the La'ie temple. We have a tendency to gravitate to either parks or the beach and this allows my kids to be physically active and for me to be physically active with them." – Female*

Figure 24 was selected to show that playgrounds designed for children also can be an opportunity for adults to be physically active by walking to the park, and by using the green space available for exercise. To one participant, her children were facilitators to being physically active. Since her children like to go to the park, she often takes them there, which then in turn allows her to be physically active. A female participants photographed a Trailhead close to her house, which she uses regularly with her family (Figure 25).

Figure 25. Trailhead

This is the trailhead that goes up the mountain to the bunkers and the pond. We get some exercise just walking up to the top of the mountain. – Female

Since many community members work at the Polynesian Cultural Center, many are involved in performing cultural numbers (i.e., dancing and drumming) as part of their employment. One participant, who drums for cultural (e.g., Tahitian and Samoan) dances shared how he stays active in Figure 26. Another participant took a picture of a stairwell at her workplace that she uses sometimes instead of riding the elevator (Figure 27).

Figure 26. Drums

"I have drums (Tahitian and Samoan drums) that I can use to stay physically active. I practice in a group or by myself." – Male

Figure 27. Stairwell at workplace

"This is the stairs at work that I use sometimes instead of riding the elevator. I can use it more and leave the elevator for people who can't get up and down easily and those in wheelchairs." – Female

Barriers and Facilitators Overlap

The participants' perceptions of barriers and facilitators are unique in that they are community-specific. What may be viewed as a facilitator to being physically active could also be viewed as a barrier at times (Walia & Liepert, 2012). For example, the bike path was observed as a facilitator that participants could use to be physically active, but it was also seen as a barrier because of a perceived safety issue – no guardrail to serve as a physical barrier between bike path and Kamehameha Highway (see Figure 13).

> *"That's the thing with the bike path. Once you get there there's no parking anywhere, so you have to park on the road. And sometimes people don't want to park on the side of Kam Highway because it's a parking lot. You feel like you have to park further, then walk. You know, it's just a little bit more inconvenient even though it's there to help us be active." -Female*

The beach was also observed as both a facilitator and barrier. There are public beaches that are available in these communities, and easily accessible. However, signage at public beaches indicate a high incidence of vehicle break-ins (see Figure 14). In addition, marked bike lanes provide opportunities for residents to use their bicycles. Study participants have used the designated lanes for travel close to their home. However, some residents park their vehicles on the side of the road, with part of the vehicle obstructing the bike lane (see Figure 11). There are also some parts in the community where bike lanes were created, and then covered over by other lanes – making it confusing for cyclists. One participant photographed a bike lane at her workplace (Figure 28) which was confusing because it looked like a bike lane, but also included other markings.

Figure 28. Bike lane or no parking lines

"This is a picture of a bike lane right by my work and I could ride my bike around there. But they drew lines through it. So, I feel that's a barrier because it's confusing. You can't tell if there's still a bike lane because of the construction that's going on. I can see how someone can be confused about it, and it could discourage people from using it." – Female

Some of the sidewalks also have a grass buffer that spaces the sidewalk from vehicular traffic. Participants use it to travel to work, school, the beach, and to the grocery store. However, it has also been obstructed by vehicles, just as the bike lane has been (Figure 29).

Figure 29. Vehicle parked on sidewalk

"I hope this isn't somebody's car, but they're parking on the sidewalk. So there's this sidewalk, but for whatever reason, he's parking on the sidewalk. So when you're walking with a stroller and you have to wait, stop, and go around on the grass. They did the right thing by

Figure 30. CrossFit Koʻolau

"It's a place we can work out because we don't have any gyms here in Laʻie. So at least it's something. I also see it as a barrier because if you live in Laʻie or Hauʻula, you have to drive to Kahuku, and it's expensive to work out there." -Female

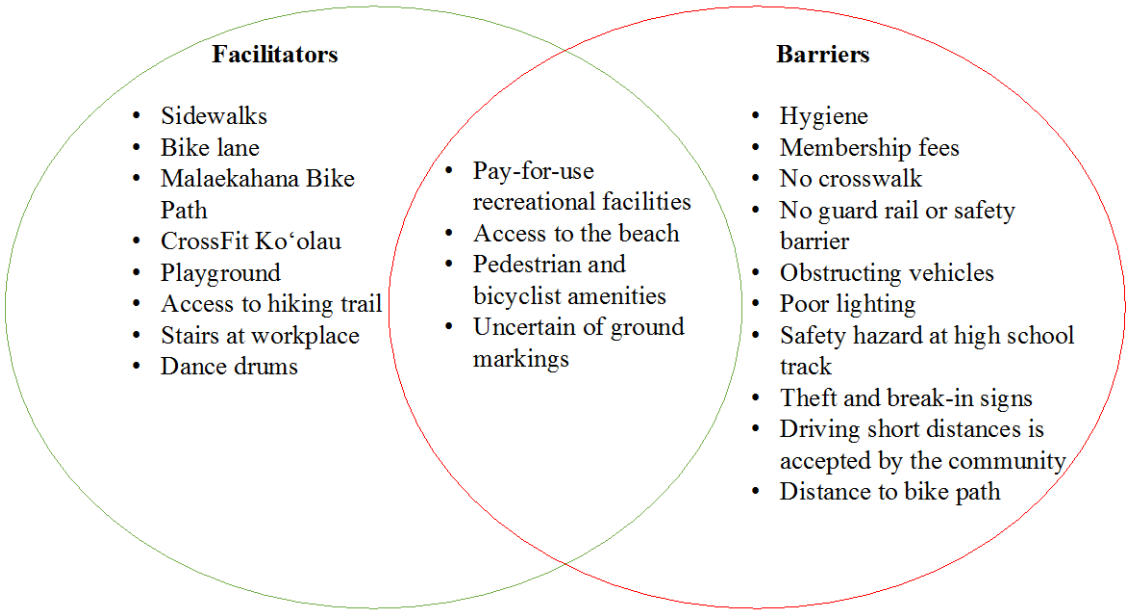
making the sidewalk, but I can't even fully use the sidewalk" – Male	

There is one CrossFit box in the area – CrossFit Koʻolau (Figure 30). It offers instructor-led classes early in the morning (5 AM, 6 AM, and 8 AM) and in the evening (5 PM and 6 PM) from Monday to Friday. On Saturday, it is open from 8 AM to 10 AM. It is open to the public and is in an area that is easily accessible within the community. The CrossFit facility was observed as a facilitator to physical activity because it is available for all adults, with occasional classes for elementary-age children. The membership fee (Table 27) was considered a barrier, as it may not be affordable for all community members. This was also observed in other Photovoice studies where participants had access to recreational facilities, but could not enroll because of membership fees (Richter, Wilcox, Greaney & et al., 2002; Romero 2005; Salmon, Owen, Crawford & et al., 2003). It is also important to remember that median household incomes in Kahuku and Hauʻula were lower than that of the state, and the median household income in Laʻie was much higher than the state median. The high membership fees at Crossfit Koʻolau and Turtle Bay may not be attractive or affordable to all community members (Table 26). One participant stated that the environment at the CrossFit box may be a barrier to working out there – the individual did not want to work out there because she felt she would be intimidated by others working out at the box.

Table 26. Crossfit Koʻolau membership fees

Unlimited classes	$120
Couples unlimited classes	$180
Student (unlimited)	$65 for 3 months
Military (unlimited)	$100

Figure 31. Facilitators, barriers, and overlapping perceptions.



Adapted from Walia & Liepert (2012)

Theme Differences by Town

The distance between Kahuku and Hauʻula's town centers is roughly six miles. The close distance between the three towns allows community members to use any available facilities within the area, not just within their town. This has allowed participants to identify barriers and facilitators in the town where they live, and in neighboring towns.

Nearly half of the photographs in Kahuku were identified as facilitators to being physically active Most of the facilitators were physical facilities (Turtle Bay, CrossFit Koolau, and the Malaekahana Bike Path). All three physical facilities were also expressed as barriers according to participants. Table 27 show what participants identified facilitators and barriers in Kahuku.

Table 27. Kahuku categories

Kahuku		
Facilitators (n=1)	Barriers (n=5)	Both (n=4)
• Stairs at work	• No sidewalk (2) • Car • Elevator at work • Dirt track	• Turtle Bay Fitenss Room • CrossFit Koolau • Malaekahana Bike Path • Beach theft sign

Participants identified five facilitators to being physically active in Laʻie. Six barriers were identified, and one photograph expressed both a facilitator and barrier to being physically active. Table 28 show the breakdown in Laʻie.

Table 28. Laʻie categories

Laʻie		
Facilitators (n=5)	Barriers (n=6)	Both (n=1)
• Sidewalk (2) • Cultural drums • Fitness class • Park with playground equipment	• Cars parked on sidewalk • Vehicle parked in bike lane • Temperature/weather • Space but no equipment • Shrubbery making street should inaccessible • No crosswalk	• Bike lane not clearly marked

More facilitators (n=3) were identified than barriers (n=2) in Hauʻula. Participants identified sidewalks and a hiking trail, as well as poor lighting and cars parked on a sidewalk, which was also a barrier in Laʻie. Table 29 shows the photograph categories as identified by the participants.

Table 29. Hauʻula categories

Hauʻula		
Facilitators (n=3)	Barriers (n=2)	Both (n=0)
• Sidewalk (2) • Trailhead	• Poorly lit sidewalk • Cars parked on sidewalk	

Most of the photographs were located in La‘ie (n=12, 44.4%; Table 30). The most facilitators were identified in La‘ie (n=5). The most barriers were also identified in La‘ie (n=6), and most photographs identified as both barriers and facilitators were located in Kahuku (n=4).

Table 30. Photographs by category and town

	Kahuku (n=10)	La‘ie (n=12)	Hau‘ula (n=5)	Total (n=27)
Facilitators	1	5	3	9
Barriers	5	6	2	14
Barrier and Facilitator	4	1	0	4

Action Items

There were four main action items and ideas generated by the participants during the Photovoice sessions were:

- Identify and disseminate information on existing programs within the community that provide opportunities for physical activity. These programs include a yoga class on the beach, a kickboxing and Jiu Jitsu class, a “Walk with the Doc” program that uses the Malaekahana Bike Path, and free Zumba classes held at churches in the community.

  “In the BYU parking lot there are always groups of people walking in the parking lot because that’s the only space to be able to run or whatever. In the past we’ve gone there to lift weights. There are groups that have been created that use resources that we do have. There have a kickboxing class at [John’s] house. And a Jiu Jitsu class, and yoga on the beach.” – Female

- Contact BYU-H representatives to add outdoor exercise equipment across campus. Some participants recalled a time when exercise equipment was placed at several different locations across BYU-H’s campus. Those participants would like to see if BYU-H can bring something similar back to campus for community members.

"Remember when BYU-H used to have equipment like Kapiolani Park? They probably had 20 stations all around campus. Pull up bar and all kinds of things. And I don't know why they took it out. We were little kids. It would be nice if BYU-H could put those back in." -Male

- Contact representatives at Honolulu City & County and the State Department of Transportation offices. Participants expressed interest in contacting local elected officials to voice their concerns to address some of the barriers they identified in this project (cars parking in bike lanes and sidewalks, creating more sidewalks and crosswalks, creating a physical barrier between Kamehameha Highway and the Malaekahana Bike Path, and making improvements to local parks [adding lights to use at night] and high school [improve current track conditions])

  "I think promoting awareness and communicating with the City and County, so we would be able to have sidewalks to walk safely and for the City and County if they could put the street lines up so everybody knows the streets and shoulders."

  "People in our community are still creative in how they are able to be physically active."

- Create workplace policies that would promote physical activity. Although the community's largest employers (BYU-H, the Polynesian Cultural Center, and Department of Education schools) can be accessed by using public transportation, walking, or bicycling, most employees drive to work.

  Worksite programs and incentives could be offered for employees. Some participants expressed concerns about showing up to work sweaty if they decided to ride the bike or walk that morning.

  "For me, I walk to work but I don't like to do it. It's not that I'm lazy, it's that I don't want to be sweaty all day at work. I'm going to be there 8 hours and I don't want to be sweaty and smell. It's not necessarily being lazy at times, part of it is more hygiene." -Female

Showers could also be something that worksites could look at if hygiene is something that would prevent employees from being my physically active. Participants suggested that employers reserve escalators strictly for people who are disabled.

"What if, at work and other public places, elevators were only allowed for people who were disabled and everybody else had to walk upstairs? Something to promote physical activity at work."

DISCUSSION

The purpose of this study was to engage NHPIs in identifying barriers and facilitators to physical activity in their community. To the knowledge of the student researcher, this study is the first to examine barriers and facilitators to physical activity from the lens of NHPIs using Photovoice. The results provide insight of what NHPIs perceived as barriers and facilitators to being physically active in their rural community. Findings can be used to examine potential environmental changes to improve security, access, and availability for physical activity opportunities. Although participants and pictures were from different towns, the themes that emerged from their photographs were similar.

Some of the barriers that participants identified were similar to barriers found in previous studies examining non-urban areas such as feeling unsafe, the lack of recreational facilities, sidewalks, and bicycling facilities (Findholt, Michael, Davis & et al., 2010, Walia & Liepert, 2012; Yousefian et al., 2009). Of the three towns observed, La'ie had the highest median income ($86,731). Some of the facilitators which were identified in La'ie are consistent with studies where areas with higher income levels have, such as sidewalks and safer active transportation environment around schools (Gibbs, Slater, Nicholson & et al., 2012).

One limitation to this study was that there were only 13 participants. Although a review of 37 Photovoice studies by Catalini and Minkler (2010) found a median of 13 participants, the limited sample size suggests that all the community's perceived barriers and facilitators to physical activity may not have been captured. The results may not be generalizable to other NHPI populations, as this participants in this study were all married – non-married adults may perceive differences in barriers and facilitators to being physically active in their community.

Even with the limited sample size, similar photograph selections and agreement during discussions suggest that participants were able to portray a comprehensive view on what they perceived as barriers and facilitators to physical activity. This led the student researcher to believe that data saturation was achieved with the group discussion and the similar photographs selected and discussed (Fusch & Ness, 2015). Since the observed towns are small, the number of participants was also sufficient for data saturation rather than diversity – where more participants would have been needed in a larger community/town setting (Nykiforuk et al., 2011).

The most notable strength to this study was that community perceptions were obtained using a qualitative method. Unlike quantitative methods such as a questionnaire, the participant's responses may not illustrate the real magnitude or meaning of their perception. The discussions and descriptions of the photographs provided valuable insight to the barriers and facilitators perceived by the community, which may not have been achieved if a quantitative method was used.

Another strength was that the barriers, facilitators, and emerging themes were identified by the participants instead of the researcher. Though the themes supported previous research about the built environment in rural areas, there were also community-specific themes that emerged from the participants.

All three towns are located along the north and northeast shores of the island, giving residents access to public beaches in the area. However, very little mention was made by the participants of the beach being used for physical activity. One participant photographed a warning sign in a beach parking lot. Another participant stated that parking was also an issue:

> *"Whenever I tell people from the mainland I live in Hawai'i they trip out and say, 'oh you go to the beach every day' and I'm like, 'maybe once every four months.' Part of that is there's tons of cars. Like Hukilau, if I go on a Saturday there's ton of cars parked there." -Male*

Participants discussed indoor facilities at BYU-H and how students and faculty can use it. The university has an indoor gym, indoor basketball courts, outdoor tennis courts, and an outdoor swimming pool that could greatly benefit the community. It is not open to the public, however, there may be opportunities to discuss possible agreements with the university to use their recreational facilities. BYU-H recently eliminated all collegiate sports programs but have still maintained their sports facilities. A "joint use agreement" (JUA) can be a formal or informal agreement between a school and the community to use facilities conducive to physical activity (Young, Spengler, Frost & et al., 2014). Healthy People 2020 Objective PA-10 (2010) calls for efforts to:

> Increase the proportion of the Nation's public and private schools that provide access to their physical activity spaces and facilities for all persons outside of normal school hours (that is, before and after the school day, on weekends, and during summer and other vacations).

A study by Maddock et al. (2008) on Oahu examined the implementation of a JUA with high school facilities located in a low-income and high immigrant area of Honolulu. The JUA increased opportunities for physical activity, but also provided other benefits such as making new friends, kept youth out of trouble, and promoted healthy lifestyles (Maddock

et al., 2008). If similar benefits could be replicated in the observed communities, a JUA with BYU-H should be a priority among community members.

In Kaneohe, James B. Castle High School received upgrades to their high school football field and track. The high school in Kahuku could also use some upgrades, as one participant noted that the track surrounding the football field was not safe to use (Figure 3). When talking about the facility improvements at Castle High School, Former Hawai‘i Governor, Neil Abercrombie noted that “our facilities average 65 years in age” (Hawai‘i News Now). It was also reported that the upgrades at Castle High School took 10 years to be planned, constructed, and completed. With unsafe conditions at the Kahuku High and Intermediate track, the community can explore Kaneohe’s successes in implementing improvements to their local high school facilities.

The discussion proved to be insightful, as participants explained that although they may have focused more on barriers in their community, there are still several opportunities to be physically active in the community (e.g., walking to the park, lift weights at a neighbor’s house, walking or bicycling to work; Figure 32).

Figure 32. Home gym

“I took a picture of this because there are places in the community where you can work out. This is my cousin’s house.”

“I see in our community, because we don’t have a lot of resources, people still find ways to be physically active or to workout regardless of what we have”

Being heavily reliant on automobiles for travel has also been noted in other studies examining the built environment in rural and small-town settings – resulting in a "car culture" (Shearer, Blanchard, Kirk & et al., 2012; Stewart, Vernez Moudon, Saelens & et al., 2016; Zhang, Holt, Lu & et al., 2014). The observed communities could apply recommendations by Brownson et al. (2005), which encouraged low cost interventions such as painting a new crosswalk or adding public art to the Malaekahana bike path, instead of expensive infrastructure improvements, to increase walking behavior in rural and small towns.

CONCLUSION

The results have added to the existing literature by examining the perspective from a community with a high proportion of NHPIs. The findings from this study emphasize how the social ecological model and environmental factors can influence physical activity behaviors in this community and how there are many layers to improving physical activity behaviors. The findings also support the need to do more research in NHPI populations to find community-specific barriers and facilitators to being physically active. For example, in this community, even though there was a sidewalk or bike lane available in a participant's neighborhood, they did not necessarily use it because of the behaviors of other community members (parking their vehicles on the sidewalk or in the bike lane) and their perception of safety. Another finding, as presented by the Photovoice participants, is that it is very common for community members to use their vehicles, even for short (less than 5 minutes) trips.

It has been well documented that residents in rural areas are heavily dependent on automobiles for employment, healthcare services, and social inclusion (Hanson & Hildebrand, 2011; Osti, 2010; Soder & Peer, 2017). In the observed community, their vehicles were used for short trips around town:

> *I work at [employer omitted]- basically my backyard, but I drive my car to work even though I live so close. I don't know anyone who doesn't have a car. It's out mode of transportation. It takes us where we need to go, faster*. -Female

> *Foodland is literally 10 steps from our house if we walk down the stairs, but since we're up on the Point and Foodland is down there, we feel the need to drive down to Foodland. So, 90% of the time we need to go down to the shopping center we'll always drive.* -Female

A collaborative effort will be needed to address and eliminate the barriers identified and to promote the identified facilitators from this study. Harding et al. (2017) identified that Malaekahana bike path as an intervention that has increased walking and biking in the community. Since these communities are outside of urban Honolulu, but still under Honolulu City & County jurisdiction, partnering with private organizations is important for environmental interventions. Recreational facilities may not seem reasonable for city officials since Kahuku and Hauʻula may not provide enough financial support to maintain such a facility. The Malaekahana bike path was created by partnering with private land owners, which emphasizes the need for this type of continual collaboration in this community.

One unique aspect of this community is that several community members work at the Polynesian Cultural Center, and may be involved in cultural activities (e.g., dancing, singing, and drumming). As one participant noted, he can practice drumming to stay physically active. Community members can be physically active by practicing cultural dances (e.g., hula) and sharing those talents with other community members (Albright, Mau, Choy & et al., 2017).

Although participants identified more barriers than facilitators to being physically active, community member still find ways to be physically active, as expressed by the results in Chapter 1.

Future research should include participants from multiple sectors (government, community and private stakeholders) and various age groups (children, adolescents and older

adults) to get their perspective on what may prohibit or promote physical activity for them. Findings will be useful in identifying specific interventions across different environments in the social ecological model.

It is also recommended that future studies use qualitative methods to examine specific domains (work, home, garden, and leisure) of physical activity, and how those barriers can be overcome by local community efforts. For example, there have been efforts in the community that have already been recognized by the participants of this study. Community-led programs include a yoga class on the beach, a "Walk with a Doc" program that uses the Malaekahana Bike Path, a paddling group (at Kahana Bay), and a jiu jitsu and kickboxing class held in a car port. Since Kahuku, La'ie, and Hau'ula public roads and walkways fall under jurisdiction of Honolulu City & County (HC&C), working with government officials may be cumbersome – traveling to the HC&C offices, or to the observed towns for county officials, may not be feasible. Creating sidewalks, crosswalks, and other amenities may take much longer than communities are expecting – thus, having community-led and volunteer programs can be one way to work around some of the existing barriers in the community.

Parking vehicles on a sidewalk or bike lane is something that could be addressed at a town level before looking for a parking enforcement policy from HC&C. Raising concerns about this issue can be discussed at community association meetings. For this purpose, any future research should include input and participants from different sectors of the community (a member from the community association, a school official, parents of school-age children, older-age adult, and children).

There has been minimal research about NHPIs and their perceptions of the environment as it relates to physical activity barriers and facilitators. The results from this study reflect the

need for different sectors to collaborate in creating a healthy environment that promotes physical activity and adds to the existing literature in taking a social ecological approach to improve physical activity behaviors.

Chapter 5: Conclusion

The purpose of this dissertation was to identify the physical activity status of NHPI and their perceptions of the environment, assess their active living environment, and identify community barriers and facilitators to being physically active. The three research questions and studies aimed to use the social ecological model as a framework Data for the first research question was gathered by combining the IPAQ and RALPESS tools. The aim for RQ1 was to identify associations between perceptions of the environment and meeting physical activity recommendations. Over 300 community members completed the IPAQ-RALPESS survey. The RALA Tools were used in RQ2 to assess the observed community's active living environment. The aim was to assess community amenities, programs and policies that promote physical activity. The objective of RQ3 was to take a participatory approach to identify community perceptions of the environment and how it affected their physical activity behavior. The Photovoice methodology was used in RQ3 and meetings were held to discuss photographs and identify themes they thought were important to their community.

Summary of Findings

Chapter two analyzed data from 311 participants. Data was collected by using a paper survey, and then as requested by the community, an electronic version of the same survey. The IPAQ was used to capture physical activity data and the RALPESS captured perceptions of the environment. Physical activity status was dichotomized into "Meets physical activity recommendations" and "Does not meet physical activity recommendations," which was defined as achieving at least 150 minutes of physical activity in the past seven days. Just over 87% (n=271) of particpants met physically activity recommendations. Participants achieved the most minutes of physical activity as part of their work and the least amount of physical activity in

active transportation. Items from the RALPESS were also dichotomized to “Agree” and “Disagree” and logistic regression models were produced to examine odds ratios. Participants who agreed that there were outdoor equipment in the Town Center had an odds of more than two (2.314 [1.088, 4922], p=.029) of meeting physical activity recommendations.

The purpose of chapter three was to examine the environment of the three towns individually to see how it promoted physical activity by using the RALA Tools. Kahuku scored the highest in the Town Wide Assessment (83/100). La‘ie scored the highest in the Policy and Program Assessment (72/100) and 60 total street segments were objectively assessed for selected features and amenities. According to the Street Segment Assessement, three items expressed differences between the three towns: sidewalk shoulders and buffers, crosswalks, and connectivity of sidewalks and crosswalks; La‘ie had the highest frequency of active transport amenities and facilities. Existing policies have not yet benefited the observed community. Since the three towns do not have a town-government, they all fall under the jurisdiction of the Honolulu City & County. Existing policies have not yet focused on rural areas and currently seem to only benefit more urban areas.

Chapter four focused on identifying facilitators and barriers to being physically active within the community by using the Photovoice method. Thirteen participants were purposefully recruited for the study. Over a three-week period, participants selected 27 photographs and collaboratively identified themes that influenced their physical activity behavior. The barriers and facilitators identified by the participants spanned across all environments of the social ecological model.

Recommendations

The main finding from this dissertation is that even with a lack of recreational facilities and amenities, the community is still very physically active. This may be as a result of the social environment in the community. To build on the findings from the three studies, future research is needed to further fill gaps that were identified in this dissertation. These gaps were specific to this community and is specific to NHPI populations.

Recommendations for chapter two will include capturing specific physical activity within a domain and within a cultural context. Future studies should include physical activity for cultural activities and events such as weddings, funerals, birthday parties, and church functions. It is very common for NHPI families to lease land to cultivate root crops, bananas, breadfruit and other crops commonly found throughout the Pacific. More research should be done to examine culturally-specific areas where physical activity might be achieved. The social environment of the social ecological model should be focused on in future resarch of this population. It is also recommended that more work focus on the churches in the community, as they may possibly be one of the factors that have assisted in women agreeing to RALPESS items in Church Areas – open to the public,

As recommended in study two, findings from chapter three suggest more research should be done to examine physical activity by NHPI within a cultural context. The RALA in chapter three examined the active living environment. Future research should examine the food environment and cultural practices around certain types of foods. A better understanding of the social and cultural environment may help to better understand how to create and target interventions to reduce NCDs among NHPI. A modified tool could help to identify household items that could promote physical activity (e.g., bicycle, farming tools and sports equipment).

Although these items are not part of the built environment, it will capture items that may give a greater insight to the social environment of the community.

The Photovoice proved to be very helpful in identifying barriers and facilitators to being physically active across all environments of the social ecological model. As the "community experts," participants were able to provide an "insider" perspective to what they perceived as influencers to being physically active. Most of the barriers and facilitators were identified as amenities and facilities, of which most of the discussion was about. Very limited photographs were taken about social norms in the community, which led to limited discussions around the social enviornment. As an overall recommendation from the findings from this dissertation, a closer look thould be taken to identify how social norms in the community influence physical activity behaviors.

Conclusion

This three-study dissertation used the sociall ecological model to examine the physical activity status in a rural community with a high proportion of NHPIs. Despite populaiton reserach indicating that a very low percentage of NHPI meet physical activity recommendations, the conclusions from the three studies indicate otherwise. Chapter two provided data on the current physical activity status of participants – which was high in all domains except Active Transportation. Chapter three presented areas, programs, and policies within each town that support physical activity in the community. Participants in the final study provided a unique perspective of the community's environment through their lenses. Findings in chapter four further emphasize the need for future research to examine the social environment in NHPI communities.

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APPENDIX I. INFORMED CONSENT FORMS

Purpose of Research

You are invited to participate in a research study conducted by Siosaia Hafoka, from the Office of Public Health Studies at the UNIVERSITY OF HAWAII at MANOA. The intent of this survey is to gain a better understanding on the physical activity levels and perceptions of Native Hawaiian and other Pacific Islanders on their built environment, with hopes that the information will identify areas of improvement and provide insights for future programs to promote physical activity. You were selected as a possible participant in this study because you reside in Kahuku, Laʻie or Hauʻula and because you are identified as a Native Hawaiian or other Pacific Islander.

This research study is looking for 300 adults age 18 years and older, with 100 adults each from Kahuku, Laʻie and Kahuku.

Human Risk

There are no known risks or discomfort associated with this survey.

Voluntary Participation

Your participation in this study is entirely voluntary. Your decision not to participate will not have any negative effect on you. You can decide to participate now, and/or withdraw anytime during the questionnaire. Your responses will be kept strictly confidential and any report of this research will not include any information by which you could be identified.

Duration of Study Involvement

If you decide to participate, you will complete the International Physical Activity Questionnaire (IPAQ) and the Rural Active Living Perceived Environment Support Scale (RALPESS). You will require an estimated 15 minutes to complete the 65-item questionnaire.

Freedom of Consent

I have read this Informed Consent form, fully understand its terms, understand that I have given up substantial rights by signing it freely and voluntarily.

If you have any questions about whether you have been treated in an illegal or unethical way, contact the University of Hawaii at Manoa Institutional Review Board (uhirb@hawaii.edu or 808-956-5007).

Participant Signature_____
Participant Name (Print) _____
Date _____

Consent Form

You are invited to participate in a research study conducted by Siosaia Hafoka, from the Office of Public Health Studies at the UNIVERSITY OF HAWAII at MANOA. The intent of this survey is to gain a better understanding on the physical activity levels and perceptions of Native Hawaiian and other Pacific Islanders on their built environment, with hopes that the information will identify areas of improvement, and provide insights for future programs to promote physical activity. You were selected as a possible participant in this study because you reside in Kahuku, Laʻie or Hauʻula and because you are identified as a Native Hawaiian or other Pacific Islander.

Phtovoice is a participatory photographic research method. This study involves taking photographs that represent individual perspectives and lived experiences. These pictures are then shared back with other study participants and discussed to pull out connecting themes.

Human Risk
There are no known risks or discomfort associated with this survey.

Duration of Study Involvement
If you decide to participate, you will meet for a training on Photovoice that will last no more than 90 minutes. Following the training, you will be asked to photograph things in your environment that you perceive as barriers or facilitators to physical activity. Participants will be required to attend all 5 group meetings. Each meeting will be no longer than 90 minutes. The final meeting, where common themes will be discussed, will be audio-recorded.

Freedom of Consent
I have read this Informed Consent form, fully understand its terms, understand that I have given up substantial rights by signing it freely and voluntarily.

If you have any questions about whether you have been treated in an illegal or unethical way, contact the University of Hawaii at Manoa Institutional Review Board (uhirb@hawaii.edu or 808-956-5007).

Participant Signature_____
Participant Name (Print) _____
Date _____

Photovoice Instructions

The purpose of this project is to capture your daily activities to identify what are barriers and supports to physical activity. There is no limit to the number of photographs you can take, however, keep in mind that you will have to select two that you believe are the most important.

When choosing to capture an image, please consider some of the following prompts: How do I get to work? What do I do when I am at work? What kind of housework do I accomplish on a daily or weekly basis? What kind of yard work do I do? How do I spend my weekend? How do I spend my free time? What kind of activities do I do with family and/or friends?

Step 1. Taking the photograph

- Be sure that your smartphone has sufficient battery life to take the photograph, add the description and send it in.
- Check to see if geotagging features have been enabled.
- Images with recognizable faces and/or minors will be discarded.
- Images must be original and taken within the two-week time period.
- Capture an image with your smartphone or digital camera.
    - Check to see if image is clear

Step 2: Describe your photograph immediately after capturing the image

- Please consider the following description prompts:
    - SHOWED: S: What do you SEE here? H: What is really HAPPENING here? O: How does this relate to OUR lives? W: WHY does this problem exist? E: How can we be EMPOWERED by this? D: What can we DO about it?

Step 3: Sending photographs

- Be sure that the photographed image is clear and the description is complete.
- Verify the email address or phone number is correct (shafoka@hawaii.edu, 801-735-4861)
- Verify that your image and description was received.

Step 4: Save all images

- Please save all images and descriptions until after the final meeting and until the facilitator has properly recorded and stored them.

***If at any time you would like to withdraw from this project, or if you have any questions or concerns please contact shafoka@hawaii.edu and/or (801)735-4861.**

APPENDIX II. IPAQ-RALPESS SURVEY
INTERNATIONAL PHYSICAL ACTIVITY QUESTIONNAIRE (IPAQ)

We are interested in finding out about the kinds of physical activities that people do as part of your everyday lives. The questions will ask you about the time you spent being physically active in the **last 7 days**. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport.

Think about all the **vigorous** and **moderate** activities that you did in the **last 7 days**. **Vigorous** physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. **Moderate** activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal.

PART 1: JOB-RELATED PHYSICAL ACTIVITY

The first section is about your work. This includes paid jobs, farming, volunteer work, course work, and any other unpaid work that you did outside your home. Do not include unpaid work you might do around your home, like housework, yard work, general maintenance, and caring for your family. These are asked in Part 3.

1. Do you currently have a job or do any unpaid work outside your home?

   ☐ Yes

   ☐ No → ***Skip to PART 2: TRANSPORTATION***

The next questions are about all the physical activity you did in the **last 7 days** as part of your paid or unpaid work. This does not include traveling to and form work.

2. During the **last 7 days**, on how many days did you do **vigorous** physical activities like heavy lifting, digging, heavy construction, or climbing up stairs **as part of your work**? Think about only those physical activities that you did for at least 10 minutes at a time.

   _____ **days per week**

   ☐ No vigorous job-related physical activity → ***Skip to Question 4***

3. How much time did you usually spend on one of those days doing **vigorous** physical activities as **part of your work**?

_____ **hours per day**
_____ **minutes per day**

4. Again, think about only those physical activities you did for at least 10 minutes at a time. During the **last 7 days**, on how many days did you do **moderate** physical activities like carrying light loads **as part of your work**? Please do not include walking.

   _____ **days per week**

   ☐ No moderate job-related physical activity → ***Skip to Question 6***

5. How much time did you usually spend on one of those days doing **moderate** physical activities as **part of your work**?

   _____ **hours per day**
   _____ **minutes per day**

6. During the **last 7 days**, on how many did you **walk** for at least 10 minutes at a time **as part of your work**? Please do not count any walking you did to travel to or from work.

   _____ **days per week**

   ☐ No job-related walking → ***Skip to PART 2: TRANSPORTATION***

7. How much time did you usually spend on one of those days **walking** as **part of your work**?

   _____ **hours per day**
   _____ **minutes per day**

PART 2: TRANSPORTATION PHYSICAL ACTIVITY

These questions are about how you traveled from place to place, including to places like work, stores, movies, and so on.

8. During the **last 7 days**, on how many days did you **travel in a motor vehicle** like a train, bus, car or tram?

   _____ **days per week**

   ☐ No traveling in a motor vehicle → ***Skip to Question 10***

9. How much time did you usually spend on one of those days **traveling** in a train, bus, car, tram, or other kind of motor vehicle?

   _____ **hours per day**
   _____ **minutes per day**

Now think only about the **bicycling** and **walking** you might have done to travel to and from work, to do errands, or to go from places to place.

10. During the **last 7 days**, on how many days did you **bicycle** for at least 10 minutes at a time to go **from place to place**?

    _____ **days per week**

    ☐ No bicycling from place to place → ***Skip to question 12***

11. How much time did you usually spend on one of those days to **bicycle** from **place to place?**

    _____ **hours per day**
    _____ **minutes per day**

12. During the **last 7 days**, on how many days did you **walk** for at least 10 minutes at a time to go **from place to place**?

    _____ **days per week**

    ☐ No walking from place to place → ***Skip to PART 3: HOUSEWORK, HOUSE MAINTENANCE, AND CARING FOR FAMILY***

13. How much time did you usually spend on one of those days **walking** from place to place?

    _____ **hours per day**
    _____ **minutes per day**

PART 3: HOUSEWORK, HOUSE MAINTENANCE, AND CARING FOR FAMILY

This section is about some of the physical activities you might have done in the **last 7 days** in and around your home, like housework, gardening, yard work, general maintenance work, and caring for your family.

14. Think about only those physical activities that you did for at least 10 minutes at a time. During the **last 7 days**, on how many days did you do **vigorous** physical activities like heavy lifting, chopping wood, shoveling snow, or digging **in the garden or yard**?

_____ **days per week**

☐ No vigorous activity in garden or yard → ***Skip to question 16***

15. How much time did you usually spend on one of those days doing **vigorous** physical activities **in the garden or yard**?

_____ **hours per day**
_____ **minutes per day**

16. Again, think about those physical activities that you did for at least 10 minutes at a time. During the **last 7 days**, on how many days did you do **moderate** activities like carrying light loads, sweeping, washing windows, and raking **in the garden or yard**?

_____ **days per week**

☐ No moderate activity in garden or yard → ***Skip to question 18***

17. How much time did you usually spend on one of those days doing **moderate** physical activities **in the garden or yard**?

_____ **hours per day**
_____ **minutes per day**

18. Once again, think about only those physical activities that you did for at least 10 minutes at a time. During the **last 7 days**, on how many days did you do **moderate** activities like carrying light loads, washing windows, scrubbing floors and sweeping **inside your home**?

_____ **days per week**

☐ No moderate activity inside home → ***Skip to PART 4: RECREATION, SPORT AND LEISURE-TIME PHYSICAL ACTIVITY***

19. How much time did you usually spend on one of those days doing **moderate** physical activities **inside your home**?

_____ **hours per day**
_____ **minutes per day**

PART 4: RECREATION, SPORT, AND LEISURE-TIME PHYSICAL ACTIVITY

This section is about all the physical activities that you did in the **last 7 days** solely for recreation, sport, exercise or leisure. Please do not include any activities you have already mentioned.

20. Not counting any walking you have already mentioned, during the **last 7 days**, on how many days did you **walk** for at least 10 minutes at a time **in your leisure time**?

    _____ **days per week**

    ☐ No walking in leisure time → ***Skip to question 22***

21. How much time did you usually spend on one of those days **walking** in your leisure time?

    _____ **hours per day**
    _____ **minutes per day**

22. Think about only those physical activities that you did for at least 10 minutes at a time. During the **last 7 days**, on how many days did you do **vigorous** physical activities like aerobics, running, fast bicycling, or fast swimming **in your leisure time?**

    _____ **days per week**

    ☐ No vigorous activity in leisure time → ***Skip to question 24***

23. How much time did you usually spend on one of those days doing **vigorous** physical activities **in your leisure time**?

    _____ **hours per day**
    _____ **minutes per day**

24. Again, think about only those physical activities that you did for at least 10 minutes at a time. During the **last 7 days**, on how many days did you do **moderate** physical activities like bicycling at a regular pace, swimming at a regular pace, and doubles tennis **in your leisure time**?

    _____ **days per week**

    ☐ No moderate activity in leisure time → ***Skip to PART 5: TIME SPENT SITTING***

25. How much time did you usually spend on one of those days doing **moderate** physical activities in your leisure time?

    _____ **hours per day**
    _____ **minutes per day**

PART 5: TIME SPENT SITTING

The last questions are about the time you spend sitting while at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading, or sitting or lying down to watch television. Do not include any time spent sitting in a motor vehicle that you have already told me about.

26. During the **last 7 days**, how much time did you usually spend **sitting** on a **weekday**?

    _____ **hours per day**
    _____ **minutes per day**

27. During the **last 7 days**, how much time did you usually spend **sitting** on a **weekend day**?

    _____ **hours per day**
    _____ **minutes per day**

The Rural Active Living Perceived Environment Support Scale (RALPESS)

Directions: This survey asks you questions about your town and the area where you live. There are questions that ask you about the town center, indoor and outdoor exercise areas, community buildings, and sidewalks and roadways.

It should take 15-20 minutes to complete the survey.

Here are some things to think about as you take the survey.

The area around your home – This includes your home and yard; the streets, parks and field around your home, and the homes close to your home.

Your Town – The community or town that is closest to your home **(i.e. where you go to work, to school, or shop)**.

INDOOR exercise areas – think about **indoor** places people use to be active, such as indoor pools, recreation centers, gyms, fitness centers, exercise rooms, sports courts, skate areas or areas

with exercise or sports gear (balls, treadmills, etc.) in your town. These are places you can either get in free or pay to use.

OUTDOOR exercise areas in your town – think about **outdoor** places that are designed for physical activity, such as pools, sports field, sports courts, skate areas, tracks, trails, parks, lakes, rivers, or playgrounds. Please consider all outdoor areas in your town when answering the questions.

- **Public places** are FREE to use, like parks, trails, tracks at schools.
- **Private places** you have to PAY money to use, like private pools, fitness clubs.

These questions have to do with INDOOR AREAS. **Please check one answer for each statement.**	**Strongly Disagree**	**Disagree**	**Agree**	**Strongly Agree**
1. My town has private indoor exercise areas (pay to use).				
2. The indoor exercise areas are nice to use and well kept (there is little or no trash, no broken glass, and equipment works).				
3. The indoor exercise areas in town are generally safe.				
4. My town offers indoor exercise activities (programs, sports teams, classes, lessons, etc).				
5. There is equipment for physical activity or exercise at the indoor exercise areas in my town.				
6. There are choices of activities for physical activity of exercise at the indoor exercise areas in my town.				
These questions have to do with OUTDOOR AREAS **Please check one answer for each statement**	**Strongly Disagree**	**Disagree**	**Agree**	**Strongly Agree**
7. Outdoor exercise areas in my town have available restrooms.				
8. Outdoor exercise areas in my town have water fountains.				
9. There are sufficient police officers or sheriffs patrolling the outdoor				

areas in my town where people could be physically active or exercise.				
These questions have to do with the TOWN CENTER in your community. **Please check one answer for each statement**	**Strongly Disagree**	**Disagree**	**Agree**	**Strongly Agree**
10. There are shopping areas and places to eat in the town center.				
11. There are sidewalks in the town center.				
12. The sidewalks are nice to use in the town center (they are shaded, there are pleasant things to look at, no trash).				
13. The sidewalks are not to use in the town center (they are well kept and not uneven).				
14. The streets are marked where I should cross in the town center or there are crosswalks.				
15. The are around the town center has working streetlights.				
16. There is equipment for physical activity or exercise in the town center at indoor places.				
17. There is equipment for physical activity or exercise in the town center at outdoor places.				
18. There are several choices of activities for physical activity or exercise in the town center.				
These questions have to do with the SCHOOLS in your community. **Please check one answer for each statement.**	**Strongly Disagree**	**Disagree**	**Agree**	**Strongly Agree**
19. The school(s) in my town has playground(s) with equipment.				
20. There is equipment for physical activity or exercise at the school(s).				

21. There are choices of activities for physical activity or exercise at the school(s).				
These questions have to do with the CHURCHES in your community. **Please check one answer for each statement.**	**Strongly Disagree**	**Disagree**	**Agree**	**Strongly Agree**
22. My town has churches with indoor recreational areas for exercise open to the public.				
23. My town has churches with outdoor recreational areas for exercise open to the public.				
24. I can use the indoor church areas for physical activity or exercise.				
25. I can use the outdoor church areas for physical activity or exercise.				
26. Churches in my town offer exercise or physical activity programming or activities.				
27. Churches in my town have public playgrounds with equipment.				
28. Churches in my town encourage exercise or being physically active.				
These questions have to do with AREAS AROUND YOUR HOME. **Please check one answer for each statement.**	**Strongly Disagree**	**Disagree**	**Agree**	**Strongly Agree**
29. There are crosswalks in the area around my home.				
30. The roads around my home have a place to walk or ride a bike next to the road (shoulder, bike lane, built path, etc).				
31. The roads around my home have good lighting.				
32. There are sidewalks on most of the roads in the area around my home.				
33. There are sidewalks in the area I live that connect places so that you can walk from place to place				

	(like connecting a store to the post office).				

What is your age?
____ 18 to 29
____ 30 to 39
____ 40 to 49
____ 50 to 59
____ 60 or older

What is your gender?
____ Male
____ Female
____ Other

What would you say is your ethnicity?
____ Chamorro
____ Fijian
____ Maori
____ Micronesian
____ Native Hawaiian
____ Samoan
____ Tongan
____ Other (please specify): _____

In what county were you born?
_____

If you were not born in the US, how long have you lived here?
_____

What is the highest grade or year of school you completed?
____ Never attended school or only attended kindergarten
____ Grades 1 through 8 (elementary)
____ Grades 9 through 11 (Some high school)
____ Grades 12 or GED (High school graduate)
____ College 1 year to 3 years (Some college or technical school)
____ College 4 years or more (College graduate)

Are you currently…
____ Employed for wages
____ Self-employed
____ Out of work for more than 1 year
____ Out of work for less than 1 year
____ A Homemaker
____ A Student

____ Retired

What is the zip code where you live?

_____