

UTILIZING THE MULTI-THEORY MODEL TO EXPLAIN THE FRUITS AND
VEGETABLES CONSUMPTION OF ASIAN AMERICAN,
NATIVE HAWAIIAN, AND PACIFIC ISLANDER
COLLEGE STUDENTS

By

Noeheelani Cierra Bareng-Antolin

Bachelor of Science in Biological Sciences
University of Nevada, Las Vegas
2011

Master of Public Health
University of Nevada, Las Vegas
2017

A dissertation submitted in partial fulfillment
of the requirements for the

Doctor of Philosophy – Public Health

Social and Behavioral Health
School of Public Health
The Graduate College

University of Nevada, Las Vegas
May 2024

Copyright 2024 Noehealani Cierra Bareng-Antolin
All Rights Reserved



Dissertation Approval

The Graduate College
The University of Nevada, Las Vegas

March 22, 2024

This dissertation prepared by

Nohealani Cierra Bareng-Antolin

entitled

Utilizing the Multi-Theory Model to Explain the Fruits and Vegetables Consumption of Asian American, Native Hawaiian, and Pacific Islander College Student

is approved in partial fulfillment of the requirements for the degree of

Doctor of Philosophy – Public Health
Social and Behavioral Health

Jason Flatt, Ph.D.
Examination Committee Chair

Gabriela Buccini, Ph.D.
Examination Committee Member

Chad Cross, Ph.D.
Examination Committee Member

Manoj Sharma, Ph.D.
Examination Committee Member

Eduardo Robleto, Ph.D.
Graduate College Faculty Representative

Alyssa Crittenden, Ph.D.
*Vice Provost for Graduate Education &
Dean of the Graduate College*

Abstract

The benefits of fruits and vegetables have been well documented. Studies show that adequate consumption of fruits and vegetables can reduce the risk of many chronic diseases. However, many adults are consuming well below the recommended levels of fruits and vegetables (F&V) (< 5 cups daily). The transitional period from adolescence to young adulthood is an important time for the promotion of maintaining healthy dietary habits and lifestyles, as most health behaviors learned during this time may persist into later life. While there are numerous studies on the dietary behaviors in other populations, the existing literature on dietary behaviors among Asian Americans, Native Hawaiians, and Pacific Islanders (AANHPIs) is limited. Therefore, this study aimed to utilize the Multi-Theory Model (MTM) for health behavior change to explain the intention of initiating and sustaining fruits and vegetables among AANHPI college students in the U.S. that express and do not express consuming the daily cups of fruits and vegetables. Using a quantitative cross-sectional survey, data was collected from AANHPI college students over the age of 18 who are currently enrolled at a college or university in the U.S., using a 43-item questionnaire. Multiple regression models were used to analyze data. Of the 436 participants, 54.4% (n=237) reported not consuming the recommended daily five cups of F&V. Two MTM initiation constructs, behavioral confidence (b=0.119, p<0.01), and changes in the physical environment (b=0.061, p=0.004) were shown to be significantly associated with the intent to initiate F&V consumption. This model explained 33.7% of the variance. Furthermore, three MTM sustenance constructs, emotional transformation (b=0.110, p<0.001), practice for change (b=0.070, p=0.012), and changes in the social environment (b=0.065, p=0.005) were shown to be significantly associated with the intent to sustain F&V consumption behaviors and accounted for 31.1% of the variance. Approximately 45.6% (n=199) of participants reported consuming five or

more cups of F&V. Of the three sustenance constructs examined, only emotional transformation ($b=0.122$, $p<0.001$) and practice for change ($b=0.139$, $p<0.001$) were significantly associated with sustaining F&V consumption behaviors and accounted for 32.6% of the variance. It was also found that females had a 76.5% increase in odds of consuming five or more cups of F&V (OR: 1.765, 95% CI, 0.460, 1.173, $p=0.013$) compared with males. Interestingly, participants who lived on campus had an 82% increase in odds of consumption of F&V (OR: 1.82, 95% CI: 1.098, 3.017 $p=0.020$) compared with students living off campus. Lastly, those who expressed higher behavioral confidence had a 1.33 times higher likelihood of consuming adequate cups of F&V. Findings from this study show that the MTM of health behavior change is useful in predicting fruit and vegetable consumption behaviors among AANHPI college students and should be considered when designing culturally tailored theory-based interventions to encourage healthy eating behaviors.

Acknowledgments

A'ohe Hana Nui Ka Alu'ia
(No Task Is Too Big When Done Together)

First and foremost, I would like to express my deepest mahalo nui loa (thanks and gratitude) to my committee chair and advisor, Dr. Jason Flatt. No words can express the amount of gratitude and appreciation I have for you. Your mentorship is invaluable, extending far beyond the sphere of academia. Your guidance has not only shaped my research but has also fostered my personal and professional growth in ways I could never have anticipated. I am grateful for your support, understanding, encouragement, and belief in my abilities.

I would also like to extend my sincerest thanks to my committee members, Dr. Manoj Sharma, Dr. Gabriela Buccini, Dr. Chad Cross, and Dr. Eduardo Robleto. Without the support and guidance of each of you, the completion of my dissertation would not have been possible. I would also like to thank Dr. Carolee Dodge Francis for her continued guidance, mentorship, and support academically and professionally. A special thanks to Dean Gerstenberger for his guidance and mentorship throughout my graduate career.

Furthermore, I would like to acknowledge the financial support provided by the Graduate & Professional Student Association (GPSA) Sponsorship Award, the Francisco Sy Endowed Graduate Scholarship, and the Michelle Chino Dissertation Enhancement Award, all of which significantly facilitated my advancement in the Ph.D. program. Getting through my PhD program required more than just academic support, and for that, I have many thanks to give to my support system outside of academia.

A loving thanks to my Antolin Ohana, without your unconditional support throughout this journey, I would not have made it this far. To my parents Nancy and Conrad, as I reflect on

my Ph.D. journey, I am overwhelmed with gratitude for your love, support, and encouragement. Thank you for providing me with the opportunity and environment to pursue my education and to become the first in our family to graduate from college. Who would have imagined that the little girl who started her educational journey at Na Lei Preschool would one day embark on the path to earning a Ph.D. To my three lovely brothers (Kekoa, Keola, and Kawika) your unconditional support throughout life has brought me to where I am today. I would like to also thank my sister-in-laws for lending a listening ear and always being my biggest cheerleaders throughout this journey. I would be remiss if I did not thank the Villa Ohana for all their support and encouragement over the years. I am truly grateful to have you all in my corner. To my friends, peers, and both current and former colleagues whom I've encountered along this journey, thank you for your guidance on my PhD and for encouraging me to finish. To my long-time friends thank you for always being a pillar of support and perspective.

To Michael, my partner, who has seen me through the many challenges and triumphs of my PhD journey, I want to express my appreciation for your support. Your steadfast presence has been a source of strength and comfort throughout this process, and I am truly thankful from the bottom of my heart. Last but certainly not least, I want to express my deepest appreciation and aloha to my six-year-old son, Kaden, for his patience and understanding as I balanced my responsibilities in pursuing my Ph.D. while embracing motherhood.

Mahalo ke Akua
(Thanks be to God)

Dedication

I dedicate this work to my beloved grandparents, Luciano and Ferlita Bareng, and Conrad and Sharon (Noe) Antolin. Additionally, I express deep gratitude to my parents, Conrad and Nancy Antolin, and my brothers and their families: Kekoa, Uilani, and Keala Antolin; Keola, Eden, Kealani Antolin, and Keola Jr. Antolin; and Kawika, Stacey, and Keahi Antolin. Lastly, I extend this dedication to my main loves, Michael Villa Jr., and Kaden Michael Kawai Villa.

Table of Contents

Abstract.....	iii
Acknowledgements.....	v
Dedication.....	vii
List of Tables.....	xii
Chapter 1: Introduction.....	1
Introduction.....	1
Problem Statement.....	3
Purpose.....	4
Theoretical Framework.....	4
Operational Definitions.....	8
Research Questions and Statistical Hypotheses.....	11
Assumptions.....	14
Limitations.....	14
Delimitations.....	16
Significance.....	16
Summary.....	19
Chapter 2: Literature Review.....	20
Introduction.....	20
College of Students Dietary Behaviors and F&V Consumption Behaviors.....	20
Determinants of Influence on Fruit F&V Consumption.....	21
Psychosocial Determinants.....	23
Acculturation and Diet in Asian American, Native Hawaiian, and Pacific Islanders.....	24

Epidemiological Review	25
Asian American, Native Hawaiian, and Pacific Islander F&V Consumption	25
Theory-based F&V Consumption Interventions	26
Theoretical Framework	30
Summary	32
Chapter 3: Methodology	33
Introduction	33
Purpose	33
Research Questions and Hypotheses	34
Research Study Design	36
Population and Sampling	37
Instrumentation	38
Initiation Model	38
Sustenance Model	40
Content Validity and Reliability	41
Data Collection	41
Ethical Consideration	42
Data Analysis	42
Summary	43
Chapter 4: Results	44
Introduction	44
Socio-demographic Characteristics of Study Sample	44
Confirmatory Factor Analysis	46

Descriptive Statistics and Internal Consistency of MTM Constructs	49
Pearson Correlation between MTM Constructs and Likelihood of Initiation and Sustenance	52
Hierarchical Multiple Regression (HRM) among MTM Constructs and Covariates	54
Logistic Regression Model among MTM Constructs, Covariates, and Meeting F&V	
Guidelines	58
Summary	59
Chapter 5: Discussion	61
Introduction.....	61
Summary of Purpose and Findings.....	61
Interpretation of Findings	62
Descriptive Statistics.....	62
Initiation of Consuming of Recommended Daily Five cups of F&V Behavior	62
Sustenance of Consuming of Recommended Daily Five Cups of F&V Behavior	64
Strengths of the Study.....	66
Limitations	66
Reproducibility and Validity of Study	67
Research Recommendations	68
Implications for Practice	69
Conclusion	70
Appendix A: Summary of Theory-Based F&V Interventions- Literature Review	72
Appendix B: F&V Consumption Behaviors in AANHPI College Students- Survey Instrument	77
Appendix C: IRB Approval Notification Letter.....	92
References.....	94

Curriculum Vitae..... 111

List of Tables

Table 1: Socio-Demographic Characteristics of AANHPI College Students by F&V Consumption Guidelines (N=436).....	45
Table 2: Confirmatory Factor Analysis: Construct Validity of MTM Construct Variables	47
Table 3: Mean and Score Ranges of MTM Constructs Based on F&V Consumption	51
Table 4: Pearson Correlation between MTM Constructs.....	53
Table 5: Hierarchical Multiple Regression among AANHPI College Students Who Do Not Consume the Recommended Five Cups of F&V Daily (N=237) – Initiation and Sustenance...	55
Table 6: Hierarchical Multiple Regression among AANHP College Students and Sustenance of Consuming Five or More Cups of F&V (N=199) – Sustenance Model.....	57
Table 7: Multiple Logistic Regression to Investigate Factors Associated with Meeting F&V Guidelines	59

Chapter 1: Introduction

Introduction

Non-communicable diseases (NCDs) (e.g., diabetes, cardiovascular disease, respiratory disease, and cancers) persist as a significant public health concern in the United States (U.S) (World Health Organization (WHO), 2023). In 2016, dietary risks were attributed to more than half a million deaths with approximately 84% of deaths linked to cardiovascular diseases (Murray et al., 2018). Studies consistently underscore the increased risks of obesity and various NCDs among individuals who either do not consume fruits and vegetables (F&V) entirely or consume inadequate amounts (Alissa & Ferns, 2017; Angelino et al., 2019; Arnotti & Bamber, 2020; Aune et al., 2017; Farvid et al., 2019). Incorporating a balanced diet rich in fruits and vegetables (F&V) plays a pivotal role as an opportunity to mitigate the risk of obesity and associated health issues (Slavin & Lloyd, 2012). NCDs encompass a broad category of chronic health conditions not transmitted directly from person to person but result from a combination of unmodifiable factors – such as age, sex, race/ethnicity, and environment – and modifiable factors, including the lack of physical activity, overconsumption of high-caloric foods, inadequate sleep, and heightened stress levels (Budreviciute et al., 2020). The multifaceted nature of these risk factors highlights the complexity of addressing and preventing NCDs, emphasizing the importance of comprehensive approaches to public health and lifestyle interventions.

To promote optimal health, adult females aged 19 - 30 years old following a 1,800-2,400-calorie diet should incorporate a minimum of at least two cups of fruits and three cups of vegetables in their daily intake, whereas males following a 2,400-3,000-calorie diet are advised to incorporate approximately two and a half cups of fruits and three servings of vegetables in their daily intake (U.S. Department of Agriculture and U.S. Department of Health and Human

Services, 2020). However, according to the Behavioral Risk Factor Surveillance Survey, American adults report eating less than one fruit daily (39.2%) and less than one vegetable daily (21.0%) (Lee et al., 2022). Specifically, Asian American, Native Hawaiian, and Pacific Islander (AANHPI) populations in the U.S. consume low intakes of fruit and vegetables, thus making this population susceptible to increased risk of NCDs (Moy et al., 2012; Sarwar et al., 2015; Wyatt et al., 2014).

When disaggregating data, health disparities become apparent. For instance, Native Hawaiians and Pacific Islanders are 80% more likely to be obese, displaying higher rates of obesity compared to those among Asian Americans and White Americans (U.S. Department of Health and Human Services Office of Minority Health, 2020). Furthermore, they are three times more likely to be obese in comparison to the overall Asian American population (U.S. Department of Health and Human Services Office of Minority Health, 2020). Furthermore, cancer, cardiovascular disease, and diabetes are prevalent health conditions in the Asian American population. In 2016, cancer and cardiovascular disease were the top two leading causes of death in Asian American populations (Heron, 2018).

The transitional period from adolescence to adulthood is pivotal for maintaining a healthy diet and lifestyle. Most college students begin to develop their own choices regarding their dietary behaviors (Mello Rodrigues et al., 2019). Evidence shows that college students engage in unhealthy diet and lifestyle behaviors (Alkhalidy et al., 2021; Downes, 2015). Dietary habits formed during college will likely persist through adulthood (Nelson et al., 2008). Therefore, it is crucial to identify the modifiable factors influencing college students' initiation and sustenance of fruit and vegetables. Health behavior theories help us understand and identify why people engage in certain healthy behaviors.

The Multi-Theory Model (MTM) of health behavior change is a comprehensive health behavioral theory and diverse framework that integrates elements of other health behavior theories and aims to offer a more comprehensive understanding of the factors influencing health behavior (Sharma, 2015). The MTM considers individual, physical, social, and environmental factors that influence health behaviors and has been adapted to various health behaviors and populations allowing for flexibility and applicability (Sharma, 2015). Further, the MTM has been utilized among college students examining various health-related issues. Researchers have utilized the MTM to investigate and understand various health-related issues among college students, ranging from physical activity to dietary habits (Nahar et al., 2016; Sharma et al., 2016; Sharma et al., 2017; Wilkerson et al., 2023).

Problem Statement

While many studies target the fruit and vegetable consumption behaviors of children, adolescents, and adults, only a limited few are guided by a behavioral health theory, with even fewer specifically focusing on the AANHPI populations. For example, a thematic analysis of research literature on the F&V consumption behaviors among Asian Americans yielded a total of 33 studies (Dai et al., 2021). Among these studies, only one was an intervention, none utilized a theoretical framework, and most of the participants reported not meeting the recommended cups of F&V (Dai et al., 2021). Despite the benefits of F&V and their established protective factors against many chronic illnesses, research indicates that a significant number of college students are falling below the recommended daily intake of cups of F&V. For instance, a study revealed 88% of females and 90% of male college students at a 2-year university had a daily consumption of less than five cups of F&V (Laska et al., 2011). Over 80% of U.S. college students reported eating less than three cups of fruits and vegetables, and approximately 40% reported being

overweight or obese (American College Health Association [ACHA], 2022). To the best of the researcher's knowledge, there are limited studies examining the intentions of AANHPI's students and their F&V consumption behaviors. The AANHPI population constitutes diverse subgroups rich in culture and unique in dietary practices. Consequently, it is essential to understand the current F&V consumption behaviors of college students and AANHPI populations. This understanding is important for developing effective health interventions aiming at increasing or promoting F&V consumption.

Purpose

The study aimed to utilize the MTM to explain the intention to initiate consuming F&V among AANHPI college students in the U.S. The MTM is guided by the constructs of participatory dialogue, behavioral confidence, and changes in the physical environment. Additionally, this study explores the long-term sustenance of consuming F&V guided by the constructs of emotional transformation, practice for change, and changes in the social environment among AANHPI college students enrolled a college or university in the U.S..

Theoretical Framework

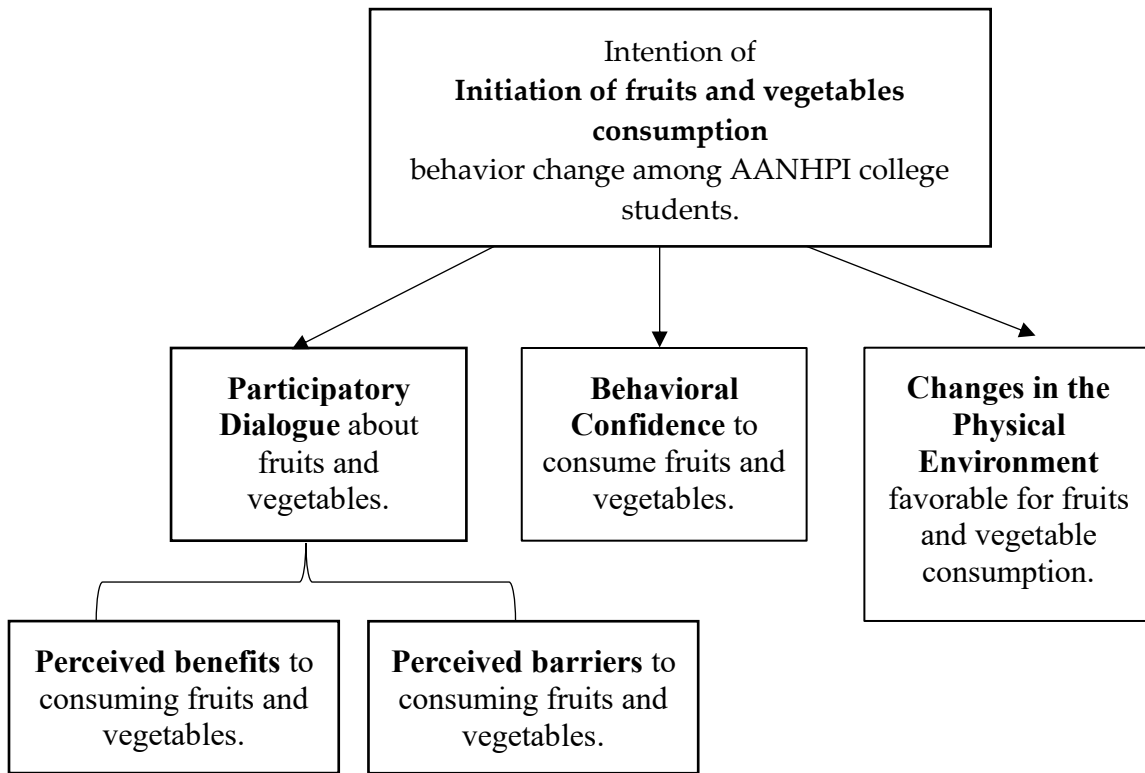
Theories serve as frameworks that can help us understand the reasons behind individuals' involvement or non-involvement in positive health behaviors (Glanz & Bishop, 2010). Additionally, they help in the development of effective interventions to promote health behavior change (Glanz & Bishop, 2010). Multiple factors contribute to the initiation, maintenance, and long-term change of health behavior patterns (Middleton et al., 2013). The MTM works across multiple levels (e.g., interpersonal, intrapersonal, community, etc.), integrates evidence-based constructs for health behavior change, and promotes both the initiation and the sustained health behavior change among diverse cultures (Sharma, 2015). Thus, this makes the MTM an

appropriate theoretical framework to explain the intention to initiation and maintain F&V consumption among AANHPI college students (Sharma, 2015).

The fourth generation MTM was developed for health promotion and education, aiming to explain and predict one-time and long-term changes in health behavior (Sharma, 2015). In this framework, health behavior is divided by the initiation model and sustenance model (Sharma, 2015). The first model represents the initiation of health behavior as a one-time adoption of health behavior, leading to the adoption of subsequent behaviors (Sharma, 2015). The sustenance model of health behavior change defined by Sharma (2015), refers to the long-term continuation of health. Three constructs guide each model.

The initiation model within MTM is guided by participatory dialogue, behavioral confidence, and changes in the physical environment are the guiding constructs for the initiation model within MTM (Sharma, 2015). Figure 1 illustrates the interaction between these constructs that explain the intent to initiate the consumption of F&V. Participatory dialogue is a two-way communication discussing the pros (advantages) and cons (disadvantages) of health behavior change (Sharma, 2015). Behavioral confidence pertains to the ability to perform the health behavior change influenced by internal or external forces (e.g., health educators, God, etc.) with a future-oriented perspective rather than focusing on the present time, as such behavioral confidence is culturally specific (Sharma, 2015). Changes in the physical environment is the last construct of the initiation model and is defined as the accessibility and convenience of resources to begin health behavior change (Sharma, 2015).

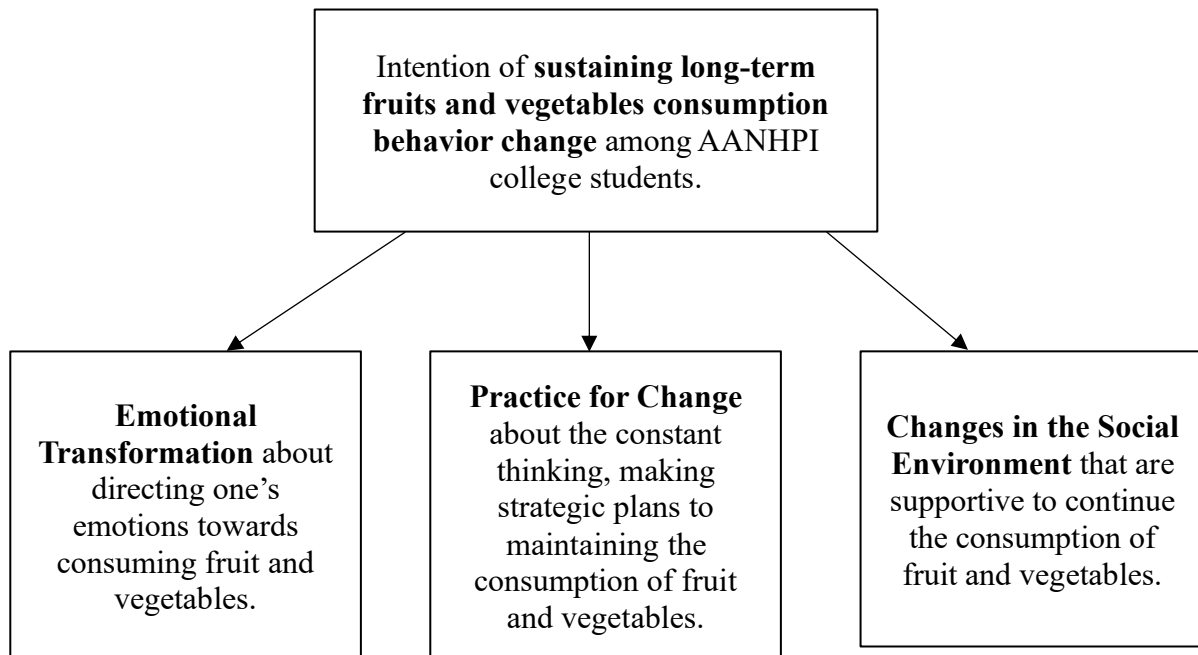
Figure 1: F&V Consumption among AANHPI College Students- Theoretical Framework MTM – Initiation



The sustenance model comprises of three constructs. The constructs are as follows: emotional transformation, practice for change, and changes in the social environment (Sharma, 2015). Figure 2 illustrates the interaction of these three constructs in explaining the long-term or continuation of F&V consumption. The ability to channel one’s emotions towards a change in health behavior relates to the construct of emotional transformation (Sharma, 2015). Practice for change involves the continuous thinking about the health behavior change, development of

strategic plans to overcome barriers, and to maintain focus on the health behavior through monitoring progress by taking conscientious actions (Panahi et al., 2018; Sharma, 2015). Sharma indicates the final construct of the sustenance model entails the “changes in the social environment” that is explained by the support provided by family, peers, or health professionals to sustain the health behavior change for long-term (2015).

Figure 2: F&V Consumption among AANHPI College Students- Theoretical Framework MTM – Sustenance



This study will utilize the MTM to examine the intentions of AANHPI college students across the nation concerning the initiation and sustenance of F&V consumption. Specifically, the

MTM initiation model with its three constructs aims to assess the intent among AANHPI college students nationally to consume F&V as a one-time behavior. Additionally, the sustenance model of the MTM framework with its three constructs will assess the sustained behavior change of consuming F&V among AANHPI college students.

Operational Definitions

The independent variables in this study relate to the MTM constructs of participatory dialogue (advantages and disadvantages), behavioral confidence, changes in the physical environment, emotional transformation, practice for change, and changes in the social environment. The dependent variables include the intent to consume five cups of F&V [initiation], the long-term consumption of five cups F&V [sustenance], and the actual consumption of five cups of F&V.

Asian American: A person with ancestral ties to the indigenous peoples of Far East Asia region or the Indian subcontinent, including countries of Philippines, Thailand, Korea, Japan, India, China, Malaysia, etc. (U.S. Census Bureau, 2022).

Native Hawaiian and Pacific Islander: A person with ancestral ties to the indigenous peoples of Samoa, Hawaii, Fiji, Guam, Palau, Micronesia, or other Pacific Islands (U.S. Census Bureau, 2022).

Fruit and Vegetable (F&V) Consumption: To maintain a healthy diet, it is recommended that adults incorporate at least 1-2 cups of fruit and 2-3 cups of vegetables into their daily intake (Lee et al., 2022).

Advantages of F&V Consumption: This is one component of participatory dialogue in involving the two-way communication between individuals on the benefits of consuming five cups of F&V daily (Sharma et al., 2016; Sharma, 2021). “Advantages” were defined as the

Benefits associated with maintaining good health, enjoying variety of foods, managing weight, etc. This construct was measured on a scale of 0 to 4, with 0 representing 'not sure at all,' 1 indicating 'slightly sure,' 2 for 'moderately sure,' 3 for 'very sure,' and 4 for 'completely sure,' respectively. The cumulative score was calculated between 0-20 units.

Disadvantages of F&V Consumption: This is the second component of participatory dialogue involving the two-way communication between individuals on the disadvantages of consuming five cups of F&V daily (Sharma et al., 2016; Sharma, 2021). “Disadvantages” were defined as the Barriers, associated with having less protein, an increased appetite, reduced energy, increased food-related expenses, and not enjoying meals. This construct was measured on a scale of 0 to 4, with 0 - representing 'not sure at all,' 1 indicating 'slightly sure,' 2 - for 'moderately sure,' 3 - for 'very sure,' and 4 - for 'completely sure,' respectively. The cumulative score ranged from 0-20 units.

Behavioral Confidence in F&V Consumption: This is pertaining to self-efficacy and perceived behavioral control of consuming five cups of F&V in the future (Sharma et al., 2016; Sharma, 2021). In this study, it was operationalized as being sure to consume five cups of F&V daily for a week while adhering to a budget, enjoying meals without being fed up with eating them and without feeling hungry. This construct was measured on a scale of 0 to 4, with 0 - representing 'not sure at all,' 1 - indicating 'slightly sure,' 2 - for 'moderately sure,' 3 - for 'very sure,' and 4 for 'completely sure,' respectively. The cumulative score ranged from 0-20 units.

Changes in the Physical Environment of F&V Consumption: This is defined as modifying or changes in the physical environment regarding the convenience of F&V resources for consumption (William et al., 2020). Being sure to have five cups of F&V available for each meal, their availability at restaurants, and affordability is defined by this construct. This construct

was measured on a scale of 0 to 4, with 0 representing 'not sure at all,' 1 - indicating 'slightly sure,' 2 - for 'moderately sure,' 3 - for 'very sure,' and 4 - for 'completely sure,' respectively. The cumulative score ranged from 0-12 units.

The Intention of Initiation of F&V Consumption: The primary aspect of the MTM involves an initial, singular action or short-term action to initiate a health behavior change (Brown et al., 2019). The likelihood of consuming five cups of F&V every day in the upcoming week and will be scored on a scale of 0 representing 'not sure at all,' 1 indicating 'slightly sure,' 2 for 'moderately sure,' 3 for 'very sure,' and 4 for 'completely sure,' which was summed for a cumulative score ranging from 0-4 units.

Emotional Transformation of F&V Consumption: One's emotion towards overcoming self-doubt and having self-motivation towards consuming five cups of F&V daily (Sharma, 2021). This may include putting forth intentions to overcome emotional doubts about consuming F&V. In this study, it was defined as putting one's emotions toward a goal of consuming five cups of F&V, self-motivation, and overcoming self-doubt. This construct was measured on a scale of 0 to 4. The scores are assigned as follows: 0 - representing 'not sure at all,' 1- indicating 'slightly sure,' 2 - for 'moderately sure,' 3 - for 'very sure,' and 4 - for 'completely sure'. The cumulative score ranged from 0-12 units.

The Practice of Change of F&V Consumption: This is the active reflection and reflective action of consuming the daily intake of five cups of F&V (Sharma et al., 2018). This may include consuming five cups of F&V and the reflection of consuming F&V daily. In this study, it was defined as maintaining a self-diary, overcoming barriers, and adjusting plans for daily consumption of five cups of F&V daily. This construct was measured on a scale of 0 to 4. The scores are assigned as follows: 0 -representing 'not sure at all,' 1 - indicating 'slightly sure,' 2

- for 'moderately sure,' 3 - for 'very sure,' and 4 - for 'completely sure'. The cumulative score ranged from 0-12 units.

Changes in the Social Environment of F&V Consumption: This refers to the social environment where the support of one's social circle (i.e., family, friends, and peer) and health professionals promotes the consumption of adequate cups of (five) F&V daily (Sharma, 2015). In this study, it was defined as the level of certainty regarding social support such as family members, friends, and trusted health professionals for consuming five cups of F&V daily. The scores are assigned as follows: 0 - representing 'not sure at all,' 1 - indicating 'slightly sure,' 2 - for 'moderately sure,' 3 - for 'very sure,' and 4 - for 'completely sure'. The cumulative score ranged from 0-12 units.

The Intention of Sustenance of F&V Consumption: Sharma describes the long-term behavior change of consuming five cups of F&V daily from now on, as the second component of the MTM framework (2015). The likelihood of consuming five cups of F&V from now on. It was scored on a scale of 0 - representing 'not sure at all,' 1 - indicating 'slightly sure,' 2 - for 'moderately sure,' 3 - for 'very sure,' and 4 - for 'completely sure,' which was summed for a cumulative score ranging from 0-4 units.

Research Questions and Statistical Hypotheses

This study examines the intention of AANHPI college students in the U.S., to both initiate and sustain their consumption of F&V. Demographic variables (e.g., age, gender, student status, employment, and GPA) were controlled for in the analysis (Williams et al., 2020). The following research questions are:

1) Among those who do not consume the recommended daily cups of F&V, to what extent do MTM initiation constructs (specifically, participatory dialogue, behavioral confidence, and

changes in the physical environment) describe the intent to initiate F&V consumption among U.S AANHPI college students, while controlling for age, gender, student status, housing, employment, and GPA?

H_0^1 : There was no observed association among the MTM initiation constructs regarding the intention of initiating F&V consumption. This analysis was conducted while controlling for age, gender, student status, housing, employment, and GPA among AANHPI college students who do not consume the recommended daily cups of F&V in the U.S..

H_a^1 : There was an association among the MTM initiation constructs regarding the intention of initiating F&V consumption. This analysis was conducted while controlling for age, gender, student status, housing, employment, and GPA among AANHPI college who do not consume the daily recommended daily cups of F&V in the U.S..

2) Among those who do not consume the recommended daily cups of F&V, to what extent do the MTM sustenance constructs (specifically, emotional transformation, practice for change, and change in the social environment describe the intent to sustain F&V consumption among U.S. AANHPI undergraduate college students, while controlling for age, gender, race, student status, housing, employment, and GPA?

H_0^2 : There was no observed association among the MTM sustenance constructs regarding the intent to sustain F&V consumption. The analysis was conducted while controlling for age, gender, race, student status, housing, employment, and GPA among AANHPI college students who do consume the recommended daily cups of F&V in the U.S..

H_a^2 : There is an association among the MTM sustenance constructs regarding the intent to sustain F&V consumption. The analysis was conducted while controlling for age,

gender, race, student status, housing, employment, and GPA among AANHPI college students who do consume the recommended daily cups of F&V in the U.S..

3) Among those who express consuming the recommended daily cups of F&V, to what extent do the MTM sustenance constructs (specifically, emotional transformation, practice for change, and change in the social environment) describe the intent to sustain F&V consumption among U.S. AANHPI undergraduate college students, while controlling for age, gender, race, student status, housing, employment, and GPA?

H₀³: There is no observed association among the MTM sustenance constructs regarding the intent to sustain F&V consumption while controlling for age, gender, race, student status, housing, employment, and GPA among AANHPI college students who consume the recommended daily cups of F&V in the U.S..

H_a³: There is an association among the MTM sustenance constructs regarding the intent to sustain F&V consumption while controlling for age, gender, race, student status, housing, employment, and GPA among AANHPI college students who consume the recommended daily cups of F&V in the U.S..

4) To what extent do the MTM constructs explain whether U.S. AANHPI undergraduate college students meet recommended guidelines for fruit and vegetable (F&V) consumption, while controlling for age, gender, race, student status, housing, employment, and GPA?

H₀⁴: There is no association between the MTM sustenance constructs and whether U.S. AANHPI undergraduate college students meet recommended guidelines for F&V consumption, controlling for age, gender, race, student status, housing, employment, and GPA..

Ha⁴: There is an association between the MTM sustenance constructs and whether U.S. AANHPI undergraduate college students meet recommended guidelines for F&V consumption, controlling for age, gender, race, student status, housing, employment, and GPA.

Assumptions

1. The target population is representative of Asian American, Native Hawaiian, and Pacific Islander college students in general. This study assumes that the researchers are capturing the most accurate perspectives of the study's target population.
2. The participants will self-report honestly and accurately to the survey questions and can recall their behavior to report accurately. This study assumes that we will be analyzing accurate results based on participants' self-reported responses.
3. The instrumentation used is guided by a theoretical framework that is valid and reliable. This study assumes the use of theory-based constructs will draw accurate responses from participants.
4. The survey is at a reading level appropriate for the target population. This study assumes the participants will be able to understand the question on the survey.

Limitations

Study Design

There are several limitations to the proposed study. The study is quantitative cross-sectional study design, which has a few limitations. Establishing causality is challenging in cross-sectional studies due to the simultaneous collection of independent and dependent variables. The lack of a clear temporal sequence makes it difficult to determine which variable causes the other, presenting challenges in establishing causality (Setia, 2016). This type of

observational study design examines a specific point in time, thus results from the same study may be different a few months from now, due to dietary intake of F&V fluctuating daily.

Population Representation

Historically, AANHPI populations have been grouped together in data collection, resulting in several limitations (Nguyen et al., 2022). There are sample size challenges within this study due to some AANHPI subgroups having small numbers making it a challenge to generalize findings to specific subgroups and limiting statistically significant findings across subgroups (Heyrana et al., 2023).

Data collection and analysis:

Several biases exist in the intended study. There is a potential for volunteer bias because participants can volunteer to be in the study, wherein participants who were interested in the study or volunteer for the study are likely to participate in the survey. This study will use a self-report instrument; thus, health behavior change may not be accurately measured. Response bias/social desirability bias may occur in the event there was a systematic difference between the student's responses and their actual experiences (Sedgwick, 2014). To minimize non-response bias in the study, survey response rate must be high (Sedgwick, 2014). Recall bias may occur which is the result of participants answering questions dishonestly. Because this survey asks participants to report the past 24-hour dietary recall of fruits and vegetables, this may not be representative of participants overall intake, as dietary intake differs from day to day.

Confounding Factors

Several variables were considered as potential confounders in this study, such as lifestyle factors (e.g., smoking status, levels of physical activity, body mass index, and alcohol intake), which are often associated with fruit and vegetable intake (Aune et al., 2017). These confounders

may have an impact on the study's results. Additional confounding factors not measured in the study could also have been missed and considered in future research.

Delimitations

This study focuses exclusively on Asian American, Native Hawaiian, and Pacific Islander (AANHPI) college students enrolled in universities and colleges within the U.S.. The study's sample selection relies on a convenience sampling approach and randomization was not feasible given resources and time constraints; thus, the results may not be broadly applicable to college students globally. The research study design is cross-sectional, which offers a snapshot of F&V consumption behaviors among AANHPI college students between July 2023 – August 2023. However, this design limitation impacts the temporal aspect of the study, in which the results are only from a single point of time and do not capture longitudinal changes or establish causal relationships over time. The survey was administered in English through the Qualtrics platform, limiting the linguistic diversity among the participants in the study. These delimitations provide a clear framework for understanding the study's scope, population focus, sampling method, study design, and specific choices that influence the interpretation of results.

Significance of the Study

The importance of F&V and their many protective factors against cardiovascular disease, cancers, gastrointestinal diseases, hypertension, and obesity are well documented in the literature (Farvid et al., 2019; Kaur & Aeri, 2019; Milajerdi et al., 2020; Subica et al., 2017). Despite this knowledge, many adults are not consuming adequate amounts fruits and three cups of vegetables. College is a time when many students experience newfound freedom to which they can make their own dietary decisions. College students are at a crucial age where health decisions made during this time could have a long-term impact (Frech, 2012). Therefore, the

results from this study can shed light on the effective intervention strategies for increasing the consumption of F&V among college students, aiming to improve their quality of life and promote healthy behaviors.

Diet has been shown to be a contributor to many chronic illnesses, thus it is important to understand where the disparities exist among vulnerable populations. Despite the low obesity rates in Asian Americans, research has shown an upward trend in obesity with older populations (Park et al., 2014). Acculturation has been a contributor to the increasing risk of obesity among AANHPIs. A systematic review among AANHPI in Hawaii showed that Native Hawaiians and Samoans had higher rates of obesity which may be attributable to dietary changes that are a part of the acculturation process (i.e., processed foods are made more available and fast foods incorporating calorie dense versions of regional foods) (Davis et al., 2004).

Many influencing factors contribute to F&V intake. Students report time, cost and accessibility were factors in their F&V intake. To address the many influencing factors experienced by AANHPI college students, public health official must have knowledge on the concerns and barriers associated with college student intake of F&V. Findings from this study may be used to inform the design and development of culturally appropriate interventions/strategies in addressing these challenges and barriers.

Various theoretical frameworks, such as the Theory of Planned, the Social Cognitive Theory, the Health Belief Model, and other multicomponent frameworks, have been used to predict F&V consumption (Guillaumie et al., 2010). Studies using only one theory to predict F&V intake were significantly better than studies utilizing a multicomponent framework (Guillaumie et al., 2010). A review of literature of behavioral theory on F&V intervention effectiveness showed that theory had a small to moderate effect on F&V intake, however,

interventions with theory had significantly larger effect sizes than interventions that were not theory driven (Diep et al., 2014). Thus, more research is needed to study the theoretical influence on dietary behaviors among adolescents and adults. Being a more recent model, the MTM has been explored for its predictive capability across diverse health behaviors among many cultural backgrounds (Sharma et al., 2021; Sharma et al., 2016; Sharma et al., 2021; Sharma et al., 2018; Williams et al., 2020). The model derives its constructs from traditional health education and promotion theories and looks at health behavior change in two models (initiation and sustenance) derived from constructs that are solely independent (Sharma, 2015). Because of this, constructs can be analyzed independently to determine what is most significant to health behavior change (Sharma, 2015). Findings from this study will enhance the application of the MTM, and provide empirical evidence for the design, development, and implementation of theory-based fruit and vegetable interventions and research based on this theoretical framework.

These findings are essential to public health professionals, educators, college institutions, and healthcare professionals as it may provide insights for the development of health promotion interventions and social marketing messages that promote F&V consumption among college students. Also, findings from this study can encourage structural changes on college campuses as to what they make available to their students, and how they can improve the overall health of their student population. Healthcare providers and other health education specialists can leverage these findings to further educate and increase behavioral confidence in initiation and sustaining adequate fruit and vegetable intake.

Summary

Consuming five cups of F&V has been linked with reduced mortality. Unfortunately, a substantial number of college students fall short of meeting the recommended consumption of F&V. The period from adolescence to young adulthood marks an essential time for improving dietary behaviors as eating habits developed now can persist long-term. Notably, the AANHPI population experience higher rates of cardiovascular disease compared to their White counterparts. Native Hawaiians have higher rates of obesity compared to other Asian American and Pacific Islander groups. Given the limited literature on AANHPI F&V consumption behaviors, there is an emphasis in the need to explore factors that impact F&V intake in this population. Therefore, the purpose of this study is to utilize the MTM to investigate and explain the intention of initiating eating five cups of F&V daily, which are based on the MTM initiation constructs of the initiation model— specifically, participatory dialogue (two-way communication), behavioral confidence, and changes in the physical environment. Additionally, the study seeks to explore the sustenance of long-term or continued consumption of five cups of F&V based on the constructs of emotional transformation, practice for change, and the changes in the social environment among AANHPI college student.

Chapter 2: Review of Literature and Theoretical Framework

Introduction

The Multi-Theory Model (MTM) was used to describe the intentions behind the initiation and sustenance of adequate F&V consumption among Asian American, Native Hawaiian, and Pacific Islander (AANHPI) college students. This chapter serves the purpose of reviewing the existing literature of fruit and vegetable behaviors among college students and the AANHPI population, examining the determinants of influence that affect F&V consumption, providing an epidemiological review, exploring theoretical frameworks used in fruit and vegetable studies, and a comprehensive review of theory-based intervention fruit and vegetable studies within children and adult populations.

College Students Dietary Behaviors and F&V Consumption Behaviors

Unhealthy dietary habits are synonymous with college life. Young adults in college have newfound freedom and responsibility to make their own dietary choices; thus, it is a critical time for promoting healthy diet behaviors and lifestyle (Mello Rodrigues et al., 2019). Studies show that college students' daily fruit and vegetable intake and physical activity decline during this period (Downes, 2015; Small et al., 2013). Based on a national representative survey, approximately 18% of college students in the U.S. reported consuming three cups or more of fruit daily, while nearly 30% reported consuming three or more cups of vegetables daily (ACHA, 2022). As of 2022, 40% of college students were overweight or obese (ACHA, 2022). Although the importance of F&V intake is highly known, there are barriers and other factors that impact adequate intake.

Determinants of Influence on F&V Consumption

The factors influencing the F&V consumption behaviors among college students have been well-documented. Rasmussen et al. (2006) conducted a comprehensive literature review of quantitative studies focused on the factors influencing F&V consumption in children and adolescents. These factors included gender, age, socio-economic status, taste preference, prenatal care, and accessibility/access (Rasmussen et al., 2006). The findings indicated that the highest consumption of fruits and vegetables were among females, individuals with high socio-economic status, those with higher taste preference for fruits and vegetables, those who experienced a high intake of prenatal fruits and vegetables, and when access to F&V were available in the home.

Krølner et al. (2011) reviewed qualitative studies to determine the potential determinants of F&V consumption among children and adolescents, and found time costs, availability (e.g., preparation, access to unhealthy foods), peer influence (e.g., sharing food), sensory aspects like texture and appearance, the time and occasion to consume fruits and vegetables, the school's availability (e.g., not being able to make food choices and short breaks), and perceived long-term impact of F&V intake is not of a concern, all play a role in consumption behaviors.

The transition into college is a pivotal time for students and is often accompanied by life changes which include leaving the parental home and acquiring more responsibilities and freedom which can be influenced by peers and campus life. A qualitative study conducted by Dhillon et al. examined the perceptions of first year minority college students regarding the campus food environment and its impact on eating behaviors (2019). The study population was majority Hispanic/Latinx and Asian/Pacific Islander students. The four common themes that influenced food choice and eating behaviors were affordability (i.e., students perceived healthier foods were higher in cost), acceptability (i.e., taste preference and familiarity), accessibility (i.e.,

access to high energy dense foods on campus, lack of transportation, access to cooking facilities), and adequacy (i.e., on-campus availability; Dhillon et al., 2019). The study also found that subjective norms like family and peers informed student's decision-making in food preferences, and personal introspection were factors that impacted food choices (Dhillon et al., 2019).

Several studies examined the various influences of F&V consumption among college students. Freshman college students indicated that price, busy life, food preferences, healthy aesthetics were influencing factors for food choice (Vilaro et al., 2018). Housing provisions and access to transportation were found to be a determinant of F&V consumption in college students (Mirabatur et al., 2016). There are many levels of influence that impact eating behaviors. The impact of diet on academic success is a research area being explored. A review study conducted by Burrows et al., revealed that students who consumed breakfast regularly and had higher fruit and vegetable intake, were those with higher academic achievement (i.e., grade point average scores) (2017).

Studies have shown that increasing obesogenic environments are contributing to the prevalence of obesity (Jia, 2021; Kapinos et al., 2014). Individuals have a continuous interaction with micro-environments (e.g., home, schools, workplace), which is influenced by the macro-environments (e.g., attitudes, beliefs, government, food industry; Ba et al., 2004). A qualitative study using ecological principles conducted by Deliens et al. was used to identify the eating behaviors of university students (2014). The researchers found that intrapersonal (individual) factors that influenced college students eating behaviors were taste preference, values norms, stress, self-image, diet knowledge, past eating habits, time and convenience, current level of physical activity, energy level, and metabolism. It was also determined that the interpersonal (social environment) factors were parental influence, home education, support from peers and

family, and peer pressure. Community-level influences identified were accessibility and availability of nutritious food choices. Cooking resources, along with expenses related to campus food, and the appeal of foods look also was identified as influences on the community-level. Additionally, it was identified in the study that the macro environment factors were policy and legislation, socio-cultural norms and values and media advertising influenced eating behaviors. Moreover, the researchers found that university characteristics such as living on campus, student society, college lifestyle, and exams all influence student eating behavior (Deliens et al., 2014). It is evident that environmental influences impact eating behaviors, but much can be said about the psychosocial determinants that influence eating behaviors.

Psychosocial Determinants

In a study by Allom and Mullan (2012), the Theory of Planned Behaviors was utilized, revealing that students who reported healthy eating important, self-regulation was a moderator of intention and behavior when compared to those who do not find healthy eating important. A longitudinal study conducted with undergraduates from a university in China found that action planning (i.e., behavioral plans are made before the situation) compared to action control (i.e. the ongoing behavior is continuously evaluated regarding a behavioral standard) to be a stronger determinant of fruit and vegetable consumption (Zhou et al., 2015). A study conducted at a university in Thailand among undergraduate students found that self-efficacy planning played a role in promoting dietary changes among college students. Similarly, a study examined the psychosocial factors such as self-efficacy, knowledge, and barriers, and found that self-efficacy had the most positive effect on the amount of fruit and vegetables consumed by college students, while knowledge and barriers were not a stronger predictor of fruit and vegetable (Al-Otaibi, 2014).

Acculturation and Diet in Asian American, Native Hawaiian, and Pacific Islanders

Acculturation is described as the “phenomena which result when groups of individuals having different cultures come into continuous first-hand contact, with subsequent changes in the original cultural patterns of either or both groups” (Redfield et al., 1936). Acculturation occurs both at the individual (micro) and group (macro) level. At the individual level (micro), acculturation refers to the changes in behaviors (such as diet), beliefs, and attitudes, while in the group (macro) level it entails the adoption or modification of social structures, institutions, and cultural norms among the acculturating group (Berry, 2017; Satia-Abouta et al., 2002).

Dietary acculturation is defined as the process by which members of a minority group adopt a dominant or host group's eating behaviors and food choices (Satia-Abouta et al., 2002). Contributors to poor dietary behaviors among immigrant AANHPIs include the accessibility and convenience of high caloric foods, a lack of access to traditional foods, an increase consumption of sweets, dairy products, and a decrease in vegetable intake (Pan et al., 1999).

Serafica et al. conducted a literature review to better understand dietary acculturation in Asian Americans and how it impacts the dietary intake of Asian Americans in the U.S. (U.S.) (2014). Only seven articles met the inclusion and exclusion criteria. The review resulted in findings among few Asian American (Korean, Chinese, Japanese, Filipino, Thai, and Hmong), and immigrant Chinese in North America. Results indicated that dietary acculturation was impacted by duration of residence in the U.S. to which individuals were likely to consume higher caloric diets if they lived longer in the U.S., and immigrants or those born outside of the U.S., maintained their traditional eating habits (Lv & Cason, 2004). The investigation concluded research in diet acculturation is limited.

Epidemiological Review

Approximately 20.6 million individuals (about the population of New York) identify as AANHPI, making it the fastest growing racial/ethnic population in the U.S. (U.S. Census Bureau, 2020). Many AANHPI groups have noticeably high burden of cardiovascular diseases, cancers, diabetes, and hypertension. A California study found that AANHPI men and women have high mortality rates of nasopharynx, stomach, and liver cancer and Native Hawaiian and other Pacific Islander women had high rates of breast and endometrial cancers when compared to non-Hispanic whites (Medina et al., 2021).

In 2016, Native Hawaiians and Pacific Islanders exhibited an 80% higher likelihood of obesity (U.S. Department of Health and Human Services Office of Minority Health, 2020). Additionally, in 2018 this demographic was 2.5 times more likely of having a diagnosis and succumb to diabetes compared to non-Hispanic Whites (Centers for Disease Control and Prevention [CDC], 2021). Despite, global recognition of the health benefits associated with adequate F&V consumption, racial/ethnic minorities continue to fall short of meeting the daily recommended cups of F&V, contributing to the burden of disease and death globally (Aune et al., 2017; Leenders et al., 2013; Wang et al., 2021).

Asian American, Native Hawaiian, and Pacific Islander F&V Consumption

The limited research and disaggregated data on the eating habits of AANHPI exists (Kwon et al., 2015). When data is aggregated, noticeable health disparities among AANHPI are recognized. U.S. Asian immigrants reported eating less F&V when compared to Asians in their respective countries (Rosenmöller et al., 2011). A study found that Native Hawaiians and Pacific Islanders in the U.S. reported consuming less than 1 cup of fruits and vegetables daily, well below the recommended five cups daily (Moy et al., 2010). Similarly, in California, Asian

Americans (Chinese (58%), Filipinos (62%), Japanese (54%), Korean (56%), and Vietnamese (57%)) reported not meeting the recommended five cups of F&V daily (Sarwar et al., 2015).

Dai et al. conducted a 15-year scoping review and a thematic analysis on F&V consumption among Asian Americans (2021). The review found 33 relevant articles that examined the F&V consumption behaviors of Asian Americans to which the authors categorized their study aims by prevalence, consequences, determinants, and interventions. Prevalence studies showed that most participants did not meet the recommended cups of F&V. For example, a study examined the eating behaviors of Chinese American foreign-born elderly in New York City and found that only 19% consumed five or more cups of F&V (Wyatt et al., 2014).

Consequence studies showed that participants that did not consume adequate amounts of fruits and vegetables reported an increase in unhealthy lifestyle behaviors (Wyatt et al., 2014). Determinant studies revealed that factors that contributed to inadequate intake of F&V were among low-income status individuals, lack of knowledge of the adequate amount of cups fruit and vegetable intake, and accessibility and affordability of fruits and vegetables. There was only one intervention study that impacted F&V intake among Asian Americans, which involved a nutrition intervention that used printed materials and lectures to increase fruit and vegetable intake.

Theory-based F&V Consumption Interventions

Behavioral theories play an essential role in understanding human behaviors (Keil, 2006). To explore the practical uses of behavioral theories and their real-world application, the author conducted a comprehensive literature review between November and December 2021, focusing on theory-based interventions aimed at promoting fruit and vegetable (F&V) consumption, particularly among vulnerable populations. The review yielded insights from 10 social and

behavioral theory interventions that examined F&V consumption behaviors. These studies spanned diverse locations and populations, providing a broad perspective on the strategies used to increase and promote F&V intake. The findings from this review are presented in a detailed table summary in Appendix A.

Intervention Study Designs

Most of the intervention studies utilized different types of randomized controlled trial study designs. Lin et al. utilized a cluster randomized controlled trial design among three high schools participating in the study (2017). One study utilized a quasi-randomized controlled trial design among the study participants through the random clustering method, and two schools of the six were randomly selected as an intervention and control group (Taghdis et al., 2016). Duncan et al. (2015) used a non-random assignment when selecting their study sample. Menezes et al. (2018) utilized a randomized controlled community trial. One study used a pretest and posttest study design to evaluate a F&V intervention (Kothe et al., 2012). Lastly, five studies utilized a randomized controlled trial (Ahn et al., 2016; Brown et al., 2020; Kothe & Mullan, 2014; Kreauskon et al., 2012; Najimi & Ghaffari, 2013).

Intervention Location and Population

Two intervention studies were conducted in the U.S. (Ahn et al., 2016; Brown et al., 2020). Many of the intervention studies were conducted internationally in, Iran (Lin et al., 2014; Taghdis et al., 2016; Najimi & Ghaffari, 2013), United Kingdom (Duncan et al., 2015), Australia (Kothe & Mullan, 2014; Kothe et al., 2012), Brazil (Menezes et al., 2018), and Thailand (Kreauskon et al., 2012). Three of the intervention studies were conducted among primary (elementary) school students (Duncan et al., 2015; Najimi & Ghaffari, 2013; Taghdisi et al., 2016). One study was conducted among middle school-aged students (7-13 years old) (Ahn et

al., 2016), and one study among high school students aged 13-18 years old (Lin et al., 2017).

There were three studies conducted among college students, two of which were done at the same university (Kothe & Mullan, 2014; Kothe et al., 2012; Kreausukon et al., 2012). One intervention study was conducted among adults aged 20 years and older (Menezes et al., 2018), and another study was conducted only on African American women 18 years or older (Brown et al., 2020).

Intervention Strategies

The studies varied in intervention strategies and duration. One study utilized a school garden-based intervention to increase F&V consumption (Duncan et al., 2015). One intervention implemented 60-minute nutritional education workshops over a four-week period (Najimi & Ghaffari, 2013). Three studies utilized technology types of strategies such as nutritional email messages (Kothe et al., 2012; Kothe & Mullan, 2014) and virtual assessments using a digital “pet” to encourage F&V intake (Ahn et al., 2016). Four studies had a combination of educational strategies such as brochures, workshops, postcards, pamphlets, and discussions (Kreausukon et al., 2012; Taghdisi et al., 2016; Lin et al., 2017; Menezes et al., 2018).

Health Behavioral Theories and Outcomes

Many of the interventional studies utilized the Theory of Planned Behavior (TPB) (Duncan et al., 2015; Kothe et al., 2012; Kothe & Mullan, 2014; Taghdisi et al., 2016). The Social Cognitive Theory (SCT) was used in two intervention studies looking at F&V consumption (Najimi & Ghaffari, 2013; Ahn et al., 2016). Two studies utilized the Health Action Approach Process (HAPA) (Kreausukon et al., 2012; Lin et al., 2017), and one study used the transtheoretical model (TM) in combination with the dialogic-pedagogical approach (Menezes et al., 2018). One study intervention used the Multi-Theory Model (MTM) (Brown et al., 2020). One study in the review documented an increase in F&V consumption within their intervention

group. Notably in this review, two studies from the same author who did an evaluative test of their intervention program before conducting a randomized controlled trial (Kothe et al., 2012; Kothe & Mullan, 2014). The randomized controlled trial showed that their intervention program did not increase F&V consumption (Kothe & Mullan, 2014).

Summary of Theory-Based Fruits and Vegetables Interventions Review

Diverse intervention strategies were used, with most studies using randomized controlled trial study designs. The review resulted in intervention studies globally, with interventions conducted in the U.S., Iran, the United Kingdom, Australia, Brazil, and Thailand, targeting populations ranging from elementary school students to adults. Furthermore, each study used various study designs, from cluster randomized controlled trials to quasi-randomized trials, showing the adaptability of interventions to different settings and conditions. Additionally, the interventions varied in their strategies and durations. For example, some study interventions utilized school garden-based approaches, nutritional education workshops, and technology-driven strategies to engage participants in F&V consumption.

Various theoretical frameworks such as the TPB, SCT, HAPA, and TMT, were utilized to promote and increase F&V consumption in individuals. The effectiveness of the Multi-theory Model (MTM) intervention was demonstrated in the study by Brown et al., 2020, providing further evidence of the model's capability in promoting F&V consumption among its population. Interestingly, most studies in this review reported an increase in F&V consumption among their intervention groups; however, Kothe & Mullan (2014) reported their randomized controlled trial revealed a lack of efficacy in their intervention program.

The importance of theoretical frameworks in guiding interventions was evident. College students were the focal point in this review, as seen in studies conducted at an Australian

University to programs in Thailand. Through examining findings specific to college students, we can understand the challenges and opportunities associated with promoting healthy eating behaviors within this group. Additionally, the review emphasized the importance of expanding the scope of research to vulnerable populations, which could include specific subgroups within the college student demographic.

Therefore, the implications for college students are twofold. For instance, the positive outcomes from the interventions emphasize the potential for theory-based approaches to influence F&V consumption positively. However, the limitations and the need for more research suggest the need for tailored interventions that consider the unique factors influencing their dietary behaviors. The existing literature gap indicates that current theoretical frameworks, like the Theory of Planned Behavior (TPB) and others, may have limitations in fully capturing the details of college students' dietary behaviors, namely in F&V consumption.

Theoretical Framework

The health behavioral change theoretical framework used in this study was the MTM. This theoretical framework was used to explore the intention to initiate and sustain F&V consumption among AANHPI college students in the U.S.. To date, three cross-sectional survey studies utilized the MTM of health behavior change to assess F&V consumption behaviors among college students in the U.S. (Sharma et al., 2018), African American women (Brown et al., 2019), African American males (Williams et al., 2020). An experimental study conducted by Brown et al. investigated African American women F&V (2020).

Researchers applied the MTM among U.S. college students at a university to predict the initiation and sustenance of F&V behaviors (Sharma et al., 2018). The findings from this study revealed that the two MTM initiation constructs (behavioral confidence and the changes in the

physical environment), along with all the MTM sustenance constructs (emotional transformation, practice for change, and the changes in the social environment), played a role in college students' F&V behaviors. However, participatory dialogue was not a predictive construct in initiating behavior change.

Brown et al. conducted a cross-sectional study among African American women in Mississippi, U.S. using the MTM framework (2019). The study revealed that the full models (initiation and sustenance) and their associated constructs were predictive for the initiation of F&V consumption. Moreover, the third cross-sectional study using the MTM framework was conducted in Urban barbershops in Mississippi, U.S. (Williams et al., 2020). The study only found behavioral confidence and changes in the physical environment (initiation model), and emotional transformation and practice change (the sustenance model) constructs predictive of F&V consumption behaviors (William et al., 2020).

The only intervention study to utilize the MTM framework to encourage F&V intake among African American women in the Jackson area of Mississippi, U.S. was conducted by (Brown et al., 2020). The researchers implemented an intervention spanning over three weeks and was evaluated using a pre-posttest with a follow-up several weeks later after the intervention. The study found an increase of consumption of F&V from pre-posttest to follow-up, and all by one construct (participatory dialogue) dialogue were statistically significant (Brown et al., 2020). Rasmussen and colleagues' literature review on F&V intake determinants among children and adolescents revealed that only four papers tested the relevance of theory, and 12 papers were based on a theoretical framework (2006).

While studies examining F&V intake among children, students, and adults, often lack a comprehensive theoretical framework, the MTM has been shown to be a valuable framework for

explaining and predicting behaviors among college students. The findings from MTM studies on fruit and vegetable consumption behaviors suggest its effectiveness in explaining and promoting positive health behavior change. Further, college students' experiences are often evolving and changing, thus the MTM offers a framework for interventions that extend beyond short-term impact, but by also promoting long-term positive health behavior changes in F&V consumption.

Summary

In summary, the use of the MTM addresses the literature gap by providing a comprehensive framework that accounts for the various factors influencing F&V consumption among college students. Its adaptability aligns with the need for tailored approaches, further highlighting the potential to significantly improve intervention effectiveness in this context.

Chapter 3: Methodology

Introduction

This chapter provides a summary overview of the research study plan. The purpose of this quantitative cross-sectional survey-based research study is to measure the intent to initiate and sustain consuming five cups of fruits and vegetables (F&V) daily among Asian American, Native Hawaiian, and Pacific Islander (AANHPI) college students. The study is directed by the health behavior change theory, the Multi-Theory Model (MTM). Outcomes from this study will allow researchers to further comprehend the cultural intricacies influencing the F&V consumption behaviors among AANHPI, identify barriers that prevent adequate intake. Additionally, the study aims to examine the effectiveness of this theoretical framework (MTM) in addressing health behaviors in college students among the AANHPI populations. Four research questions guide this study and were addressed and analyzed to determine how they predicted the intent to initiation and sustain F&V consumption among AANHPI college students who report consuming less than five cups and those who report consuming five or more cups daily.

Purpose

The objective of this study is to use the MTM framework to explain the intention to initiate the consumption of F&V among AANHPI college students enrolled at colleges and universities in the U.S.. This initiation model is guided by the MTM constructs of participatory dialogue, behavioral confidence, and changes in the physical environment. Additionally, the study looks at the MTM sustenance constructs regarding long-term health behavior change by examining emotional transformation, practice for change, and changes in the social environment among AANHPI college students.

Research Questions and Hypotheses

This study examined the intent for initiation and sustenance among the following groups: AANHPI college students who reported consuming less than five cups of F&V in the past 24 hours, and those who reported they did not consume five cups or more. The following covariates controlled for effects on F&V consumption were, age, gender, race, employment status, student status (e.g., freshman, sophomore, junior, senior, graduate student), housing (e.g., living on or off campus) and GPA. The four research questions are as follows:

1) Among those who do not consume the recommended daily cups of F&V, to what extent do MTM initiation constructs (specifically, participatory dialogue, behavioral confidence, and changes in the physical environment) describe the intent to initiate F&V consumption among U.S. AANHPI college students, while controlling for age, gender, student status, housing, employment, and GPA?

H_0^1 : There was no observed association among the MTM initiation constructs regarding the intention of initiating F&V consumption. This analysis was conducted while controlling for age, gender, student status, housing, employment, and GPA among AANHPI college students who do not consume the recommended daily cups of F&V in the U.S..

H_a^1 : There was an association among the MTM initiation constructs regarding the intention of initiating F&V consumption. This analysis was conducted while controlling for age, gender, student status, housing, employment, and GPA among AANHPI college students who do not consume the recommended daily cups of F&V in the U.S..

2) Among those who do not consume the recommended daily cups of F&V, to what extent do the MTM sustenance constructs (specifically, emotional transformation, practice for change, and

change in the social environment) describe the intent to sustain F&V consumption among U.S. AANHPI undergraduate college students, while controlling for age, gender, race, student status, housing, employment, and GPA?

H_0^2 : There was no observed association among the MTM sustenance constructs regarding the intent to sustain F&V consumption. The analysis was conducted while controlling for age, gender, race, student status, housing, employment, and GPA among AANHPI college students who do consume the recommended daily cups of F&V in the U.S..

H_a^2 : There is an association among the MTM sustenance constructs regarding the intent to sustain F&V consumption. The analysis was conducted while controlling for age, gender, race, student status, housing, employment, and GPA among AANHPI college students who do consume the recommended daily cups of F&V in the U.S..

3) Among those who express consuming the recommended daily cups of F&V, to what extent do the MTM sustenance constructs (specifically, emotional transformation, practice for change, and change in the social environment) describe the intent to sustain F&V consumption among U.S. AANHPI undergraduate college students, while controlling for age, gender, race, student status, housing, employment, and GPA?

H_0^3 : There is no observed association among the MTM sustenance constructs regarding the intent to sustain F&V consumption while controlling for age, gender, race, student status, housing, employment, and GPA among AANHPI college students who consume the recommended daily cups of F&V in the U.S..

H_a^3 : There is an association among the MTM sustenance constructs regarding the intent to sustain F&V consumption while controlling for age, gender, race, student status,

housing, employment, and GPA among AANHPI college students who consume the recommended daily cups of F&V in the U.S..

4) To what extent do the MTM constructs explain whether U.S. AANHPI undergraduate college students meet recommended guidelines for fruit and vegetable (F&V) consumption, while controlling for age, gender, race, student status, housing, employment, and GPA?

H_0^4 : There is no association between the MTM sustenance constructs and whether U.S. AANHPI undergraduate college students meet recommended guidelines for F&V consumption, controlling for age, gender, race, student status, housing, employment, and GPA..

H_a^4 : There is an association between the MTM sustenance constructs and whether U.S. AANHPI undergraduate college students meet recommended guidelines for F&V consumption, controlling for age, gender, race, student status, housing, employment, and GPA.

Research Study Design

The research study design was a quantitative cross-sectional survey. This type of observational study measures the outcomes and exposures simultaneously and is described as taking a “snapshot” of a subset of a population (Carlson & Morrison, 2009). While cross-sectional studies cannot determine casual inference, this study design was used because it is feasible to conduct, cost-effective, and often with no ethical difficulties (Wang & Cheng, 2020). This study incorporates the constructs from both the initiation model (participatory dialogue, behavioral confidence, and changes in the physical environment) and sustenance model (emotional transformation, practice for change, and changes in the social environment) of the MTM as independent variables.

The dependent variables for this study included: 1) the intention of consuming the recommended cups of F&V (<5 cups) and 2) the sustained consumption of the recommended cups of F&V (2 cups of fruits and 3 cups of vegetables). Two groups will be analyzed in this study: 1) those who did report consuming the recommended daily cups of F&V and 2) those who did not report consuming the recommended daily cups of F&V. The covariates of this study to be controlled for were age, race, gender, students' status (e.g., freshman, sophomore, junior, senior, graduate), housing (e.g., living on or off campus) and employment status and GPA.

Population and Sampling

Asian American, Native Hawaiian and Pacific Islander college students currently enrolled at a college or university in the U.S. were the study's population sample. For multiple regression the necessary sample size was determined through G*Power Version 3.1.9.6 to compute an estimated sample size (Faul et al., 2007). The established parameters set included a medium to large effect size (0.05), power at 0.80, and an alpha level at 0.05. The calculation yielded a minimum required sample size of n=425, which is considered a sufficient sample size for confirmatory factor analysis (Ahmad & Halim, 2017). Between July 2023 and August 2023, a web-based survey designed in Qualtrics was disseminated. A convenience sampling approach was used to recruit and enroll participants into the study. Inclusion criteria for this study are those who: 1) identify as Asian American, Native Hawaiian and Pacific Islander 2) 18 years of age or older 3) currently enrolled at a university or college in the U.S. and 4) provided informed consent to participate in the study. The exclusion criteria for this study are those who: 1) who are non-degree seeking students.

Instrumentation

A 43-item questionnaire, previously validated, was used in this study. The questionnaire used the MTM constructs and was adapted for AANHPI Asian American, Native Hawaiian, and Pacific Islander college students by the researcher (see Appendix B). Permission for one-time use for this study was granted from the original author of the MTM Fruit and Vegetable Questionnaire for College Students, Dr. Manoj Sharma. The survey began with consent to participate in the study, to which students were required to be 18 years of age or older to participate in the study. Participants were first asked three separate questions: how many cups of F&V they consumed in the past 24 hours, and if their total was greater or less than five. For this study, we captured all participants regardless of their consumption totals falling short of the recommended five cups of F&V daily. The second block of questions consisted of 18 items focused on the MTM initiation constructs (Sharma et al., 2018). While the third block of questions consisted of nine items focused on the MTM sustenance constructs. The final two items of the questionnaire measured the intention to initiate and sustain the consumption of five cups of F&V daily. Lastly, the final block of seven questions consisted of socio-demographic questions.

Initiation Model

Five items measured the participatory dialogue of advantages of consuming five cups of F&V (Sharma et al., 2018). Participants were asked if by consuming the recommended cups of F&V they would experience the benefits of be healthy, having more options in meals, weight maintenance, increased energy, and better tasting foods. A 5-point Likert scale was used to score each item and were represented with 0 = never to 4 = always, with a possible cumulative score ranging from 0 to 20 units. Five items measured the participatory dialogue of disadvantages of

consuming five cups of F&V. Participants were asked if they consumed five cups F&V, this would lead to not having appropriate amounts of protein in their diet, feeling hungry, having decreased energy, increased food expenses, and having less enjoyment in meals. A 5-point Likert scale was used to score each item and was represented with 0 = never to 4 = always, with a possible cumulative score ranging from 0 to 20 units. To determine the participatory dialogue score, the disadvantages score is subtracted by the advantages score for a possible range of -20 to +20 units. A mean score of 10 or more indicated a positive score in participatory dialogue.

Five items measured behavioral confidence. Participants were asked about their confidence in consuming F&V during the week, while adhering to a budget, enjoying meals, etc. A 5-point Likert scale with 0 = not at all sure to 4 = completely sure was used to score each item. A possible cumulative score ranged between 0 to 20 units. A mean score of 10 or more is a positive score in behavioral confidence.

The final initiation MTM construct, changes in the physical environment were measured by three items. The participants were asked about their sureness in consuming five cups of F&V. Participants were asked about their certainty of consuming F&V in all meals, at restaurants, and being able to afford it. A 5-point Likert scale with 0 = not at all sure and 4 = completely sure was used to score each item, with a possible cumulative score ranging from 0-12 units. A mean score of six or more indicated a positive score in the construct related to changes in the physical environment.

The intention of initiating the daily consumption of five cups of F&V was measured by asking participants how sure they were in consuming five cups of F&V in the coming week. A 5-point Likert scale with 0 = not at all likely to 4 = completely likely was used to score each item,

with a possible cumulative score of 0 to 4 units. A positive mean score of two or more signified that an intention to initiate the consumption of F&V was present.

Sustenance Model

Three items measured emotional transformation by asking participants about their sureness that they can direct their emotions, be self-motivated, and overcome barriers to consuming five cups of F&V daily. A 5-point Likert scale with 0 = not at all sure to 4 = completely sure was used to score each item. A possible cumulative score ranged between 0-12 units.

Practice for change was measured by asking participants about their sureness that they can keep track of the F&V consumption behaviors through a self-diary, consume five cups F&V daily if they encounter challenges and adapt their plans for consuming five cups F&V daily if they face difficulties. A 5-point Likert scale with 0 = not at all sure to 4 = complete sure was used to score each item. A possible cumulative score ranged between 0-12 units.

Three items measured the changes in the social environment by asking participants about their sureness if they can receive help from family, friends, and health professionals to support them in consuming five cups of F&V daily. A 5-point Likert scale with 0 = not at all sure to 4 = completely sure was used to score each item. A possible cumulative score ranged between 0-12 units. The intention of sustaining the daily consumption of five cups of F&V was assessed by how sure participants were that they would consume five cups of F&V daily from now on. A 5-point Likert scale with 0 = not at all likely to 4 = completely likely was used to score each item. A possible cumulative score ranged between 0-4 units.

Content Validity and Reliability

The study used confirmatory factor analysis to evaluate the construct validity of the MTM subscales— participatory dialogue (advantages and disadvantages), behavioral confidence, changes in the physical environment, emotional transformation, practice for change, and changes in the social environment. The maximum likelihood estimation was used for this analysis. Factor loading values exceeding the critical threshold of 0.384 and yielding an Eigenvalue greater than or equal to 1 were considered acceptable (Guttman, 1954). To assess the internal consistency reliability of the instrument, Cronbach’s alphas were measured. To determine the acceptability of the instrument’s scale, a Cronbach’s alpha range of 0.70 or higher will be used to determine if the scale of the instrument is acceptable (Taber, 2018).

Data Collection

The survey was conducted using the web-based survey platform called Qualtrics. Data for this study was collected between July 2023 and August 2023. The researcher contracted the Qualtrics Research Marketing team to perform the data collection for this study as part of a contractual agreement. Participants were from various regions across the U.S. were recruited based on the inclusion and exclusion criteria of the study. Utilizing a research panel was ideal because panelists are carefully selected to represent the intended sample and are ready and willing to participate in the study. Qualtrics partners with various sample providers who actively recruit a diverse set of research panel participants (Miller et al., 2020). Once eligibility was ensured, panelists were invited to participate in the survey where study consent was given prior to the survey instrument. Any participants ineligible to participate will be exited from the survey with a message response of ineligibility. In accordance with the research panel agreement with

Qualtrics, eligible respondents will receive incentives for completing the survey, such as cash, entries into sweepstakes, reward points programs, etc., (Sharma et al., 2021).

Ethical Considerations

The University of Nevada, Las Vegas approved this study with an exempt status (protocol #: UNLV-2023-241; Appendix C) on June 12, 2023. This study was strictly voluntary, and participants received comprehensive information on the study's purpose and objectives via an informed consent. Prior to participating in the study, participants were required to give consent. Also, participants could withdraw from the survey at any point. To ensure anonymity, no identifiable information was collected during the study. The prevent multiple submissions Qualtrics enabled to restrict multiple submissions from participants the same participant.

Data Analysis Plan

The data from the study was obtained from Qualtrics and downloaded to a Microsoft Excel file. It was exported for analysis using the Statistical Package for Social Sciences (SPSS V.26, IBM). Descriptive statistical analysis of all study variables was conducted. Counts and percentages were used to represent categorical variables, while mean and standard deviation represented continuous variables. A Pearson correlation analysis was performed among the MTM construct variables for determining the significant bivariate relationship among them, and among the initiation and sustenance in the two groups (those who do not consume the recommended five cups of F&V daily, and those who do). To predict the variance in the likelihood of initiation and sustenance of F&V consumption behaviors, hierarchical regression models (HRM) were utilized, while considering factors like demographics and all the MTM constructs. Additionally, a logistic regression model was utilized to explore the predictors that explain meeting the F&V

consumption guidelines. A significance level was set to 0.05 with 95% confidence intervals for all data analyses performed in this study.

Summary

The methodology employed in this study to answer the four research questions pertaining to the F&V consumption behaviors of AANHPI college students was outlined in Chapter 3. The survey was designed with the MTM framework to determine if the constructs in the initiation model explain the initiation of F&V consumption, and if the constructs in the sustenance model explain the sustenance of F&V consumption. This study was conducted in AANHPI populations; thus, it is crucial to target universities and colleges with high representation of AANHPI to ensure the sample size is reached for statistical power of the study. Results and analysis of this study are presented in Chapter Four.

Chapter 4: Results

Introduction

Chapter 4 provides a summary of the study's results addressing the four research questions, testing the hypotheses, and drawing conclusions regarding MTM constructs associated with F&V consumption behaviors among AANHPI college students. Two research questions focused on each of MTM constructs to explain and predicted the initiation and sustenance among students who reported not consuming five cups of F&V. Another research question examined the MTM constructs that explained and predicted sustenance among students were meeting the recommended five cups or more of F&V daily. The fourth research question examined how the MTM sustenance constructs explained the number of F&V consumed by the target population. Data collection occurred from June 3, 2023, through August 10, 2023. A research panel of eligible participants was provided by Qualtrics marketing services to participate in the study (Miller et al., 2020 –maybe add another citation). Descriptive statistics, Pearson's correlations, hierarchical multiple linear regression, and multiple logistic regression analyses were used to answer the study's research questions. Four hundred and thirty-six participants completed this study. Of the 436 participants, 237 participants (54.4%) reported not consuming the recommended five cups of F&V, whereas 199 participants (45.6%) reported meeting the recommended five cups daily of cups of F&V.

Socio-Demographic Characteristics of Study Sample

The mean age of the study participants was 24.17 ± 9.96 years (Table 1). All participants in the study identified as being AANHPI, with majority of the respondents reported being Asian American ($n = 329$, 75.5%, Table 1). The most common Asian subgroups were Chinese ($n = 80$), Asian Indian ($n = 70$), and Filipino ($n = 55$). Out of the 95 respondents in the study who identified as Native Hawaiian and/or Pacific Islander (NHPI), the largest group consisted of

those who identified as Native Hawaiian (n = 55), followed by individuals of Samoan ethnicity (n = 19). Table 1 shows the F&V consumption behaviors of participants who consumed five or more of the daily cups of F&V were predominately females compared to males (57.3% vs 41.2%, p = 0.001). Conversely, participants who were not meeting the daily recommended cups of F&V were predominately males compared to females (57.0% vs. 40.1% p = 0.001). More than half of the participants consisted of upperclassman who were unemployed and held a GPA of a 3.0 or higher. Participants who consumed five or more cups of F&V were more likely to report living on-campus compared to those consuming less than five cups (34.7% vs. 25.3%, P = 0.03, Table 1). Majority of participants were from the Southern (38.1%) or Western (24.3%) regions of the U.S..

Table 1: Socio-Demographics Characteristics of AANHPI College By F&V Consumption Guidelines (N=436)

Variable name	Categories	Overall sample	Fruit and Vegetable Consumption Guidelines		P value
			Five or more cups (n=199)	Less than five cups (n=237)	
Age in years (Mean ± S.D.)	-	24.17 ± 9.96	24.69 ± 10.65	23.73 ± 9.34	0.32
Gender n (%)	Male	209 (47.9)	82 (41.2)	135 (57.0)	0.001
	Female	217 (49.8)	114 (57.3)	95 (40.1)	
	Other/Prefer not to say	10 (2.3)	3 (1.5)	7 (3.0)	
Race n (%)	Asian American	329 (75.5)	145 (72.9)	184 (77.6)	0.09
	Asian Indian	70 (16.1)	29 (19.6)	41 (21.2)	
	Chinese	80 (18.3)	40 (27.0)	40 (20.7)	
	Filipino	55 (12.6)	18 (12.2)	37 (19.2)	
	Japanese	19 (4.4)	6 (4.1)	13 (6.7)	
	Korean	29 (6.7)	13 (8.8)	16 (8.3)	
	Vietnamese	28 (6.4)	11 (7.4)	17 (8.8)	
	Cambodian	2 (0.5)	1 (0.7)	1 (0.5)	
	Indonesian	2 (0.5)	1 (0.7)	1 (0.5)	
	More than one Asian Group	19 (4.4)	9 (6.1)	10 (5.2)	
	Other	37 (8.5)	20 (13.5)	17 (8.8)	

	Native Hawaiian and/or Pacific Islander	95 (21.8)	51 (25.6)	44 (18.6)	
	Native Hawaiian	53 (12.2)	27 (50.0)	26 (49.1)	
	Tongan	7 (1.6)	4 (7.4)	3 (5.7)	
	Samoan	19 (4.4)	9 (16.7)	10 (18.9)	
	Micronesian	6 (1.4)	5 (9.3)	1 (1.9)	
	Guamanian (Chamorro)	12 (2.8)	6 (11.3)	6 (11.1)	
	More than one NHPI	8 (1.8)	3 (5.6)	5 (9.4)	
	Other	2 (0.5)	2 (3.8)	0 (0.0)	
	Both Asian American, Native Hawaiian and/or Pacific Islander	12 (2.8)	3 (1.5)	9 (3.8)	
Class Standing <i>n</i> (%)	Freshman	94 (21.6)	45 (22.6)	49 (20.7)	0.32
	Sophomore	102 (23.4)	39 (19.6)	63 (26.6)	
	Junior	81 (18.6)	36 (18.1)	45 (19.0)	
	Senior	159 (36.5)	79 (39.7)	80 (33.8)	
Grade Point Average <i>n</i> (%)	Less than 1.99	8 (1.8)	2 (1.0)	6 (2.5)	0.08
	2.00-2.49	15 (3.4)	5 (2.5)	10 (4.2)	
	2.50-2.99	47 (10.8)	23 (11.6)	24 (10.1)	
	3.00-3.49	139 (31.9)	53 (26.6)	86 (36.3)	
	3.50-4.00	227 (52.1)	116 (58.3)	111 (46.8)	
Living Arrangement <i>n</i> (%)	On- campus	129 (29.6)	69 (34.7)	60 (25.3)	0.03
	Off- campus	307 (70.4)	130 (65.3)	177 (74.7)	
Employment <i>n</i> (%)	No	268 (61.5)	116 (58.3)	152 (64.1)	0.21
	Yes	168 (38.5)	83 (41.7)	85 (35.9)	
Region <i>n</i> (%)	South	166 (38.1)	73 (39.2)	93 (36.7)	0.90
	Midwest	89 (20.4)	43 (21.6)	46 (19.4)	
	Northeast	75 (17.2)	33 (16.6)	42 (17.7)	
	West	106 (24.3)	50 (25.1)	56 (23.6)	

Notes: *Group 1*: AANHPI students who consumes the recommended five or more cups F&V

Group 2: AANHPI students who do not consume the recommended five cups of F&V

P values less than 0.05 are considered statistically significant.

Confirmatory Factor Analysis

Confirmatory factor analysis extraction method with the maximum likelihood approach was conducted on a sample size $n = 436$ among seven subscales of the MTM (advantages, disadvantages, behavioral confidence, changes in the physical environment, emotional transformation, practice for change, and the changes in the social environment). Construct

validation yielded a one-factor solution for each MTM subscale, generating Eigenvalues greater than 1 and all factor loadings exceeded the critical value of 0.32 (Tavakol & Wetzel, 2020). However, one item under the participatory dialogue – disadvantages construct had the lowest factor loading of 0.161. This item asked participants, “If you eat five cups of fruits and vegetables every day you will have more food-related expenses.” Factor loadings ranged from 0.507 to a maximum loading of 0.880 (Table 2).

The total variance of each subscale is reported in Table 2. Regarding the MTM initiation constructs, advantages items account for 41.43% of the total variance, while disadvantages items accounted 32.84% of the variance, behavioral confidence 49.58% of the variance, and changes in the physical environment 41.29% of the variance. Conversely, the MTM sustenance construct, specifically emotional transformation items explained 61.63% of the total variance in the questionnaire, while practice for change items accounted for 50.75%, and changes in the social environment items accounted for 50.35% of the total variance.

Table 2: Confirmatory Factor Analysis: Construct Validity of MTM Construct Variables

MTM Construct	Item	Corresponding Factor Loadings	Eigenvalues	Overall Variance Explained by the Factor
Advantages			2.071	41.43%
	If you eat five cups of fruit and vegetables every day you will be healthy.	0.696		
	If you eat five cups of fruit and vegetables every day you will have variety in meals.	0.601		
	If you eat five cups of fruit and vegetables every day you will manage your weight.	0.747		
	If you eat five cups of fruit and vegetables every day you will have more energy.	0.616		
	If you eat five cups of fruit and vegetables every day you will have tasty food.	0.536		
Disadvantages			1.642	32.84%
	If you eat five cups of fruit and vegetables every day you will not have enough proteins in your diet.	0.590		

	If you eat five cups of fruit and vegetables every day you will be hungry most of the time.	0.707		
	If you eat five cups of fruit and vegetables every day you will have less energy.	0.715		
	If you eat five cups of fruit and vegetables every day you will have more food-related expenses.	0.161		
	If you eat five cups of fruit and vegetables every day you will enjoy meals less.	0.507		
Behavioral Confidence			2.479	49.58%
	How sure are you that you will eat five cups of fruit and vegetables every day this week?	0.715		
	How sure are you that you will eat five cups of fruit and vegetables every day this week while maintaining your budget?	0.699		
	How sure are you that you will eat five cups of fruit and vegetables every day this week while enjoying the meals?	0.751		
	How sure are you that you will eat five cups of fruit and vegetables every day this week without getting fed up of eating them?	0.686		
	How sure are you that you will eat five cups of fruit and vegetables every day this week without feeling hungry?	0.666		
Changes in the Physical Environment			1.239	41.29%
	How sure are you that you will have fruits and vegetables available to you for all meals?	0.789		
	How sure are you that you will be able to eat fruits and vegetables at a restaurant?	0.541		
	How sure are you that you will be able to afford fruit and vegetables for meals?	0.568		
Emotional Transformation			1.849	61.63%
	How sure are you that you can direct your emotions/feelings to the goal of eating five cups of fruits and vegetables every day?	0.730		
	How sure are you that you can motivate yourself to eat five cups of fruit and vegetables every day?	0.880		
	How sure are you that you can overcome self-doubt in accomplishing the goal of eating five cups of fruits and vegetables every day?	0.736		

Practice for Change			1.522	50.75%
	How sure are you that you can keep a self-diary to monitor eating five cups of fruits and vegetables every day?	0.626		
	How sure are you that you can be able to eat five cups of fruit and vegetables every day if you encounter barriers?	0.836		
	How sure are you that you can change your plan for eating five cups of fruits and vegetables every day if you face difficulties?	0.657		
Changes in the Social Environment			1.510	50.35%
	How sure are you that you can get the help of a family member to support you with eating five cups of fruits and vegetables every day?	0.736		
	How sure are you that you can get the help of a friend to support you with eating five cups of fruit and vegetables every day?	0.771		
	How sure are you that you can get the help of a health professional to support you with eating five cups of fruit and vegetables every day?	0.611		

Notes: Extraction method: Maximum likelihood

Descriptive Statistics and Internal Consistency of MTM Construct Variables

Table 3 illustrates the descriptive statistics of the MTM constructs. The independent variables are all the MTM constructs (i.e., participatory dialogue, behavioral confidences, changes in the physical environment, emotional transformation, practice for change, and changes in the social environment). The dependent variables are represented by the initiation and sustenance of F&V consumption among AANHPI college students.

The mean scores for initiation and sustenance were significantly different across the groups who reported not meeting the recommended daily cups of F&V and those who met the recommended daily cups of F&V (Table 3). Mean scores were highest among the AANHPI college students who reported the intake of five cups or more of F&V when compared to the AANHPI college students with reported lower consumption of less than five cups of F&V. The

constructs, behavioral confidence, changes in the physical environment, emotional transformation, practice for change, and changes in the social environment were highly associated among the AANHPI students who reported consuming five or more cups of F&V daily. Conversely, no significant difference was found in participatory dialogue between AANHPI college students who consumed the recommended five cups of F&V daily and those who did not.

Among AANHPI students who consumed five or more cups of F&V daily the mean scores were higher ($M = 2.62$, $SD = 0.98$) compared to those not consuming the recommended five cups of F&V daily ($M = 1.71$, $SD = 1.00$). This showed a statistically significant mean difference of 0.91, 95% CI [0.723, 1.098, $p < 0.0001$, Table 3]. It was also found that the mean sustenance score was higher among those who consumed five or more daily cups of fruit and vegetables ($M = 2.39$, $SD = 1.13$) than those who were not consuming the recommended five cups of F&V ($M = 1.44$, $SD = 1.05$). This showed a statistically significant mean difference of 0.95, 95% CI [0.744, 1.154, $p < 0.0001$, Table 3].

In table 3, Cronbach's alpha was also reported. Cronbach's alpha was used to assess the internal consistency across all MTM constructs among AANHPI college students who were meeting the recommended F&V daily consumption ($n=237$) and with those who did not ($n=199$). The commonly acceptable Cronbach's alpha value is 0.70; however, both participatory dialogue – disadvantages (0.65), and changes in the physical environment (0.66), fell below this acceptable threshold.

Table 3: Mean and Score Ranges of MTM Constructs Based on F&V Consumption

Groups	Five or more cups (n = 199)				Less than five cups (n = 237)				p-value
	Possible score range	Observed score range	Mean ± S.D.	Cronbach's alpha	Possible score range	Observed score range	Mean ± S.D.	Cronbach's alpha	
Initiation	0–4	0–4	2.62±0.98	-	0–4	0–4	1.71±1.00	-	<0.0001
Participatory dialogue: advantages	0–20	4–20	14.16±2.80	0.73	0–20	0–20	13.29±3.41	0.80	0.004
Participatory dialogue: disadvantages	0–20	0–18	8.04±3.31	0.67	0–20	0–18	8.02±3.13	0.65	0.951
Participatory dialogue: advantages—disadvantages score	-20–20	-5–+20	6.12±4.53	-	-20–+20	-10–+18	5.27±5.02	-	0.066
Behavioral confidence	0–20	0–20	12.01±3.97	0.80	0–20	0–20	7.77±3.95	0.77	<0.0001
Changes in the physical environment	0–12	0–12	6.91±2.67	0.66	0–12	0–12	5.65±2.77	0.64	<0.0001
All Initiation scales	-	-	-	0.74	-	-	-	0.71	-
Sustenance	0–4	0–4	2.39±1.13	-	0–4	0–4	1.44±1.05	-	<0.0001
Emotional transformation	0–12	0–12	7.53±2.56	0.81	0–12	0–12	5.77±2.86	0.81	<0.0001
Practice for change	0–12	0–12	6.39±2.63	0.71	0–12	0–12	4.83±2.71	0.73	<0.0001
Changes in the social environment	0–12	0–12	7.07±2.72	0.74	0–12	0–12	5.85±3.02	0.73	<0.0001
All Sustenance scales	-	-	-	0.85	-	-	-	0.85	-
Entire scale	-	-	-	0.87	-	-	-	0.86	-

Pearson Correlation between MTM Constructs and Likelihood of Initiation and Sustenance

Table 4 describes the Pearson correlations among all MTM constructs and the likelihood of initiation and sustenance by meeting the daily F&V consumption guidelines (i.e., five or more cups vs less than five cups) among AANHPI college students.

There was a direct correlation between participatory dialogue and the following constructs: behavioral confidence ($r = 0.317, p < 0.001$), changes in the physical environment ($r = 0.264, p < 0.001$) emotional transformation ($r = 0.326, p < 0.001$), practice for change ($r = 0.237, p < 0.001$), and changes in the social environment ($r = 0.264, p < 0.001$). Furthermore, there was a strong correlation between behavioral confidence and four constructs: changes in the physical environment ($r = 0.516, p < 0.001$), emotional transformation ($r = 0.624, p < 0.001$), practice for change ($r = 0.548, p < 0.001$), and changes in the social environment ($r = 0.495, p < 0.001$). Additionally, there was a direct correlation between changes in the physical environment with three constructs: emotional transformation ($r = 0.484, p < 0.001$), practice for change ($r = 0.426, p < 0.001$), and changes in social environment ($r = 0.534, p < 0.001$). Emotional transformation had a high correlation between practice for change ($r = 0.638, p < 0.001$), and changes in the social environment ($r = 0.528, p < 0.001$). Lastly, there was a correlation between the following two constructs, practice for change and changes in the social environment ($r = 0.525, p < 0.001$).

Table 4: Pearson Correlations between MTM Constructs

MTM Construct	Participatory Dialogue	Behavioral Confidence	Changes in the Physical Environment	Emotional Transformation	Practice for Change	Changes in the Social Environment
1. Participatory Dialogue	1	0.317** [0.230, 0.399]	0.264** [0.175,0.349]	0.326** [0.240, 0.408]	0.237** [0.147,0.324]	0.264** [0.174, 0.349]
2. Behavioral Confidence		1	0.516* [0.443, 0.582]	0.624** [0.564, 0.679]	0.548** [0.479, 0.611]	0.495** [0.421,0.563]
3. Changes in the Physical Environment			1	0.484** [0.409,0.553]	0.426** [0.346, 0.500]	0.534** [0.464,0.598]
4. Emotional Transformation				1	0.638* [0.579, 0.691]	0.528* [0.457, 0.593]
5. Practice for Change					1	0.525** [0.453, 0.589]
6. Changes in the Social Environment						1

** $p < 0.01$; Participatory dialogue is represented by perceived advantages and perceived disadvantages

Hierarchical Multiple Regression (HRM) among MTM Constructs and Covariates

A hierarchical multiple regression analysis was conducted to assess the association between the likelihood of initiation and the consecutive incorporation of the MTM initiation constructs. This analysis conducted controlled for socio-demographic characteristics of age, gender, GPA, class standing, living arrangement, and employment (Table 5).

Among the AANHPI college students who do not meet the daily recommended five cups of F&V, Model 4 showed a statistically significant likelihood of initiation, $R^2 = 0.362$, $F(1, 227) = 8.603$, p -value = 0.004 with an adjusted $R^2 = 0.337$ (refer to Table 5). With the addition of behavioral confidence, Model 3 showed an increase in R^2 of 0.338, $F(1, 228) = 80.632$, $p < 0.0001$. The dependent variable regarding sustenance, showed the full model (Model 4) had an increase in $R^2 = 0.337$, $F(1, 227) = 12.813$, p -value = 0.005 with an adjusted $R^2 = 0.311$ (Table 5). Furthermore, Model 3 (the addition of practice for change) also showed a statistically significant increase in R^2 of 0.313, $F(1, 228) = 11.355$, $p < 0.001$

Table 5: Hierarchical Multiple Regression among AANHPI College Students Who Do Not Consume the Recommended Five Cups of F&V Daily (N=237) – Initiation and Sustenance Models

Do not consume the recommended daily five cups of F&V	B	SE	Beta	p	95.0% CI for B	
					LL	UL
Initiation						
Age	-.003	.006	-.029	.597	-.015	.009
Gender (ref Male)	.028	.111	.014	.800	-.191	.248
GPA (ref upper)	-.213	.146	-.080	.145	-.500	.074
Class standing	-.067	.111	-.033	.546	-.285	.151
Living arrangements (ref off-campus)	.166	.129	.072	.199	-.088	.420
Employment (ref employed)	.114	.113	.055	.313	-.108	.336
Participatory Dialogue	.015	.011	.076	.185	-.007	.037
Behavioral Confidence	.119	.015	.470	<.001	.090	.149
Changes in the Physical Environment	.061	.021	.169	.004	.020	.102
Model Statistics: predictors of covariates and all three MTM initiation constructs (participatory dialogue, behavioral confidence, and changes in the physical environment) produced the following results: $R^2 = 0.362$, $F(1, 227) = 8.603$, p -value = 0.004; adjusted $R^2 = 0.337$						
Sustenance						
Age	-.001	.006	-.011	.840	-.014	.011
Gender (ref Male)	-.041	.116	-.019	.725	-.270	.188
GPA (ref upper)	.013	.155	.005	.933	-.293	.319
Class standing	.100	.118	.048	.397	-.133	.333
Living arrangements (ref off-campus)	.344	.136	.143	.012	.076	.612
Employment (ref employed)	-.040	.120	-.018	.740	-.277	.197
Emotional Transformation	.110	.027	.301	<.001	.058	.163
Practice for Change	.070	.028	.182	.012	.016	.125
Changes in the Social Environment	.065	.023	.186	.005	.020	.109
Model Statistics: predictors of covariates and all three MTM sustenance constructs (emotional transformation, practice for change, and changes in the social environment) produced the following results: $R^2 = 0.337$, $F(1, 227) = 12.813$, p -value = 0.005; adjusted $R^2 = 0.311$						

Note. Abbreviations: B = Coefficient Estimate, SE = Standard Error, Beta = Standardized Coefficient, LL = Lower Limit, UL = Upper Limit

Hierarchical multiple regression analysis was conducted to assess the association between the likelihood of sustenance and the sequential addition of its corresponding constructs— emotional transformation, practice for change, and changes in the social environment, while controlling for socio-demographic characteristic of age, gender, GPA, class standing, living arrangement, and employment (Table 6).

Among the AANHPI college students who do consume the recommended five cups of F&V daily, Model 2 showed a statistically significant likelihood of sustenance. Model 2 (the addition of emotional transformation) showed a significant increase in R^2 of 0.277, $F(1, 191) = 63.814, p < 0.001$. Furthermore, Model 3 (the addition of practice for change) also showed a significant increase in R^2 of 0.354, $F(1, 190) = 22.378, p\text{-value} < 0.001$; adjusted $R^2 = 0.326$ (Table 6).

Table 6: Hierarchical Multiple Regression Among AANHP College Students and Sustenance of Consuming Five or More Cups of F&V (N=199) – Sustenance Model

Consume the recommended daily five cups of F&V	<i>B</i>	<i>SE</i>	Beta	<i>p</i>	95.0% CI for B	
					LL	UL
Sustenance						
Age	.006	.007	.058	.348	-.015	.009
Gender (ref Male)	-.065	.134	-.028	.630	-.191	.248
GPA (ref upper)	-.059	.187	-.019	.752	-.500	.074
Class standing	.103	.142	.045	.467	-.285	.151
Living arrangements (ref off-campus)	-.106	.145	-.045	.468	-.088	.420
Employment (ref employed)	.259	.136	.113	.058	-.108	.336
Emotional Transformation	.122	.033	.276	<.001	-.007	.037
Practice for Change	.139	.033	.058	<.001	.090	.149
Changes in the Social Environment	.023	.030	-.028	.447	.020	.102
Model Statistics: predictors of covariates and two MTM sustenance constructs (emotional transformation, and practice for change) produced the following results: $R^2 = 0.354$, $F(1, 190) = 22.378$, p -value < 0.001; adjusted $R^2 = 0.326$						

Logistic Regression Model among MTM Constructs, Covariates, and Meeting F&V Guidelines

Females had a 76.5% increase in odds of consuming five or more cups of fruit and vegetables compared with males (Odds Ratio [OR]: 1.765, 95% Confidence Interval [CI]: 0.460-1.173., $p = 0.013$). Those who were living on campus had an 82% increase in the odds of consuming five or more cups of fruit and vegetables when compared with those who do not live on campus (OR: 1.82, 95% CI: 1.098-3.017, $p=0.020$). Those expressing higher behavioral confidence had a 1.33 times higher likelihood to consume five or more cups of F&V compared with those with lower behavioral confidence. The odds of consuming five or more cups of F&V were not significantly associated with age, participatory dialogue, changes in the physical environment, emotional transformation, practice for change, or changes in the social environment (Table 7).

Table 7: Multiple Logistic Regression to Investigate Factors Associated with Meeting F&V Guidelines

Variables	Odds Ratio	95% Confidence Interval		P value
Age	1.01	0.985	1.037	0.410
Gender: Female vs. Male	1.76	1.127	2.765	0.013
Class Standing: Lower Classman vs. Upperclassman	0.73	0.460	1.173	0.196
GPA: Below a 3.0 vs. Above a 3.0	1.02	0.556	1.855	0.960
Living Arrangement: On campus vs. Off-campus	1.82	1.098	3.017	0.020
Work status: Yes vs. No	1.10	0.693	1.737	0.693
Participatory Dialogue	0.97	0.919	1.015	0.170
Behavioral Confidence	1.33	1.224	1.437	<0.001
Changes in the Physical Environment	0.96	0.861	1.058	0.377
Emotional Transformation	1.05	0.932	1.176	0.437
Practice for Change	1.03	0.918	1.147	0.648
Changes in the Social Environment	0.98	0.855	1.085	0.699

* p -value < 0.05

Summary

Chapter four described the study's findings through descriptive statistics, confirmatory factor analysis, Pearson correlation, hierarchical multiple regression, and logistic regression. These analyses collectively contribute to describing MTM constructs associated with daily F&V consumption behaviors among AANHPI college students. The MTM initiation constructs were statistically significant in explaining the intent of initiation of F&V consumption among AANHPI college students who reported not consuming the recommended five cups of F&V daily. Further only two sustenance constructs, emotional transformation and practice for change

were significantly associated with the intent to sustain F&V consumption behaviors among AANHPI college students who did not meet the recommended five cups of F&V and students who did meet the recommended daily intake. The next chapter will discuss further the significant findings from this study along with the strengths and limitations, future research recommendations, and implications for practice.

Chapter 5: Discussion

Introduction

This study utilized a quantitative theory-based survey research design based on the MTM constructs of health behavior change to explain the intention AANHPI college students in the U.S. to initiate and sustain daily consumption of five cups of F&V. This chapter discusses the key findings of this study as described in chapter four as it relates to the literature. Furthermore, the strengths and limitations of this study will be discussed, along with validity and reproducibility. Implications for practice, recommendations for research, and a final summary will be provided as concluding remarks of this study.

Summary of Purpose and Findings

Results revealed that all the MTM initiation constructs (specifically, participatory dialogue, behavioral confidence, and changes in the physical environment) were associated with the intent to initiate F&V consumption behaviors among AANHPI college students who did not meet the recommended daily five cups of F&V. These constructs were found to be significantly associated with the intent to initiate F&V consumption and accounted for 33.7% of the variance among students who expressed not meeting the recommended five cups of F&V. The variance appears relatively low compared to similar studies (Sharma et al., 2018), this may suggest further exploration or refinement of the model. Similarly, the three components of the MTM sustenance model (specifically, emotional transformation, practice for change, and changes in the social environment), proved to be associated with intention to maintain F&V consumption behaviors among AANHPI college students. These factors accounted for 31.1% of the variance among students who reported not consuming the recommended five cups of F&V. Also, this study examined the sustenance of students who reported they consumed five cups of F&V daily, and

only two MTM sustenance components (specifically, emotional transformation and practice for change) were associated with intention to sustain and maintain F&V consumption behaviors and accounted for 32.6% of the variance.

Interpretation of Findings

Descriptive Statistics

There was a trend towards higher adherence to the consumption of fruit and vegetable guidelines among Asian Americans (75.5% of the overall sample). However, a more detailed analysis revealed variations within Asian American subgroups. For instance, Chinese participants had a higher prevalence of meeting the guidelines compared to other Asian groups. There was variability in fruit and vegetable consumption adherence among NHPI, with NH showing higher adherence to meeting the fruit and vegetable consumption levels. In this study, there were differences in fruit and vegetable (F&V) consumption among AANHPI students based on gender, with females indicating a higher F&V consumption compared to males. These findings align with previous studies that observed gender differences in F&V consumption (Mello Rodrigues et al., 2019; Albrahim et al., 2017).

Initiation of Consuming the Recommended Daily Five Cups of F&V Behavior

As previously noted, the college years represent a pivotal time for developing healthy habits and self-efficacy concerning one's health (Mello Rodrigues et al., 2019; Nelson et al., 2008). Previous studies show that specific factors influence F&V consumption among college students which include perceived benefits, self-efficacy for healthy eating, and accessibility (Jung et al., 2020). These factors were also examined in this current study. Approximately 33.7% of the variance in the likelihood to engage in the initiation of F&V consumption was explained by all MTM initiation constructs, namely, the advantages and disadvantages

(participatory dialogue), the sureness of consuming five cups of F&V (behavioral confidence) and how readily accessible resources are for F&V consumption (changes in the physical environment), among students who are not meeting the recommended daily cups of F&V ($p < 0.004$). These findings underscore the importance of these factors in influencing health behavior change towards F&V consumption among AANHPI college students.

The score for participatory dialogue would be higher if the perceived advantages outweighed disadvantages; however, in this study participants who did not meet the recommended intake of five or more cups of F&V perceived greater disadvantages than advantages in consuming five or cups of F&V. Each unit increase in participatory dialogue accounted for a 0.076 increase in the likelihood of the initiation of consuming the recommended daily five cups of F&V. This suggests that students with a more favorable perceived balance of perceived advantages over disadvantages had a higher likelihood of taking the initial steps towards meeting the recommended daily five cups of fruit and vegetables intake.

Furthermore, each unit of increase of behavioral confidence and changes in the physical environment corresponded to 0.470 and 0.169 increase, respectively, in the likelihood of initiating the consumption of the recommended daily intake of five cups of F&V. In behavioral and social science research, the strength and meaningfulness of these associations has been assessed in terms of an adjusted R^2 (Ozili, 2022; Sharma, 2015).

The contributions of MTM initiation constructs has been established through investigating other health behaviors among college students such as physical activity (Nahar et al., 2016), smaller portion size consumption (Sharma et al., 2016), and water consumption instead of sugar-sweetened beverages (Sharma et al., 2017). Additionally, self-efficacy is a construct like behavioral confidence which has been adequately used in the examination of fruit

and vegetable consumption behaviors among children and young adults (Al-Otaibi, 2014; Ahn et al. 2016; Kreausukon et al., 2012; Najimi & Ghaffari 2013). This suggests that initiation and behavioral confidence likely play an important role in fruit and vegetable consumption behaviors that deserve further study in future behavioral interventions.

There were statistically significant differences between all MTM initiation constructs (specifically, participatory dialogue, behavioral confidence, and changes in the physical environment) ($p < 0.001$) among ANNHPI college students. Notable differences were prominent in students who reported consuming five or more cups of F&V compared with students who were not meeting these guidelines. This finding supports the potential value of MTM constructs in helping to understand factors important for meeting recommended five cups of fruits and vegetables guidelines among college students. The design of theoretical health interventions and culturally tailored social marketing campaigns should utilize the constructs of participatory dialogue, behavioral confidence, and changes in the physical environment to encourage the consumption of the recommended daily five cups of F&V among AANHPI college students.

Sustenance of Consuming Recommended Daily Five Cups of F&V Behavior

The study examined the associations with MTM in sustaining the consumption of the recommended daily five cups of F&V. Specifically, the sustenance model was analyzed among students who reported not meeting the daily recommended five cups of F&V daily and revealed a 31.1% of the variance in the likelihood to sustain the daily consumption of five cups of F&V, which was consistent to other studies (Sharma et al., 2018). All three sustenance constructs: emotional transformation (i.e., transforming one's emotions into goals of consuming the daily five cups F&V), practice for change (i.e., the constant thinking of plans to maintain the consumption of fruits and vegetables), and changes in the social environment (i.e., the support

from family, friends, peers, and health professionals to continue the consumption of fruits and vegetables) were significantly associated with sustenance of fruit and vegetable consumption behaviors. Every unit increase in emotional transformation accounted in a 0.301 emotional transformation increase in the likelihood of sustaining the daily consumption of five cups of F&V. For each unit of increase of practice for change, there was a 0.182 increase in likelihood of sustaining the daily consumption of five cups of F&V. Similarly, a unit increase in changes in the social environment corresponded to a 0.186 rise.

Moreover, among students who reported consuming five cups of F&V, two MTM sustenance constructs, namely, emotional transformation and practice change accounted for approximately 32.6% of the variance in the likelihood of sustaining adequate consumption of five cups of F&V daily, which is consistent with a previous study assessing fruit and vegetable intake (William et al., 2020). A study conducted by William et al. among adult African American men from barbershops, yielded results consistent with this study's findings, which showed the changes in the social environment, an MTM sustenance construct, did not predict the intention to sustain daily consumption of F&V (2020). This may be due to AANHPI college students' determination of making their own decisions regarding their dietary behaviors and stepping outside of their own cultural norms and parental influence.

Additionally, emotional transformation and living arrangement (on-campus) were statistically significant predictors suggesting that individuals with higher emotional transformation and living on campus were more likely to meet the recommended fruit and vegetable consumption guidelines. Further, Gender (females) was statistically significant predictor in which females had a higher odd of meeting the guidelines of consuming five cups or

more of fruits and vegetables when compared to males which is consistent with other studies (Odum & Xu, 2019; Boek et al., 2012; Mello Rodrigues et al., 2019)

Strengths of the Study

This study provided evidence indicating that daily consumption of five cups of F&V can be explained through a theory-based research study design. These findings can be used to inform future interventions. Additionally, this study focused uniquely on the aspects of initiation and sustenance of daily consumption of F&V among AANHPI college students, in which there is a lack of studies solely focusing on this population. This study used a previously validated survey instrument assessing fruit and vegetable consumption behaviors among college students, further providing a foundation for reliability and validity of the study's findings. This study utilized a theory-based instrument designed for assessing F&V consumption among AANHPI college students. While the instrument has been used in previous research (Hayes et al., 2019; Kapukotuwa et al., 2023; Nerida et al., 2023) it is important to note that the theoretical constructs within this instrument have undergone thorough testing specifically in the context of our investigation (Brown et al., 2019; William et al., 2020; Sharma et al., 2018).

This study contributes to the growing body of research by providing valuable insights into F&V consumption behaviors among college students, further validating and extending the applicability of the theoretical constructs in this unique population. Using a cross-sectional study design has limitations; however, it provided quick results at a meager cost. This type of study design is unable to establish causation (Setia, 2016).

Limitations of the Study

This study had several limitations. This study relied on self-reported data which introduces several biases such as recall, response and social desirability biases (Althubaiti, 2016). A single 24-hr recall is unable to account for day-to-day variation of diet, thus it has the

potential to underestimate or overestimate consumption (Gibson et al., 2017). However, the primary approach for measuring attitudes towards health behavior relies only on self-reported measurements. Another limitation is the study did not test the instrument's reliability over time which is important to conduct before experimental studies.

The generalizability of this study is limited, due to the specific characteristics of the chosen sample. Most participants were predominately of Asian American identity (75.5%); thus, the study's findings were more applicable towards Asian American subgroups than NHPI groups. Additionally, the study resulted in only 95 respondents from NHPI populations which presents challenges in drawing conclusions about this group's F&V consumption behaviors. Consequently, the study's findings may not be broadly applicable to all college students and adults, and caution should be applied when interpreting the study's results.

Reproducibility and Validity of the Study

Chapter 3 describes the study's reproducibility and validity. For future studies aiming to reproduce these findings, several suggestions and recommendations should be addressed as they relate to the survey instrument. Specifically, the face and content validity of the survey were not explicitly examined in this study. Validity and reliability of the survey questions should involve a panel of six experts with expertise in behavioral theory, public health, and the AANHPI population as well as repeat testing of measures. This approach would contribute to refining the survey tool for use in diverse populations such as AANHPIs. Face and content validity was not performed on the study's survey tool based on the prior validation of the survey instrument among college students.

Furthermore, confirmatory factor analysis results indicated that all items in the survey were valid in assessing the appropriate intended construct. This was determined based on factor

loadings greater than critical threshold of 0.326 and an Eigenvalue greater than or equal to 1. The examination of the construct of participatory dialogue- disadvantages revealed that one item did not meet critical value. The item addressing participatory dialogue – disadvantages, was related to increased food-related expenses due to consuming F&V daily and yielded a factor loading 0.161, which is below the critical threshold 0.326, thus future studies may be needed to improve its validity. Each MTM construct had a Cronbach's alpha above 0.70 which further supports the reliability of this instrument and that the constructs were consistently measuring the same aspects. Therefore, this instrument is reliable and should be considered for future studies addressing F&V consumption behaviors among AANHPI populations and in the development and implementation of theory-based interventions.

Research Recommendations

This study underscores the need for longitudinal and experimental studies to determine the causal relationships between the MTM constructs and F&V daily consumption among AANHPI college students. It may be advantageous to explore the variation in fruit and vegetables consumption behaviors among the different subgroups within the AANHPI community. Aggregated data within the AANHPI group prevents researchers' ability to discern health disparities and inequities within each subgroup, posing challenges in developing effective interventions due to the immense diversity among AANHPI subgroups. Investigating how cultural norms, traditions and values impact the initiation and sustenance of F&V consumptions can help researchers understand what factors influence food choices and dietary behaviors within the AANHPI community.

As mentioned previously, validating the survey instrument further through face and content validity can improve the tool's reliability and relevance for the AANHPI population. Utilizing a mixed-methods approach that combines quantitative and qualitative data like focus

group or semi-structured interviews can provide a more comprehensive understanding of the factors influencing AANHPI college student's dietary behaviors. Further designing technology-based interventions (Fackler et al., 2021) that utilize applications or online platforms can deliver culturally tailored messages to promote fruit and vegetable consumption within the AANHPI college student population.

Implications For Practice

The findings from this study support use of the MTM for designing and evaluating interventions aimed at promoting fruit and vegetable consumption among AANHPI college students. This study demonstrates a need for individual-behavior interventions targeted at AANHPI college students as understanding and addressing health behaviors at an individual-level are essential in health promotion and intervention efforts. Designing culturally tailored interventions is important for the effectiveness and relevance of these interventions. The AANHPI population is very diverse, thus it is important to consider cultural norms, traditions, and values related to food health and dietary practices.

Utilizing the MTM construct of participatory dialogue should be considered in health behavior interventions, as a two-day dialogue with program facilitators that address the advantages and disadvantages of having a healthy diet rich in fruits and vegetables. Utilizing public health professionals and medical professionals like physicians can serve as facilitators for reinforcing this two-way participatory dialogue on aspects of a healthy diet. Building behavioral confidence can be done through programs that teach students healthy grocery shopping habits, implement goal-setting activities that are aligned with cultural values and preferences, and participating in cooking classes that introduce students to ways of meal prepping fruits and vegetables would be beneficial in boosting confidence in including F&V into daily meals.

Regarding the physical environment, changes can be employed by college campuses by improving the accessibility of F&V by offering options of affordable healthy vending machines around campus. Additionally, if the cost of fruits and vegetables were reduced, this could make them more affordable and accessible to students on campus which can encourage students to make healthier food choices (Dhillon et al., 2019; Henley et al., 2023; van den Bogerd et al., (2020).

Regarding building long-term F&V consumption behaviors among AANHPI college students, they may need to learn how to direct their emotions towards consuming adequate cups of F&V daily. This can be achieved by role playing methods, in which a student can learn how to overcome barriers and self-motivate oneself in consuming meals that have adequate F&V (Guillaumie et al., 2012; Peng, 2009). To improve the construct of practice for change, participants can meet with health educators/nutritionists on campus to learn about different strategies (mobile application or diary/log) on how to monitor their behaviors and identify ways to accomplish their healthy eating goals. To reinforce changes in the social environment construct, it is essential to integrate various forms of social support (i.e., friends, family, peers, or health professionals) when designing health promotion interventions.

Conclusions

In conclusion, this study utilized a quantitative theory-based survey design to investigate the initiation and sustenance of daily F&V consumption among AANHPI college students in the U.S.. This study found that a substantial amount of AANHPI college students were not adhering to the daily recommended five cups of F&V. Further, this study showed evidence that the MTM theoretical framework can help promote F&V consumption behaviors among AANHPI college students. Specifically, among AANHPI college students who were not adhering to the daily recommended five cups of F&V, the MTM constructs related to initiation, namely participatory

dialogue, behavioral confidence, and changes in the physical environment were significant factors in influencing initiating the behavior of F&V consumption. The MTM constructs related to sustenance, namely emotional transformation, practice for change, and changes in the social environment were also found to be significant predictors of long-term F&V consumption behaviors.

This study also examined the sustenance of AANHPI students who met the recommended F&V consumption behaviors and found that only emotional transformation and practice for changes were vital, thus further research is needed in determining what social environmental factors are influential in this group. Lastly, there is a need to develop and implement culturally tailored interventions to assess MTM for efficacy and effectiveness in fruit and vegetable consumption behaviors among AANHPI college students.

Appendix A

Summary of Theory-Based F&V Interventions - Literature Review

Author(s)/Year	Purpose	Sample	Behavioral Theory	Study Design	Intervention	Results
Kothe et al., 2012	To evaluate the impact of a theory-based F&V intervention	Australia University 1st year undergraduate (n = 194)	Theory of Planned Behavior	Pretest/Posttest	Duration 30-day program Intervention group: received Fresh Facts	F&V consumption increased by 0.83 servings/day Intention, attitudes, subjective norms, and perceived behavioral control increased (p <.05)
Kreausukon et al., 2012	To improve F&V consumption based on two components: self-efficacy and action planning skills	Thailand Chiang Mai University Full-time undergraduate students (n = 114) enrolled in second semester psychology class	The Health Action Process Approach	Randomized Controlled Trial	Duration: 2.5 hours over the weekend Intervention group: nutrition information based on Thailand's nutrition guidelines presented by a trained lecturer Control group: given general nutritional guidelines and asked to continue reading at home	F&V consumption was higher the intervention group when compared to control group.

Najimi & Ghaffari, 2013	To assess effectiveness of theory-based educational intervention on F&V consumption for grade 4 students	Isfahan, Iran Grade 4 students (n = 138)	Social Cognitive Theory	Randomized Controlled Trial	Duration: 4 weeks Intervention group: received nutrition 60 minute nutrition education over 4-week period. Control group: no specific nutritional education	SCT constructs of behavioral capability, self-efficacy, social support, and observational learning increased significantly after intervention exposure. F&V consumption increased
Kothe & Mullan, 2014	To evaluate a F&V intervention guided by Theory of Planned behavior	Australia University 1st year undergraduates (n = 162)	Theory of Planned Behavior	Randomized Controlled Trial	Duration: 30-day program called Fresh Facts Intervention group: received automated messages every 3 days ; two different email frequency levels- short and long Control group: no intervention	Fresh Facts did not increase F&V consumption

Duncan et al., 2015	To examine the impact of a school garden theory-based 12-week intervention on the intent and behavior related to children's fruit and vegetable consumption.	Coventry, UK Two primary schools Total participants (n = 77) Boys (n = 34) Girls (n = 43)	Theory of Planned Behavior	Non-randomized Controlled Trial	Duration: 12-weeks gardening intervention Intervention group: 12 weeks gardening curriculum Control group: standard school curriculum	Intervention increased F&V consumption (p<.01) and not in control group (p>.1) TPB constructs increased from pre to post
Ahn et al., 2016	To test a technology-assisted validation system integrated in the virtual pet system on F&V consumption.	Hampton, Georgia 4H Summer Camp Children 7-13 years old (n=68) Male (n=32) Female (n=36)	Social Cognitive Theory	Randomized Controlled Trial	Duration: 4 days Three experimental conditions: virtual dog, computer only, and baseline	F&V preferences increased in all three conditions. No significant differences between experimental conditions on F&V preferences.
Taghdisi et al., 2016	To determine the impact of a F&V educational intervention based on the Theory of planned behavior	Azerbaijan, Iran Elementary schools (n =6) 4-6th grade male students (n=184)	Theory of Planned Behavior	Quasi-randomized Controlled Trial	Duration: Jan 2013-Jun 2014 Intervention group (n = 94): four 45 min training sessions; one 60-min training sessions for	The nutritional education sessions significantly increased on every TPB construct (intention, attitude, subjective norm, and perceived

					<p>teachers and parents. Instructional booklet was given after the intervention sessions.</p> <p>Control group (n=90): received no nutritional education sessions.</p>	<p>behavioral control) among the intervention participants (p<.05).</p>
Lin et al., 2017	To evaluate the impact of a F&V intervention among high school students.	Qazvin, Iran High Schools (n=48) Students aged 13-18 (n=449)	The Health Action Process Approach	Cluster Randomized Controlled Trial	<p>Duration: 1 month and 6-months</p> <p>Intervention group: Mother/adolescent or Adolescent received a 20 minute discussion on healthy diets (F&V intake), and a brochure</p> <p>Control group: only received a questionnaire (HAPA constructs)</p>	<p>Intervention led to an increase of F&V consumption. Adolescents in the Mother/adolescent group had a higher increase of F&V than just the adolescent group.</p>

Menezes et al., 2018	To evaluate a F&V nutrition intervention effectiveness among vulnerable population	Belo Horizonte, Brazil Health Academy Program (n=18) Female participants; 20 years or older (n=1483)	Transtheoretical Model	Randomized Controlled Trial	Duration: 7 months Intervention group (n=9) Workshops; postcard; interactive based activities; informative material Control group (n=9)	Preliminary data showed F&V intervention was feasible for larger population groups and health service.
Brown et al., 2020	To design and evaluate a multi-theory F&V intervention among African American women.	Jackson, Mississippi African American women 18 years or older	Multi-Theory Model (MTM) of health behavior change	Randomized Controlled Trial	Duration: 8 weeks Intervention group (n=26): pretest, posttest and follow up- Sisters Adding Fruits and Vegetables for Optimal Results (SAVOR) Control group: (n=28); Knowledge based intervention	The SAVOR intervention showed an increase of consumption of F&V from pretest to posttest to follow up. All constructs of the MTM model were significant (p<0.05) in predicting F&V consumption except for participatory dialogue.

Appendix B

F&V Consumption Behaviors in AANHPI College Students – Survey Instrument



TITLE OF STUDY:

Utilizing the Multi-Theory Model (MTM) to Explain Fruit and Vegetable Consumption of Asian American, Native Hawaiian, and Pacific Islander College Students in the United States

INVESTIGATOR(S) AND CONTACT PHONE NUMBER:

Jason Flatt, Ph.D., Principal Investigator, (702) 895-5586

Nohealani Bareng-Antolin, MPH, Co-Principal Investigator, (702) 275-8783

To utilize a fourth-generation Multi-Theory Model (MTM) to explain the initiation and sustenance of fruit and vegetable consumption among Asian American, Native Hawaiian, and Pacific Islander (AANHPI) undergraduate college students in the United States. You are being asked to participate in the study because you meet the following criteria:

- 1) Enrolled as student undergraduate at a U.S. College or University
- 2) Identify as Asian American, Native Hawaiian and/or Pacific Islander
- 3) 18 years of age or older

If you volunteer to participate in this study, you will be asked to complete 43 questions on-line survey regarding your fruit and vegetable consumption behaviors.

Your participation in this study is voluntary. You may withdraw at any time. You are encouraged to ask questions about this study at the beginning or any time during the research study. There is no direct benefit of this survey to you, however your responses will help in developing effective health promotion programs. All data from this survey will be kept confidential and secured.

This study includes only minimal risks. The survey will take approximately 15 minutes of your time. For questions regarding the rights of research subjects, any complaints or comments regarding the manner in which the study is being conducted you may contact the University of Nevada Las Vegas (UNLV) Office of Research Integrity – Human Subjects at 702-895-2794, or via email at IRB@unlv.edu.

Participant Consent: I have read the above information and agree to participate in this study. I am at least 18 years of age. A copy of this form has been given to me.

If you agree to participate in this survey and meet the criteria listed above, please select yes to proceed to the survey.

- Yes
- No

Q1 During the past 24 hours how many total cups (8 oz.) of fruits did you eat?

Q2 During the past 24 hours how many total cups (8 oz.) of vegetables did you eat?

Q3 Please total your responses from Q1 and Q2. Is your total number \geq (greater than or equal to) 5?

- No
- Yes

Q4 What gender do you identify as?

- Male
- Female
- Other _____
- Prefer not to say

Q5 How old are you today? (provide a number in years- ex: 18 years old)

Q6 What is your race or ethnicity?

- Asian American, Native Hawaiian, and/or Pacific Islander
 - Neither Asian American, Native Hawaiian or Pacific Islander
-

Q7 What race or ethnicity do you associate yourself with? Please select all that apply.

- Asian
 - Native Hawaiian and or Pacific Islander
-

Q8 Which Asian group do you mostly identify with? (Select all that apply)

- Asian Indian (India)
 - Chinese
 - Filipino
 - Japanese
 - Korean
 - Vietnamese
 - Cambodian
 - Indonesian
 - Other (e.g., Pakistani, Hmong, etc.)
-

Q9 Which Pacific Islander group(s) do you associate yourself with? (Select all that apply)

- Native Hawaiian
 - Tongan
 - Samoan
 - Micronesian
 - Palauans
 - Guamanian (Chamorro)
 - Marshallese
 - Other (e.g., Tahitian, Chuukese, etc.)
-

Q10 What is your student class standing?

- Freshman
 - Sophomore
 - Junior
 - Senior
-

Q11 What is your current overall GPA (grade point average- on a 4.00 scale)?

- Less than 1.99
 - 2.00 - 2.49
 - 2.50 - 2.99
 - 3.00 - 3.49
 - 3.50 - 4.00
-

Q12 Where do you live?

- On campus
- Off-campus

Q13 Do you work?

- No
 - Yes (please indicate how many hours a week (e.g., 10, 20, 40), do not provide a range.)
-

Q14 In which state do you currently reside?

Q15

Participatory Dialogue- Advantages

If you eat five cups of fruits and vegetables every day you will be healthy.

- Never
 - Almost Never
 - Sometimes
 - Fairly Often
 - Very Often
-

Q16

Participatory Dialogue- Advantages

If you eat five cups of fruits and vegetables every day you will have variety in meals.

- Never
 - Almost Never
 - Sometimes
 - Fairly Often
 - Very Often
-

Q17

Participatory Dialogue- Advantages

If you eat five cups of fruits and vegetables every day you will manage your weight.

- Never
 - Almost Never
 - Sometimes
 - Fairly Often
 - Very Often
-

Q18

Participatory Dialogue- Advantages

If you eat five cups of fruits and vegetables every day you will have more energy.

- Never
 - Almost Never
 - Sometimes
 - Fairly Often
 - Very Often
-

Q19

Participatory Dialogue- Advantages

If you eat five cups of fruits and vegetables every day you will have tasty food.

- Never
 - Almost Never
 - Sometimes
 - Fairly Often
 - Very Often
-

Q20

Participatory Dialogue- Disadvantages

If you eat five cups of fruits and vegetables every day you will not have enough proteins in your diet.

- Never
 - Almost Never
 - Sometimes
 - Fairly Often
 - Very Often
-

Q21

Participatory Dialogue- Disadvantages

If you eat five cups of fruits and vegetables every day you will be hungry most of the time.

- Never
 - Almost Never
 - Sometimes
 - Fairly Often
 - Very Often
-

Q22

Participatory Dialogue- Disadvantages

If you eat five cups of fruits and vegetables every day you will have less energy.

- Never
 - Almost Never
 - Sometimes
 - Fairly Often
 - Very Often
-

Q23

Participatory Dialogue- Disadvantages

If you eat five cups of fruits and vegetables every day you will have more food-related expenses.

- Never
 - Almost Never
 - Sometimes
 - Fairly Often
 - Very Often
-

Q24

Participatory Dialogue- Disadvantages

If you eat five cups of fruits and vegetables every day you will enjoy meals less.

- Never
 - Almost Never
 - Sometimes
 - Fairly Often
 - Very Often
-

Q25

Behavioral Confidence How sure are you that you will eat five cups of fruits and vegetables every day this week?

- Not At All Sure
 - Slightly Sure
 - Moderately Sure
 - Very Sure
 - Completely Sure
-

Q26

Behavioral Confidence How sure are you that you will eat five cups of fruits and vegetables every day this week while maintaining your budget?

- Not At All Sure
 - Slightly Sure
 - Moderately Sure
 - Very Sure
 - Completely Sure
-

Q27

Behavioral Confidence How sure are you that you will eat five cups of fruits and vegetables every day this week while enjoying the meals?

- Not At All Sure
 - Slightly Sure
 - Moderately Sure
 - Very Sure
 - Completely Sure
-

Q28

Behavioral Confidence How sure are you that you will eat five cups of fruits and vegetables every day this week without getting fed up of eating them?

- Not At All Sure
 - Slightly Sure
 - Moderately Sure
 - Very Sure
 - Completely Sure
-

Q29

Behavioral Confidence How sure are you that you will eat five cups of fruits and vegetables every day this week without feeling hungry?

- Not At All Sure
 - Slightly Sure
 - Moderately Sure
 - Very Sure
 - Completely Sure
-

Q30

Changes in Physical Environment How sure are you that you will have fruits and vegetables available to you for all meals?

- Not At All sure
 - Slightly Sure
 - Moderately Sure
 - Very Sure
 - Completely Sure
-

Q31

Changes in Physical Environment How sure are you that you will be able to eat fruits and vegetables at a restaurant?

- Not At All sure
 - Slightly Sure
 - Moderately Sure
 - Very Sure
 - Completely Sure
-

Q32

Changes in Physical Environment How sure are you that you will be able to afford fruits and vegetables for meals?

- Not At All sure
 - Slightly Sure
 - Moderately Sure
 - Very Sure
 - Completely Sure
-

Q33 Emotional Transformation

How sure are you that you can direct your emotions/feelings to the goal of eating five cups of fruits and vegetables every day?

- Not At All Sure
 - Slightly Sure
 - Moderately Sure
 - Very Sure
 - Completely Sure
-

Q34 Emotional Transformation

How sure are you that you can motivate yourself to eat five cups of fruits and vegetables every day?

- Not At All Sure
 - Slightly Sure
 - Moderately Sure
 - Very Sure
 - Completely Sure
-

Q35 Emotional Transformation

How sure are you that you can overcome self-doubt in accomplishing the goal of eating five cups of fruits and vegetables every day?

- Not At All Sure
 - Slightly Sure
 - Moderately Sure
 - Very Sure
 - Completely Sure
-

Q36

Practice for Change

How sure are you that you can keep a self-diary to monitor eating five cups of fruits and vegetables every day?

- Not At All Sure
- Slightly Sure
- Moderately Sure
- Very Sure
- Completely Sure

Q37

Practice for Change

How sure are you that you can be able to eat five cups of fruits and vegetables every day if you encounter barriers?

- Not At All Sure
 - Slightly Sure
 - Moderately Sure
 - Very Sure
 - Completely Sure
-

Q38

Practice for Change

How sure are you that you can change your plan for eating five cups of fruits and vegetables every day if you face difficulties??

- Not At All Sure
 - Slightly Sure
 - Moderately Sure
 - Very Sure
 - Completely Sure
-

Q39 *Changes in Social Environment*

How sure are you that you can get the help of a family member to support you with eating five cups of fruits and vegetables every day?

- Not At All Sure
 - Slightly Sure
 - Moderately Sure
 - Very Sure
 - Completely Sure
-

Q40 *Changes in Social Environment*

How sure are you that you can get the help of a friend to support you with eating five cups of fruits and vegetables every day?

- Not At All Sure
 - Slightly Sure
 - Moderately Sure
 - Very Sure
 - Completely Sure
-

Q41 *Changes in Social Environment*

How sure are you that you can get the help of a health professional to support you with eating five cups of fruits and vegetables every day?

- Not At All Sure
 - Slightly Sure
 - Moderately Sure
 - Very Sure
 - Completely Sure
-

Q42 *Behavior Change- Initiation*

How likely is it that you will eat five cups of fruits and vegetables every day in the upcoming week?

- Not At All Likely
 - Somewhat Likely
 - Moderately Likely
 - Very Likely
 - Completely Likely
-

Q43 *Behavior Change- Sustenance*

How likely is it that you will eat five cups of fruits and vegetables every day from now on?

- Not At All Likely
 - Somewhat Likely
 - Moderately Likely
 - Very Likely
 - Completely Likely
-

Scoring Sheet

Construct of advantages (items 15-19): 0-4 scale; cumulative sum with a possible score of 0-20 units.

Construct of disadvantages (items 20-24): 0-4scale; cumulative sum with a possible score of 0-20 units.

Construct of participatory dialogue: Disadvantages score subtracted from advantages score to derive a possible score of -20 to + 20 units.

Construct of behavioral confidence (items 25-29): 0-4 scale; cumulative sum with a possible score of 0-20 units.

Construct of changes in the physical environment (items 30-32): 0-4 scale; cumulative sum with a possible score of 0-12 units.

Construct of emotional transformation (items 33-35): 0-4 scale; cumulative sum with a possible score of 0-12 units.

Construct of practice for change (item 36-38): 0-4 scale; cumulative sum with a possible score of and then sum to derive a possible score of 0-12 units.

Construct of changes in the social environment (39-41): 0-4 scale; cumulative sum with a possible score of 0-12 units.

Construct of initiation intention (item 42): 0-4 scale; possible score of 0-4 units.

Construct of sustenance intention (item 43): 0-4 scale; possible score of 0-4 units

© Manoj Sharma

Appendix C: IRB Approval Notification Letter



DATE: June 12, 2023

TO: Jason Flatt

FROM: Office of Research Integrity - Human Subjects

PROTOCOL TITLE: UNLV-2023-241 Utilizing the Multi-Theory Model to Explain the Fruits and Vegetables Consumption of Asian American, Native Hawaiian and Pacific Islander (AANHPI) College Students in the United States

SUBMISSION TYPE: Initial

Action: Exempt

REVIEW DATE: June 12, 2023

RVIEW TYPE: EXEMPT

REVIEW CATEGORY: Category 2.(i). Research that only includes interactions involving educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior (including visual or auditory recording) if at least one of the following criteria is met:

The information obtained is recorded by the investigator in such a manner that the identity of the human subjects cannot readily be ascertained, directly or through identifiers linked to the subjects;

This memorandum is notification that the protocol referenced above has been reviewed as indicated in Federal regulatory statutes 45 CFR 46 and deemed exempt under exempt category 2(i) as noted in the Review Category.

PLEASE NOTE:

Upon final determination of exempt status, the research team is responsible for conducting the research as stated in the exempt application reviewed by the ORI – HS, which shall include using the most recently submitted Informed Consent/Assent and recruitment materials.

If your project involves paying research participants, it is recommended to contact HSComp@unlv.edu to ensure compliance with the Policy for Incentives for Human Research

Subjects.

Any changes to the application may cause this study to require a different level of review. Should there be any change to the study, it will be necessary to submit a Modification request for review. No changes may be made to the existing study until modifications have been approved/acknowledged. All unanticipated problems involving risk to subjects or others, and/or serious and unexpected adverse events must be reported promptly to this office.

Any non-compliance issues or complaints regarding this protocol must be reported promptly to this office.

Please remember that all approvals regarding this research must be sought prior to initiation of this study (e.g., IBC, COI, Export Control, OSP, Radiation Safety, Clinical Trials Office, etc.).

If you have questions, please contact the Office of Research Integrity - Human Subjects at IRB@unlv.edu or call 702-895-2794. Please include your study title and study ID in all correspondence.

Office of Research Integrity - Human Subjects
4505 Maryland Parkway . Box 451047 . Las Vegas, Nevada 89154-1047
(702) 895-2794 . IRB@unlv.edu

References

- Ahn, S. J., Johnsen, K., Moore, J., Brown, S., Biersmith, M., & Ball, C. (2016). Using virtual pets to increase fruit and vegetable consumption in children: A technology-assisted social cognitive theory approach. *Cyberpsychology, Behavior, and Social Networking, 19*(2), 86-92.
- Ahmad, H., & Halim, H. (2017). Determining Sample Size for Research Activities. *Selangor Business Review, 2*(1), 20-34.
<https://sbr.journals.unisel.edu.my/ojs/index.php/sbr/article/view/12>
- Albrahim. T, Alshaalan R, Alhusan S. I, Alrasheedi K. R, Aldosari H. A, Albarqi H. M, Almousa Z. I, Alghamdi K. A, Almnaizel A. T. (2023). Exploring the association between nutritional knowledge and fruit and vegetable consumption among young adults: A cross-sectional study. *Current Research in Nutrition and Food Science, 11*(2), 617-626.
<https://dx.doi.org/10.12944/CRNFSJ.11.2.13>
- Alissa, E. M., & Ferns, G. A. (2017). Dietary fruits and vegetables and cardiovascular diseases risk. *Critical Reviews in Food Science and Nutrition, 57*(9), 1950-1962.
<https://doi.org/10.1080/10408398.2015.1040487>
- Al-Otaibi, H. H. (2014). The pattern of fruit and vegetable consumption among Saudi university students. *Global Journal of Health Science, 6*(2), 155.
- Alkhalidy, H., Orabi, A., Alzboun, T., Alnaser, K., Al-Shami, I., & Al-Bayyari, N. (2021). Health-risk behaviors and dietary patterns among jordanian college students: A pilot study. *Frontiers in Nutrition, 8*, 632035.

- Allom, V., & Mullan, B. (2012). Self-regulation versus habit: The influence of self-schema on fruit and vegetable consumption. *Psychology & Health, 27*(sup2), 7-24.
<https://doi.org/10.1080/08870446.2011.605138>
- Althubaiti, A. (2016). Information bias in health research: Definition, pitfalls, and adjustment methods. *Journal of Multidisciplinary Healthcare, 211*.
<https://doi.org/10.2147/jmdh.s104807>
- American College Health Association. American College Health Association-National College Health Assessment III: Reference Group Executive Summary Spring 2022. Silver Spring, MD: American College Health Association; 2022
- Angelino, D., Godos, J., Ghelfi, F., Tieri, M., Titta, L., Lafranconi, A., Marventano, S., Alonzo, E., Gambera, A., Sciacca, S., Buscemi, S., Ray, S., Galvano, F., Del Rio, D., & Grosso, G. (2019). Fruit and vegetable consumption and health outcomes: an umbrella review of observational studies. *International Journal of Food Sciences and Nutrition, 70*(6), 652-667. <https://doi.org/10.1080/09637486.2019.1571021>
- Arnotti K., & Bamber, M. (2020). Fruit and vegetable consumption in overweight or obese individuals: A meta-analysis. *Western Journal of Nursing Research, 42*(4):306-314.
doi:10.1177/0193945919858699
- Aune, D., Giovannucci, E., Boffetta, P., Fadnes, L. T., Keum, N., Norat, T., Greenwood, D. C., Riboli, E., Vatten, L. J., & Tonstad, S. (2017). Fruit and vegetable intake and the risk of cardiovascular disease, total cancer and all-cause mortality—a systematic review and dose-response meta-analysis of prospective studies. *International journal of epidemiology, 46*(3), 1029-1056. <https://doi.org/10.1093/ije/dyw319>

- Ba, S., I, C., Jc, S., & Wpt, J. (2004). Diet, nutrition and the prevention of excess weight gain and obesity. *Public Health Nutrition*, 7(1a), 123-146. <https://doi.org/10.1079/phn2003585>
- Berry, J. W. (2017). *Theories and models of acculturation*. The Oxford handbook of acculturation and health, 15-28.
- Boek, S., Bianco-Simeral, S., Chan, K., & Goto, K. (2012). Gender and race are significant determinants of students' food choices on a college campus. *Journal of nutrition education and behavior*, 44(4), 372-378. <https://doi.org/10.1016/j.jneb.2011.12.007>
- Brown, L., Nahar, V. K., & Sharma, M. (2019). Applying the multi theory model (MTM) of health behavior change for explaining fruits and vegetables consumption behavior among African American women in Mississippi, USA. *Journal of Health and Social Sciences*. 4(3). 359-372. <https://doi.org/10.19204/2019/pply4>
- Brown, L., Sharma, M., Leggett, S., Sung, J. H., Bennett, R. L., & Azevedo, M. (2020). Efficacy testing of the SAVOR (Sisters Adding Fruits and Vegetables for Optimal Results) intervention among African American women: A randomized controlled trial. *Health Promotion Perspectives*, 10(3), 270-280. <https://doi.org/10.34172/hpp.2020.41>
- Budreviciute, A., Damiatim S., Sabir, D.K., Onder, K., Schuller-Goetzburg, P., Plakys, G., Katileviciute, A., Khoja, S., & Kodzius, R. (2020). Management and prevention strategies for non-communicable diseases (ncds) and their risk factors. *Frontiers in Public Health*. 8. <https://doi.org/10.3389/fpubh.2020.574111>.
- Carlson, M. D., & Morrison, R. S. (2009). Study design, precision, and validity in observational studies. *Journal of palliative medicine*, 12(1), 77-82. <https://doi.org/10.1089/jpm.2008.9690>

- Centers of Disease Control and Prevention. (2021). Summary health statistics: National health survey:2018.
- Dai, C.-L., Sharma, M., Haider, T., & Sunchu, H. (2021). Fruit and vegetable consumption behavior among Asian Americans: A thematic analysis. *Journal of Primary Care and Community Health, 12*. <https://doi.org/10.1177/2150132720984776>
- Davis, J., Busch, J., Hammatt, Z., Novotny, R., Harrigan, R., Grandinetti, A., & Easa, D. (2004). The relationship between ethnicity and obesity in Asian and Pacific Islander populations. *Ethnicity & Disease, 14*(1), 111-118.
- Deliens, T., Clarys, P., De Bourdeaudhuij, I., & Deforche, B. (2014). Determinants of eating behaviour in university students: a qualitative study using focus group discussions. *BMC Public Health, 14*(1), 53. <https://doi.org/10.1186/1471-2458-14-53>
- Diep, C. S., Chen, T.-A., Davies, V. F., Baranowski, J. C., & Baranowski, T. (2014). Influence of behavioral theory on fruit and vegetable intervention effectiveness among children: A meta-analysis. *Journal of Nutrition Education and Behavior, 46*(6), 506-546. <https://doi.org/10.1016/j.jneb.2014.05.012>
- Dhillon, J., Diaz Rios, L.K., Aldaz, K.J., De La Cruz, N., Vu, E., Asad Asghar, S., Kuse, Q., & Ortiz, R.M. (2019). We don't have a lot of healthy options: food environment perceptions of first-year, minority college students attending a food desert campus. *Nutrients, 11*(4). [https://doi: 10.3390/nu11040816](https://doi:10.3390/nu11040816).
- Downes, L. (2015). Physical activity and dietary habits of college students. *The Journal for Nurse Practitioners, 11*(2), 192-198.e192. <https://doi.org/https://doi.org/10.1016/j.nurpra.2014.11.015>

- Duncan, M. J., Eyre, E., Bryant, E., Clarke, N., Birch, S., Staples, V., & Sheffield, D. (2015). The impact of a school-based gardening intervention on intentions and behaviour related to fruit and vegetable consumption in children. *Journal of Health Psychology, 20*(6), 765-773. <https://doi.org/10.1177/1359105315573445>
- Farvid, M. S., Chen, W. Y., Rosner, B. A., Tamimi, R. M., Willett, W. C., & Eliassen, A. H. (2019). Fruit and vegetable consumption and breast cancer incidence: Repeated measures over 30 years of follow-up. *International Journal of Cancer, 144*(7), 1496-1510. <https://doi.org/10.1002/ijc.31653>
- Faul, F., Erdfelder, E., Lang, A.-G., & Buchner, A. (2007). G* Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods, 39*(2), 175-191. <https://doi.org/10.3758/bf03193146>
- Fackler, C.A., Baugh, N., Lovegren, A.A., Nemeroff, C., & Whatley B.J. (2021). Technology-enhanced health promotion for college students: a seed development project. *Nursing Reports, 11*(1), 143-151. <https://doi.org/10.3390/nursrep11010014>
- Frech, A. (2012). Healthy behavior trajectories between adolescence and young adulthood. *Advances in Life Course Research, 17*(2), 59-68. <https://doi.org/10.1016/j.alcr.2012.01.003>
- Gibson, R. S., Charrondiere, U. R., & Bell, W. (2017). Measurement errors in dietary assessment using self-reported 24-hour recalls in low-income countries and strategies for their prevention. *Advances in Nutrition, 8*(6), 980–991. <https://doi.org/10.3945/an.117.016980>
- Glanz, K., & Bishop, D. B. (2010). The role of behavioral science theory in development and implementation of public health interventions. *Annual Review of Public Health, 31*(1), 399-418. <https://doi.org/10.1146/annurev.publhealth.012809.103604>

- Guillaumie, L., Godin, G., & Vezina-Im, L.-A. (2010). Psychosocial determinants of fruit and vegetable intake in adult population: a systematic review. *International Journal of Behavioral Nutrition and Physical Activity*, 7(1). <https://doi.org/10.1186/1479-5868-7-12>
- Guillaumie, L., Godin, G., Manderscheid, J. C., Spitz, E., & Muller, L. (2012). The impact of self-efficacy and implementation intentions-based interventions on fruit and vegetable intake among adults. *Psychology & Health*, 27(1), 30-50.
<https://doi.org/10.1080/08870446.2010.541910>
- Guttman, L. (1954). Some necessary conditions for common-factor analysis. *Psychometrika*, 19, 149–161. <https://doi.org/10.1007/BF02289162>
- Hackman, C., & Knowlden, A. (2014). Theory of reasoned action and theory of planned behavior-based dietary interventions in adolescents and young adults: a systematic review. *Adolescent Health, Medicine and Therapeutics*, 101.
<https://doi.org/10.2147/ahmt.s56207>
- Hayes, T., Sharma, M., Shahbazi, M., Sung, J. H., Bennett, R., & Reese-Smith, J. (2019). The evaluation of a fourth-generation multi-theory model (MTM) based intervention to initiate and sustain physical activity. *Health Promotion Perspectives*, 9(1), 13–23.
<https://doi.org/10.15171/hpp.2019.02>
- Henley, K., Reeder, N., Persell, A., & Tolar-Peterson, T. (2023). Fruit and vegetable liking and intake among college students: a cross-sectional study. *Journal of American College Health*, 71(6), 1815-1821. <https://doi.org/10.1080/07448481.2021.1947834>
- Heron, M. P. (2018). Deaths: leading causes for 2016.
- Heyrana, K.J., Kaneshiro, B., Soon, R., Nguyen, B.T., & Natavio, M.F. (2023). Data equity for Asian American and Native Hawaiian and other Pacific Islander people in reproductive

- health research. *Obstet Gynecol.* 142(4), 787-794.
<https://doi.org/10.1097/AOG.0000000000005340>
- Jia, P. (2021). Obesogenic environment and childhood obesity. *Obesity Reviews*, 22, e13158.
<https://doi.org/10.1111/obr.13158>
- Jung, S. E., Shin, Y. H., & Dougherty, R. (2020). A multi theory-based investigation of college students' underlying beliefs about local food consumption. *Journal of Nutrition Education and Behavior*, 52(10), 907–917. <https://doi.org/10.1016/j.jneb.2020.07.002>
- Kapinos, K. A., Yakusheva, O., & Eisenberg, D. (2014). Obesogenic environmental influences on young adults: evidence from college dormitory assignments. *Economics and human biology*, 12, 98–109. <https://doi.org/10.1016/j.ehb.2013.05.003>.
- Kapukotuwa, S., Bonsu, L., Chatterjee, A., Fudolig, M., & Sharma, M. (2023). Examining the gambling behavior of university students: a cross-sectional survey applying the multi-theory model (mtm) of health behavior change in a single institution. *Healthcare*, 11, 2151. <https://doi.org/10.3390/healthcare11152151>
- Kaur, H., & Aeri, B. T. (2019). Protective impact of fruits and vegetable intake on cardiovascular risk factors-a review. *Journal of Clinical & Diagnostic Research*, 13(5).
<https://doi.org/10.7860/JCDR/2019/41330.12884>
- Keil, F. C. (2006). Explanation and understanding. *Annual Review of Psychology*, 57(1), 227-254. <https://doi.org/10.1146/annurev.psych.57.102904.190100>
- Kothe, E. J., & Mullan, B. A. (2014). A randomised controlled trial of a theory of planned behaviour to increase fruit and vegetable consumption. *Fresh Facts. Appetite*, 78, 68-75.
<https://doi.org/10.1016/j.appet.2014.03.006>

- Kothe, E. J., Mullan, B. A., & Butow, P. (2012). Promoting fruit and vegetable consumption. Testing an intervention based on the theory of planned behaviour. *Appetite*, 58(3), 997-1004. <https://doi.org/10.1016/j.appet.2012.02.012>
- Kreausukon, P., Gellert, P., Lippke, S., & Schwarzer, R. (2012). Planning and self-efficacy can increase fruit and vegetable consumption: a randomized controlled trial. *Journal of Behavioral Medicine*, 35(4), 443-451. <https://doi.org/10.1007/s10865-011-9373-1>
- Krølner, R., Rasmussen, M., Brug, J., Klepp, K.-I., Wind, M., & Due, P. (2011). Determinants of fruit and vegetable consumption among children and adolescents: a review of the literature. Part II: qualitative studies. *International Journal of Behavioral Nutrition and Physical Activity*, 8(1), 112. <https://doi.org/10.1186/1479-5868-8-112>
- Kwon, S. C., Rideout, C., Patel, S., Arista, P., Tepporn, E., Lipman, J., Kunkel, S., Le, D. Q., Chin, K. K., & Trinh-Shevrin, C. (2015). Improving access to healthy foods for Asian Americans, native Hawaiians, and Pacific Islanders: Lessons learned from the STRIVE Program. *Journal of Health Care for the Poor and Underserved*, 26(20), 116. <https://doi.org/10.1353/hpu.2015.0063>
- Laska, M. N., Pasch, K. E., Lust, K., Story, M., & Ehlinger, E. (2011). The differential prevalence of obesity and related behaviors in two- vs. four-year colleges. *Obesity*, 19(2), 453-456. <https://doi.org/10.1038/oby.2010.262>
- Lee, S. H., Moore, L. V., Park, S., Harris, D. M., & Blanck, H. M. (2022). Adults meeting fruit and vegetable intake recommendations—United States, 2019. *Morbidity and Mortality Weekly Report*, 71(1), 1.
- Leenders, M., Sluijs, I., Ros, M. M., Boshuizen, H. C., Siersema, P. D., Ferrari, P., Weikert, C., Tjønneland, A., Olsen, A., Boutron-Ruault, M.-C., Clavel-Chapelon, F., Nailler, L.,

- Teucher, B., Li, K., Boeing, H., Bergmann, M. M., Trichopoulou, A., Lagiou, P., Trichopoulos, D., . . . Bueno-de-Mesquita, H. B. (2013). Fruit and Vegetable Consumption and Mortality: European Prospective Investigation into Cancer and Nutrition. *American Journal of Epidemiology*, *178*(4), 590-602.
<https://doi.org/10.1093/aje/kwt006>
- Lin, C.-Y., Scheerman, J. F. M., Yaseri, M., Pakpour, A. H., & Webb, T. L. (2017). A cluster randomised controlled trial of an intervention based on the Health Action Process Approach for increasing fruit and vegetable consumption in Iranian adolescents. *Psychology & Health*, 1-20. <https://doi.org/10.1080/08870446.2017.1341516>
- Lv, N., & Cason, K. L. (2004). Dietary pattern change and acculturation of Chinese Americans in Pennsylvania. *Journal of the American Dietetic Association*, *104*(5), 771-778.
<https://doi.org/10.1016/j.jada.2004.02.032>
- Mann, C. J. (2003). Observational research methods. Research design II: Cohort, cross sectional, and case-control studies. *Emergency Medicine Journal*, *20*(1), 54-60.
<https://doi.org/10.1136/emj.20.1.54>
- Medina, H. N., Callahan, K. E., Morris, C. R., Thompson, C. A., Siweya, A., & Pinheiro, P. S. (2021). Cancer mortality disparities among Asian American and Native Hawaiian/Pacific Islander populations in California. *Cancer Epidemiology, Biomarkers & Prevention*, *30*(7), 1387-1396. <https://doi.org/10.1158/1055-9965.EPI-20-1528>
- Mello Rodrigues, V., Bray, J., Fernandes, A. C., Luci Bernardo, G., Hartwell, H., Secchi Martinelli, S., Lazzarin Uggioni, P., Barletto Cavalli, S., & Proença, R. P. d. C. (2019). Vegetable consumption and factors associated with increased intake among college students: a scoping review of the last 10 years. *Nutrients*, *11*(7), 1634.

- Menezes, M. C. d., Mendonça, R. d. D., Ferreira, N. L., Guimarães, L. M. F., & Lopes, A. C. S. (2018). Promoting fruit and vegetable consumption: Methodological protocol of a randomized controlled community trial. *Contemporary Clinical Trials Communications*, 10, 131-136. <https://doi.org/10.1016/j.conctc.2018.04.003>
- Middleton, K.R., Anton, S.D., & Perri, M.G. (2013). Long-Term Adherence to Health Behavior Change. *American Journal of Lifestyle Medicine*, 7(6), 395-404. <https://doi.org/10.1177/1559827613488867>
- Milajerdi, A., Ebrahimi-Daryani, N., Dieleman, L. A., Larijani, B., & Esmailzadeh, A. (2020). Association of dietary fiber, fruit, and vegetable consumption with risk of inflammatory bowel disease: A systematic review and meta-analysis. *Advances in Nutrition*, 12(3), 735-743. <https://doi.org/10.1093/advances/nmaa145>
- Miller, C. A., Guidry, J. P., Dahman, B., & Thomson, M. D. (2020). A tale of two diverse qualitative samples: Information for online survey researchers. *Cancer Epidemiology, Biomarkers & Prevention*, 29(4), 731-735. <https://doi.org/10.1158/1055-9965.EPI-19-0846>
- Mirabitor, E., Peterson, K. E., Rathz, C., Matlen, S., & Kasper, N. (2016). Predictors of college-student food security and fruit and vegetable intake differ by housing type. *Journal of American College Health*, 64(7), 555-564. <https://doi.org/10.1080/07448481.2016.1192543>
- Moy, K. L., Sallis, J. F., Trinidad, D. R., Ice, C. L., & McEligot, A. J. (2012). Health behaviors of Native Hawaiian and Pacific Islander adults in California. *Asia Pacific Journal of Public Health*, 24(6), 961-969. <http://www.jstor.org/stable/26724081>

- Murray, C. J., Mokdad, A. H., Ballestros, K., Echko, M., Glenn, S., Olsen, H. E., Mullany, E., Lee, A., Khan, A. R., & Ahmadi, A. (2018). The state of US health, 1990-2016: Burden of diseases, injuries, and risk factors among US states. *JAMA-Journal of the American Medical Association*, *319*(14), 1444-1472. <https://doi.org/10.1001/jama.2018.0158>
- Najimi, A., & Ghaffari, M. (2013). Promoting fruit and vegetable consumption among students: a randomized controlled trial based on social cognitive theory. *Journal of Pakistan Medical Association*, *63*(10), 1235-1240.
- Nelson, M. C., Story, M., Larson, N. I., Neumark-Sztainer, D., & Lytle, L. A. (2008). Emerging adulthood and college-aged youth: An overlooked age for weight-related behavior change. *Obesity*, *16*(10), 2205-2211. <https://doi.org/10.1038/oby.2008.365>
- Nerida, T. M., Sharma, M., Labus, B., Marquez, E., & Dai, C. L. (2023). Covid-19 vaccine acceptance behavior among Hispanics/Latinxs in Nevada: A theory-based analysis. *Healthcare*, *11*(5), 688. <https://doi.org/10.3390/healthcare11050688>
- Nguyen, K.H., Lew, K.P., & Trivedi A.N. (2022). Trends in collection of disaggregated Asian American, Native Hawaiian, and Pacific Islander data: Opportunities in federal health surveys. *American Journal of Public Health*, *112*(10), 1429-1435. <https://doi.org/10.2105/AJPH.2022.306969>.
- Odum, M., & Xu, L. (2019). Racial and sex differences of fruit and vegetable self-efficacy and intake among college students in a rural, southern location. *Journal of American College Health*, *67*(8), 825-834. <https://doi.org/10.1080/07448481.2018.1515752>
- Ozili, K.P. (2022). The acceptable r-square in empirical modelling for social science research. *Social Research Methodology and Publishing Results*. <http://dx.doi.org/10.2139/ssrn.4128165>

- Pan, Y.-L., Dixon, Z., Himburg, S., & Huffman, F. (1999). Asian students change their eating patterns after living in the United States. *Journal of the American Dietetic Association*, 99(1), 54-57. [https://doi.org/10.1016/s0002-8223\(99\)00016-4](https://doi.org/10.1016/s0002-8223(99)00016-4)
- Panahi, R., Department of Health, E., Promotion, S. o. M. S. T. M. U. T. I., Pishvaei, M., Department of Family Health, S. D., Health Promotion Research Center. Gonabad University of Medical Sciences, G. I., Ghaderi, N., Department of Health, E., & Promotion, S. o. M. S. T. m. U. T. I. (2018). Multi-theory model of behavior change: an appropriate model for creating health behaviors. *Journal of Research and Health*, 8(6), 483-484. <https://doi.org/10.29252/jrh.8.6.483>
- Park, Y., Wang, S., Kitahara, C. M., Moore, S. C., Berrington de Gonzalez, A., Bernstein, L., Chang, E. T., Flint, A. J., Freedman, D. M., & Gaziano, J. M. (2014). Body mass index and risk of death in Asian Americans. *American Journal of Public Health*, 104(3), 520-525. <https://doi.org/10.2105%2FAJPH.2013.301573>
- Peng, W. (2009). Design and evaluation of a computer game to promote a healthy diet for young adults. *Health communication*, 24(2), 115-127. <https://doi.org/10.1080/10410230802676490>
- Rasmussen, M., Krølner, R., Klepp, K.-I., Lytle, L., Brug, J., Bere, E., & Due, P. (2006). *International Journal of Behavioral Nutrition and Physical Activity*, 3(1), 22. <https://doi.org/10.1186/1479-5868-3-22>
- Redfield, R., Linton, R., & Herskovits, M. J. (1936). Memorandum for the study of acculturation. *American Anthropologist*, 38(1), 149-152. <https://doi.org/10.1525/aa.1936.38.1.02a00330>

- Rosenmöller, D.L., Gasevic, D., Seidell, J., & Lear, S. (2011) Determinants of changes in dietary patterns among Chinese immigrants: a cross-sectional analysis. *International Journal of Behavioral Nutrition and Physical Activity*, 8, 42. <https://doi.org/10.1186/1479-5868-8-42>
- Sarwar, E., Arias, D., Becerra, B. J., & Becerra, M. B. (2015). Sociodemographic correlates of dietary practices among Asian-Americans: Results from the California health interview survey. *Journal of Racial and Ethnic Health Disparities*, 2(4), 494-500. <https://doi.org/10.1007/s40615-015-0097-8>
- Satia-Abouta, J., Patterson, R. E., Neuhouser, M. L., & Elder, J. (2002). Dietary acculturation: Applications to nutrition research and dietetics. *Journal of the American Dietetic Association*, 102(8), 1105-1118. [https://doi.org/10.1016/S0002-8223\(02\)90247-6](https://doi.org/10.1016/S0002-8223(02)90247-6)
- Sedgwick, P. (2014). Non-response bias versus response bias. *BMJ*, 348. <https://doi.org/10.1136/bmj.g2573>
- Serafica, R. C. (2014). Dietary acculturation in Asian Americans. *Journal of Cultural Diversity*, 21(4), 145-151.
- Setia M. S. (2016). Methodology series module 3: Cross-sectional studies. *Indian Journal of Dermatology*, 61(3), 261–264. <https://doi.org/10.4103/0019-5154.182410>
- Sharma, M. (2015). *Multi-theory Model (MTM) For Health Behavior Change*. http://www.webmedcentral.com/article_view/4982
- Sharma, M., Batra, K., & Batra, R. (2021). A theory-based analysis of covid-19 vaccine hesitancy among African Americans in the United States: A recent evidence. *Healthcare*, 9(10), 1273. <https://doi.org/10.3390/healthcare9101273>
- Sharma, M., Catalano, H. P., Nahar, V. K., Lingam, V., Johnson, P., & Ford, M. A. (2016). Using multi-theory model to predict initiation and sustenance of small portion size consumption

- among college students. *Health Promotion Perspectives*, 6(3), 137-144.
<https://doi.org/10.15171/hpp.2016.22>
- Sharma, M., Catalano, H. P., Nahar, V. K., Lingam, V. C., Johnson, P., & Ford, M. A. (2017). Applying multi-theory model (MTM) of health behavior change to predict water consumption instead of sugar-sweetened beverages. *Journal of research in health sciences*, 17(1), 370.
- Sharma, M., Dai, C.-L., Batra, K., Chen, C.-C., Pharr, J. R., Coughenour, C., Awan, A., & Catalano, H. (2021). Using the multi-theory model (mtm) of health behavior change to explain the correlates of mammography screening among Asian American women. *Pharmacy*, 9(3), 126. <https://doi.org/10.3390/pharmacy9030126>
- Sharma, M., & Petosa, R. L. (2014). *Measurement and evaluation for health educators*. Jones & Bartlett Publishers.
- Sharma, M., Stephens, P. M., Nahar, V. K., Catalano, H. P., Lingam, V. C., & Ford, M. A. (2018). Using a multitheory model to predict initiation and sustenance of fruit and vegetable consumption among college students. *Journal of Osteopathic Medicine*, 118(8), 507-517.
<https://doi.org/10.7556/jaoa.2018.119>
- Slavin, J. L., & Lloyd, B. (2012). Health benefits of fruits and vegetables. *Advances in Nutrition*, 3(4), 506-516. <https://doi.org/10.3945/an.112.002154>
- Small, M., Bailey-Davis, L., Morgan, N., & Maggs, J. (2013). Changes in eating and physical activity behaviors across seven semesters of college. *Health Education & Behavior*, 40(4), 435-441. <https://doi.org/10.1177/1090198112467801>
- Soper, D.S. (2023). *Calculator: a-priori sample size for structural equation model*.
<https://www.danielsoper.com/statcalc/calculator.aspx?id=89>

- Subica, A. M., Agarwal, N., Sullivan, J. G., & Link, B. G. (2017). Obesity and associated health disparities among understudied multiracial, Pacific Islander, and American Indian adults. *Obesity, 25*(12), 2128-2136. <https://doi.org/10.1002/oby.21954>
- Taber, K. S. (2018). The use of cronbach's alpha when developing and reporting research instruments in science education. *Research in Science Education, 48*(6), 1273-1296. <https://doi.org/10.1007/s11165-016-9602-2>
- Taghdis, M. H., Babazadeh, T., Moradi, F., & Shariat, F. (2016). Effect of educational intervention on the fruit and vegetables consumption among the students: applying theory of planned behavior. *Journal of research in health sciences, 16*(4), 195
- Tavakol, M., & Wetzal, A. (2020). Factor Analysis: a means for theory and instrument development in support of construct validity. *International Journal of Medical Education, 11*, 245–247. <https://doi.org/10.5116/ijme.5f96.0f4a>
- Vilaro, M., Colby, S., Riggsbee, K., Zhou, W., Byrd-Bredbenner, C., Olfert, M., Barnett, T., Horacek, T., Sowers, M., & Mathews, A. (2018). Food choice priorities change over time and predict dietary intake at the end of the first year of college among students in the U.S. *Nutrients, 10*(9), 1296. <https://doi.org/10.3390/nu10091296>
- Wang, D. D., Li, Y., Bhupathiraju, S. N., Rosner, B. A., Sun, Q., Giovannucci, E. L., Rimm, E. B., Manson, J. E., Willett, W. C., Stampfer, M. J., & Hu, F. B. (2021). Fruit and vegetable intake and mortality. *Circulation, 143*(17), 1642-1654. <https://doi.org/10.1161/circulationaha.120.048996>
- Wang, X., & Cheng, Z. (2020). Cross-sectional studies. *Chest, 158*(1), S65-S71. <https://doi.org/10.1016/j.chest.2020.03.012>

- World Health Organizations (WHO). 2023. *Noncommunicable diseases*.
<https://www.who.int/news-room/fact-sheets/detail/noncommunicable-diseases>
- Wilkerson, A.H., Davis, R.E., Sharma, M., Harmon, M.B., McCowan, H.K., Mockbee, C.S., Ford, M.A., & Nahar, V.K. (2023). Use of the multi-theory model (MTM) in explaining initiation and sustenance of indoor tanning cessation among college students. *Archives of Dermatological Research*, 315, 191–199. <https://doi.org/10.1007/s00403-022-02338-y>
- Williams, J. L., Sharma, M., Mendy, V. L., Leggett, S., Akil, L., & Perkins, S. (2020). Using multi theory model (MTM) of health behavior change to explain intention for initiation and sustenance of the consumption of fruits and vegetables among African American men from barbershops in Mississippi. *Health Promotion Perspectives*, 10(3), 200-206.
<https://doi.org/10.34172/hpp.2020.33>
- Wyatt, L. C., Trinh-Shevrin, C., Islam, N. S., & Kwon, S. C. (2014). Health-related quality of life and health behaviors in a population-based sample of older, foreign-born, Chinese American adults living in New York City. *Health Education & Behavior*, 41(1_suppl), 98S-107S. <https://doi.org/10.1177/1090198114540462>
- U.S Census Bureau. (2020). *P1: RACE - Census Bureau Table*.
[https://data.census.gov/table?g=0100000US&y=2020&d=DEC+Redistricting+Data+\(PL+94-171\)&tid=DECENNIALPL2020.P1](https://data.census.gov/table?g=0100000US&y=2020&d=DEC+Redistricting+Data+(PL+94-171)&tid=DECENNIALPL2020.P1)
- U.S Census Bureau. (2022). *About the Topic of Race*.
<https://www.census.gov/topics/population/race/about.html>
- U.S. Department of Agriculture and U.S. Department of Health and Human Services. (2020, December). *Dietary Guidelines for Americans, 2020-2025. Dietary Guidelines for*

Americans. https://www.dietaryguidelines.gov/sites/default/files/2021-03/Dietary_Guidelines_for_Americans-2020-2025.pdf

U.S. Department of Health and Human Services Office of Minority Health. (2020, March 26).

Obesity and Native Hawaiians/Pacific Islanders. HHS.gov.

<https://minorityhealth.hhs.gov/omh/browse.aspx?lvl=4&lvlid=85>

van den Bogerd, N., Peppelenbos, H., Leufkens, R., Seidell, J. C., Maas, J., & Dijkstra, S. C.

(2020). A free-produce stand on campus: impact on fruit and vegetable intake in Dutch university students. *Public health nutrition*, 23(5), 924–934.

<https://doi.org/10.1017/S1368980019003574>

Zhou, G., Gan, Y., Miao, M., Hamilton, K., Knoll, N., & Schwarzer, R. (2015). The role of action control and action planning on fruit and vegetable consumption. *Appetite*, 91, 64-68.

<https://doi.org/https://doi.org/10.1016/j.appet.2015.03.022>

Curriculum Vitae

Noeheelani Bareng-Antolin, MPH
Kirk Kerkorian School of Medicine at UNLV
Department of Surgery
1701 W. Charleston Boulevard, Suite 200, Las Vegas, NV 89102
noeheelaniantolin@gmail.com

Last updated: 01/26/2024

Current Position

Grants and Research Director
Kirk Kerkorian School of Medicine at UNLV
University of Nevada, Las Vegas
Las Vegas, Nevada

Education

Ph.D. Candidate in Public Health Department of Social and Behavioral Health School of Public Health University of Nevada, Las Vegas	Present
Master of Public Health Department of Social and Behavioral Health School of Public Health University of Nevada, Las Vegas	2017
Bachelor of Biological Sciences University of Nevada, Las Vegas	2011

Academic Appointment

Part-time instructor 2021-2023
School of Public Health
University of Nevada, Las Vegas
Course taught: PBH 205 - Introduction to Public Health

Professional Positions and Experience

Associate Outreach Director Nevada INBRE/ National Institute of Health	2021-2023
---	-----------

University of Nevada, Las Vegas	
Program Coordinator National Institutes of Health/ NIDDK STEP-UP Program University of Nevada, Las Vegas	2017-2023
Student Worker National Institutes of Health/ NIDDK STEP-UP Program University of Nevada, Las Vegas	2016-2016
Graduate Research Assistant, <i>Dean's Office</i> School of Community Health Sciences University of Nevada, Las Vegas	2015-2016
Certified Healthy Homes Specialist and EPA Lead Risk Assessor 2014 School of Community Health Sciences University of Nevada, Las Vegas	2015-
Nevada Healthy Homes Partnership Asthma Program Staff School of Community Health Sciences University of Nevada, Las Vegas	2014-2014
GEAR UP Academic Tutor, Center of Academic Enrichment and Outreach University of Nevada, Las Vegas	2013-2014

Licenses and Certifications

A. Current Certifications

CITI: IRB - Biomedical/Social and Behavioral, Responsible Conduct of Research
2014-Present

B. Past Licenses

NEHA Healthy Homes Specialists, ID NUMBER 22760
EPA Lead Risk Assessor, NV-R-I157019-1
EPA Lead Dust Sampling Technician, IST-0115-NBA-72740

Professional Development Activities

1. Establishing Your Researcher Identity, *Tools and Resources for Navigating Health Sciences Research Series*, Hosted by the Office of Research, Kirk Kerkorian School of Medicine at UNLV, November 2023
2. Nuts and Bolts of Grant Budget Making, *Tools and Resources for Navigating Health Sciences Research Series*, Hosted by the Office of Research, Kirk Kerkorian School of Medicine at UNLV, October 2023
3. Equity in Roadway Safety Workshop: Strategies for Meaningful Public Involvement in Roadway Safety Planning - State and Regional Agencies, October 2023
4. Who, What, When, Where, & Why of CUR Dialogues February 8 - 19, 2021

Professional Memberships and Activities

Delta Omega Public Health Honor Society Delta Theta Chapter of UNLV [Inductee]	2023-current
Nevada Public Health Association	2023-current
American Public Health Association	2022-current
Hawaii Pacific Evaluation Association	2017-2022

Committee Assignments and Administrative Services

Search Committee Member, Administrative and Grants Director, Kirk Kerkorian School of Medicine 2024

Search Committee Member, Research Assistant Position, Kirk Kerkorian School of Medicine 2023

APHA Oral Session Moderator, Injury and Emergency Health Services Data 2023

Search Committee Member, Evaluator Position, NV INBRE, UNLV 2022

Educational Activities

A. Teaching Activities

1. Part-time instructor 2021-2023

School of Public Health
University of Nevada, Las Vegas
Course taught: PBH 205 - Introduction to Public Health

B. Formal Mentoring

1. Department of Surgery, Graduate Student Worker
(08/2023-05/2024)
Mentee: Merika Charupoom, MPH student
School of Public Health
University of Nevada, Las Vegas

2. Department of Surgery, Graduate Assistantship
(08/2023-05/2024)
Mentee: Ana Reyes, PhD Student
Department of Education Psychology
University of Nevada, Las Vegas

3. Department of Surgery, Undergraduate Student Worker
(08/2023-05/2024)
Mentee: Nicole Bacani, Undergraduate student
Biological Sciences
University of Nevada, Las Vegas

4. School of Public Health, Graduate Assistantship
(08/2017-05/2018)
Mentee: Kira Tran, MPH student
School of Public Health
University of Nevada, Las Vegas

Honors and Awards

Graduate & Professional Student Association Sponsorship Award	2023
School of Public Health Graduate Scholarship Award	2023
Graduate Competition of the National Case Study Competition in Health Education (2nd Place) 2022	
Francisco Sy Endowed Graduate Scholarship	2022
School of Public Health Travel Award	2022

UNLV School of Community Health Sciences Graduate Student Leadership Recipient
2022

Grants and Contract Awards

A. Current

1. PI: Dr. Deborah A. Kuhls
Grant # GR 18529
Role/FTE: Grants and Research Director (0.95 FTE)
Funding Agency: Nevada Department of Public Safety-Office of Traffic Safety
Award Amount: \$571,279.00
Grant period: 10/01/2023 - 09/30/2024
Project Title: Nevada Road Users Linked Database Research

2. PI: Dr. Deborah A. Kuhls
Grant # GR 18592
Role/FTE: Grants and Research Director (0.05 FTE)
Funding Agency: Nevada Department of Public Safety-Office of Traffic Safety
Award Amount: \$575,000.00
Grant period: 10/01/2023 - 09/30/2024
Project Title: Statistical Transparency of Policing Data Collection

B. Past and Completed

1. PI: Dr. Deborah A. Kuhls
Grant # GR 16416
Role/FTE: Grants and Research Director (1.00 FTE)
Funding Agency: Nevada Department of Public Safety-Office of Traffic Safety
Award Amount: \$227,349.00
Grant period: 10/01/2022 - 09/30/2023
Project Title: Nevada Road Users Linked Database Research

2. PI: Dr. Carolee Dodge Francis
Role/FTE: Program Coordinator (0.50 FTE)
Funding Agency: National Institutes of Health, National Institutes of Diabetes and Digestive and Kidney Diseases
Award Amount: \$392,200.00
Grant period: 2020-2023
Project Title: Journey Pilot Supplement NIDDK STEP-UP 11th & 12th grade High School Research Experience. *To increase and strengthen the shortage of American*

Indian/Alaska Native students in the Alaska and contiguous 48 states pursuing the fields of biomedical, behavioral, and clinical research in the areas of diabetes, endocrinology, metabolism, nutrition, and obesity.

3. PI: Dr. Carolee Dodge Francis
Role/FTE: Program Coordinator (0.50 FTE)
Funding Agency: National Institutes of Health, National Institutes of Diabetes and Digestive and Kidney Diseases
Award Amount: \$52,138.00
Grant period: 2020-2021
Project Title: Journey Pilot Supplement NIDDK STEP-UP 9th & 10th grade High School Research Experience. *To increase and strengthen the shortage of American Indian/Alaska Native students in the Alaska and contiguous 48 states pursuing the fields of biomedical, behavioral, and clinical research in the areas of diabetes, endocrinology, metabolism, nutrition, and obesity.*

4. PI: Dr. Carolee Dodge Francis
Role/FTE: Program Coordinator (0.50 FTE)
Funding Agency: National Institutes of Health, National Institutes of Diabetes and Digestive and Kidney Diseases
Award Amount: \$588,300.00
Grant period: 2017-2019
Project Title: Journey Pilot Supplement NIDDK STEP-UP 11th & 12th grade High School Research Experience. *To increase and strengthen the shortage of American Indian/Alaska Native students in the Alaska and contiguous 48 states pursuing the fields of biomedical, behavioral, and clinical research in the areas of diabetes, endocrinology, metabolism, nutrition, and obesity.*

5. Co-PI: Dr. Carolee Dodge Francis
Role/FTE: Program Assistant/Evaluator (0.50 FTE)
Funding Agency: National Institutes of Health
Award Amount: \$401,956.00
Grant period: 2017-2018
Project Title: Nevada IDeA Network Biomedical Research Excellence (NV INBRE) through administrative networks linking research and institutional organizations throughout the state of Nevada supporting faculty and student researchers and research services.

Publications

Hawkins GT, Chung CS, Hertz MF, Antolin N. The school environment and physical and social-emotional well-being: implications for students and school employees. *J Sch Health*. 2023; DOI: 10.1111/josh.13375

Rivers, Robert & Norris, Keith & Hui, George & Halpern-Felsher, Bonnie & Dodge Francis, Carolee & Guerrero, Lourdes & Golshan, Aneesa & Brinkley, Kelley & Tran, Kira & McLaughlin, Sheila & Antolin, Noe & Yoshida, Tiffany & Caffey-Fleming, Dolores & Agodoa, Lawrence. (2020). The NIDDK High School Short-Term Research Experience for Underrepresented Persons. *Ethnicity & Disease*. 30. 5-14. 10.18865/ed.30.1.5.

Dodge Francis, C., Bareng-Antolin, N., & Tran, K., (2019.) "STEP-UP: A Cultural Alaska Journey for Students and Staff, "Journal of Health Disparities Research and Practice: Vol. 12: Iss. 4, Article 29. Available at: <https://digitalscholarship.unlv.edu/jhdrp/vol12/iss4/29>

Dodge-Francis, C., Bareng-Antolin., N., & Tran, K. (2019). Chapter 8: In Spycher & Haynes. *Culturally and Linguistically Diverse Learners and STEAM: Teachers and Researchers Working in Partnership to Build a Better Tomorrow*. Charlotte, NC, Informational Age Publishing. 169-187. ISBN: 978- 1-64113-605-1 &978-1-64113-6075.

Presentations

National/Professional Meetings and Conferences

Antolin, N., & Kuhls, D. (2023, October 18). *TRAFFIC SAFETY RESEARCH AT THE KIRK KERKORIAN SCHOOL OF MEDICINE*. [Invited Speaker]. The Driving School Association of the Americas, Las Vegas, NV, United States

Kazemeini, S., Antolin, N., Reyes, A., Gryder, L., & Kuhls, D. (2023, September 23). *You drink, you drive, you lose: Implications of an impaired and distracted driving prevention program*. [Medical Research Symposium presentation]. Medical Research Society's Annual Research Symposium 2023, Las Vegas, NV, United States.

Antolin, N., & Sharma, M. (2022, November 06–09). *Theory-based interventions on fruit and vegetable consumption among children, adolescents, and adults: A 10-year scoping review* [Oral Conference presentation]. The American Public Health Association Annual Meeting & Expo, Boston, MA, United States. <https://apha2022sessions.hubb.me/AbstractDetail.aspx?id=917568>

Antolin, N., Evans, A., Smith, J., Kittle, K., & Flatt, J. (2022, November 06–09). *Relationship between Employment Status and Race, Gender, Educational Level, and Mental and Physical Health Days, 2019 Nevada Behavioral Risk Factor Surveillance System* [Conference Poster]. The American Public Health Association Annual Meeting & Expo, Boston, MA, United States

Hjelm, L., Dodge Francis, C., & Bareng-Antolin, N. (2022, November 06–09). *An evaluation of a 9th and 10th grade Native American virtual Pilot: Utilizing a culturally responsive and inclusive science model*. [Roundtable Discussion]. The American Public Health Association & Expo, Boston, MA. United States.

Bowman, N., Dodge-Francis, C., & Antolin, N. (2019). Indigenous Evaluation: Foundations, Building Relations, & Educational Applications [Conference Presentation]. Hawaii Pacific Evaluation Conference.

Antolin, N., Macias, E., Wood, R., Crutcher, N. (2014) Best practices for working with students at school: The Tutor Perspective. [Featured Presentation] NCCEP/GEAR UP 2014 Annual Conference. Washington D.C.

Local/Regional Meetings

Antolin, N., & Strong, C. (August 2022). *NV INBRE Undergraduate Research Presentation*. NV INBRE Statewide Annual Meeting. Reno, NV.

Antolin, N., & Strong, C. (December 2022). *NV INBRE Undergraduate Research Presentation*. NV INBRE External Advisory Meeting. Las Vegas, NV.

Other Scholarly Products

1. Noeheelani Antolin (Role: Moderator). Oral Session Injury and Emergency Health Services Data. American Public Health Association. November 14, 2023, Atlanta, GA.

Other Creative/Educational Products

1. Noeheelani Antolin, Ana Reyes, Merika Charupoom, Nicole Bacani, Kavita Batra, Bertille Mavegam Tango, Deborah A. Kuhls, Crash vs. Accident: An Important Distinction. TREND, Nevada Traffic Research & Education Newsletter, January 26, 2024, Volume 13, Issue 1
2. Merika Charupoom, Nicole Bacani, Noeheelani Antolin, Ana Reyes, Kavita Batra, and Deborah A. Kuhls, Environmental Factors Associated with Nevada Non-Adjudicated Crash vs Non-Crash Speeding Related Citations: A descriptive analysis of statewide speeding related citations that are associated with a crash- vs non-crash-related citations (2018-2021). TREND, Nevada Traffic Research & Education Newsletter, September 30, 2023, Volume 12, Issue 4
3. Merika Charupoom, Nicole Bacani, Noeheelani Antolin, Kavita Batra, Deborah A. Kuhls, Nevada Non-Adjudicated Crash vs. Non-Crash Speeding Related Citations. TREND, Nevada Traffic Research & Education Newsletter, August 8, 2023, Volume 12, Issue 3