PINK AND DUDE CHEFS: EFFICACY OF AN ONLINE TRAIN-THE-TRAINER MECHANISM AND STUDENT PROGRAM OUTCOMES

A Thesis

presented to

the Faculty of California Polytechnic State University,

San Luis Obispo

In Partial Fulfillment

of the Requirements for the Degree

Master of Science in Nutrition

by

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June 2017

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ABSTRACT

Pink and Dude Chefs: Efficacy of an Online Train-the-Trainer Mechanism and Student Program Outcomes

Jacqueline Chen

Background: The rate of overweight and obesity among adolescents aged 12-19 years has quadrupled since 1980. Reducing obesity is a key public health priority, as obesity is associated with individual and population-level health and economic consequences. Afterschool-based obesity prevention programs that aim to develop nutrition and culinary self-efficacy have shown promise. However, the level of aptitude among program instructors is directly correlated with student success, suggesting the importance of effective train-the-trainer (TTT) mechanisms for implementing and scaling up these strategies.

Pink and Dude Chefs (PDC) is an afterschool nutrition education and culinary skills program for middle-school adolescents aged between 11-14 years. The PDC online TTT platform trains lay instructors on program content and preparation, lesson delivery, and classroom and kitchen safety. Trained instructors deliver PDC lessons on topics ranging from macronutrients and USDA MyPlate to knife skills and food preparation. The literature on online TTT models and instructor impact on student outcomes is limited and the PDC online training mechanism has not been evaluated. The current project sought to address these critical gaps with the aim of creating the most effective intervention model.

Methods: This project was implemented in Santa Maria, Guadalupe, and New Cuyama, California from Fall 2015 to Spring 2016. Eleven instructors and 68 middle school students participated and comprehensive surveys were used to evaluate instructor and student outcomes.

Results: Instructors' performance on all three domains (food and kitchen safety, program knowledge, and overall knowledge) increased following training (45%, 63%, and 53%, respectively), all $p \leq 0.01$. Students outcomes (food and kitchen safety, nutrition knowledge, and overall knowledge) also improved following participation (14%, 33%, and 23%, respectively), all $p \leq 0.001$. Impact analyses revealed that students with instructors who scored high in overall knowledge performed better than students with low-scoring instructors ($p=0.01$).

Conclusion: If obesity prevention programs that incorporate online TTT mechanisms, such as PDC, continue to show promising outcomes for both instructors and adolescents, larger scale efforts may contribute to decreasing the public health and economic burdens associated with obesity.

Keywords: adolescent obesity, obesity prevention, afterschool program, nutrition knowledge, culinary intervention, train-the-trainer, online training

ACKNOWLEDGMENTS

I would like to thank my advisor and committee chair, Dr. Nazmi, for giving me the opportunity to work with Pink and Dude Chefs and for his continual support and mentorship. I would like to thank Dr. Nazmi, Casey Heaney, and Stephanie Teaford for their exceptional help during the grant development process for my project, and my committee members Dr. Grant-Holcomb and Dr. Pilolla for their advice and support during my time at Cal Poly. I would also like to acknowledge the STRIDE Center and everyone involved in the Pink and Dude Chefs Program. Lastly, I would like to thank my parents for always supporting my aspirations and helping me to accomplish my goals.

TABLE OF CONTENTS

Page

LIST OF TABLES

Table Page

LIST OF FIGURES

Figure Page

CHAPTER 1

LITERATURE REVIEW

1.1 Introduction

Rates of obesity in the United States have increased dramatically over the past 30 years. In particular, adolescent obesity rates more than quadrupled between 1980 to 2012, from 5% to 20.5% (Barlow, 2007; Ebbeling, Pawlak, & Ludwig, 2002; The State of Obesity, 2016). Obesity is associated with a range of health consequences, including chronic disease such as cardiovascular and metabolic disorders including hypertension and diabetes, and social and psychological issues such as depression (Daniels et al., 2005). Obese and overweight children have 70-80% greater risk of adulthood obesity compared to normal weight and underweight children, leading to increased risk for lower quality of life and obesity-related conditions throughout life (Torgan, 2005; University of Southern California, 2015). The direct and indirect medical costs associated with obesity are high, having surpassed $210 billion in 2016, representing 21% of healthcare dollars in the United States (Hammond & Levine, 2010; The State of Obesity, 2016).

Owing to its significant human and economic burdens, reducing obesity is a key public health priority. Many prevention programs target schoolchildren, and research has suggested that afterschool programs may present potential opportunities due to their flexibility in time, organization, and approaches that can be used to bridge the gap in nutrition skills and knowledge among students (Veugelers & Fitzgerald, 2005). Program strategies in afterschool settings that have shown promise in reducing obesity risk include focusing on improving nutrition literacy, changing dietary behaviors, and building culinary skills (Fahlman et al., 2008). However, an important component of any approach is appropriately trained staff to implement programs.

As online training mechanisms have become a viable alternative to traditional methods, the efficacy of online training models designed for nutrition program instructors has recently been evaluated. Train-the-trainer (TTT) models have shown promise in adequately preparing nutrition educators to effectively deliver nutrition programming (Marks, Sisirak, & Chang, 2013; Wartha et al., 2013). Additionally, online training platforms allow for broad dissemination of nutrition training to larger audiences while increasing the convenience of learning and decreasing costs (Young et al., 2008).

The Pink and Dude Chefs (PDC) program provides afterschool nutrition education and culinary skills training to middle-school participants between aged 11 to 14 years. Through a combination of classroom activities and hands-on kitchen experience, students gain knowledge and skills to develop and maintain healthy eating behaviors. Prior to program implementation, PDC instructors, usually lay adults, are required to complete a comprehensive online training. During this training, instructors learn about preparing for lessons, maintaining classroom and kitchen control, managing program expenses, and proper kitchen and food safety. Student outcomes of PDC have been researched (Bierlich-Wesch, 2016; Chessen, 2008; Lockhart, 2014; Sheehan, 2013), but there is a lack of data on PDC instructor outcomes vis-a-vis the online training platform, or how instructor knowledge impacts students' learning.

The current project sought to examine the factors associated with creating the most effective intervention model for PDC. If programs such as PDC causally contribute to obesity prevention, their scaling and implementation could decrease the public health and economic burdens associated with a range of cardio-metabolic and chronic disease outcomes.

1.2 Childhood and Adolescent Obesity

Obesity affects one out of every six children and adolescents between the ages of 2 to 19 years in the United States. In children aged 2 to 11 years, the obesity rate increased dramatically between 1970-2003, from 5% to 17% (Barlow, 2007; Ogden et al., 2015). Between 1980-2012, adolescent (12 to 19 years) obesity increased from 5% to 20.5%, highlighting a major public health concern among all young people (Ogden et al., 2012). Rates have stabilized since, but in most populations are still at their highest historically (Figure 1).

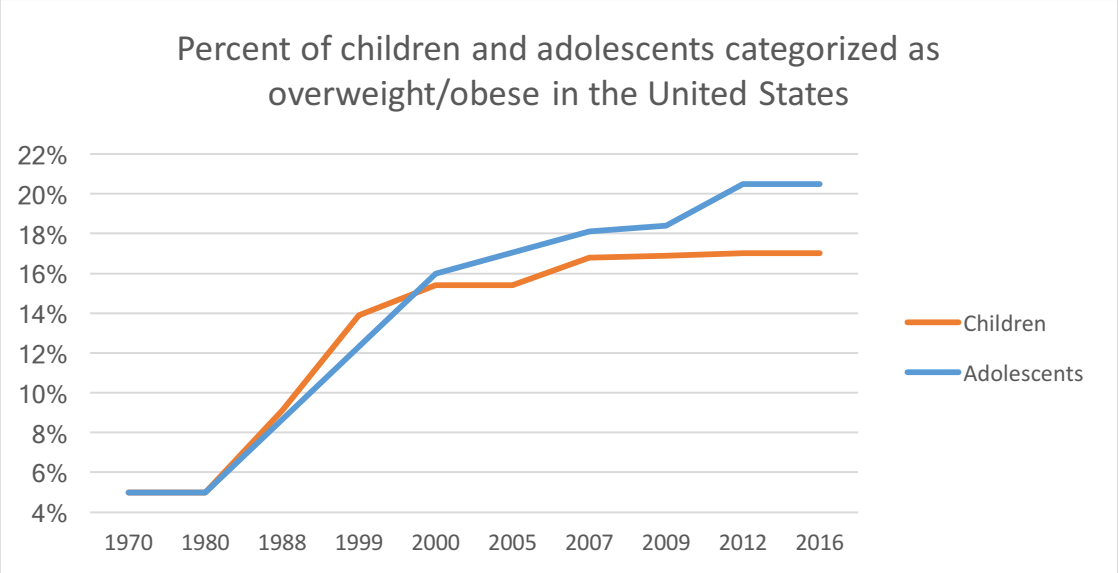

Figure 1. Percentage of children and adolescents categorized as overweight and obese in the United States from 1970 to 2016 (Barlow, 2007; Ogden et al., 2012; The State of Obesity, 2016).

Disparities in obesity rates disproportionately impact youth of minority racial/ethnic groups and those from low socioeconomic backgrounds. Overweight and obesity impact 41.2% of Hispanic/Latino and 41.8% of African American children and adolescents between ages 6-19 years, compared to 29.0% of White children and adolescents of the same age (National Institute of Health, 2012; Ogden et al., 2012).

According to the National Health and Nutrition Examination Survey (NHANES), the prevalence of overweight and obesity among Hispanic/Latino children increased from 26% to 35% for males and 37% to 44% for females, between 1999 to 2010. During this same time period, overweight and obesity rates among African American children increased from 27% to 37% for males, and 47% to 53% for females (Centers for Disease Control and Prevention, 2010). Among White children, rates increased from approximately 11% to 16% for males and females during this time (Centers for Disease Control and Prevention, 2015). Between 2001-2004, the Office of Minority Health reported the most dramatic increases in overweight Hispanic/Latino adolescents from 12% to 24% for 6-11 year olds, and 8% to 21% for 12-19 year olds (Hispanic Obesity Initiative, 2010). In 2012, 11% of African American children between ages 2-5 years and 23.8% between ages 6-11 years were considered obese (Skinner & Skelton, 2014). Among 8th graders, the Early Childhood Longitudinal Study conducted between 1999 to 2007 showed disparities in obesity rates among Hispanic, African American, and White adolescents (25.0%, 25.1%, and 17.4%, respectively (Rendall et al., 2012).

According to the Pediatric Nutrition Surveillance Survey, from 1999 to 2009, the prevalence of obesity among lower socioeconomic (SES) children increased from 12.7% to 14.8% (Kumanyika & Grier, 2006). The 2007 National Survey of Children's Health revealed that children living in households below the federal poverty level were 2.7 times at greater risk for developing overweight or obese compared to children living 400% above the federal poverty level (Frederick et al., 2013). A longitudinal study on children and adolescents from ages three to 15.5 years reported that children who experienced poverty before the age of two were 1.66 times more likely (95% CI: 1.16-2.37) to become

obese by 15.5 years of age, compared to those who did not experience early poverty (Lee et al., 2014).

In sum, obesity is a huge concern and impacts certain populations more than others. However, it should be noted that environmental and behavioral disparities in obesity, discussed below, arise at least partly from racial and ethnic minorities being overrepresented in lower SES groups, making it difficult to study these risk factors in isolation (Kumanyika & Grier, 2006; Ogden et al., 2012).

1.2.1 Measurement of obesity

Through measurements of weight and height in terms of weight (kg) divided by height squared (kg/m^2), body mass index (BMI) can identify weight categories for specific ages and genders that may lead to higher risk of health problems (Center for Disease Control, 2015). Children and adolescents who fall between the 85th and 94th BMI percentiles of their age and sex determinants are considered "overweight," whereas children and adolescents who fall at or above the 95th BMI percentile among their age and sex groups are classified as "obese" (Table 1; Alberga et al., 2012).

Table 1. Weight status category and percentile range of childhood and adolescent obesity categories adapted from Centers for Disease Control and Prevention, (2014).

Weight Status Category	Percentile Range
Underweight	< 5th percentile
Healthy weight	5th to < 85th percentile
Overweight	85th to < 95th percentile
Obese	95th or higher percentile

1.2.2 Consequences of obesity

Obesity is associated with a wide range of comorbid diseases and negative health consequences, including but not limited to metabolic disorders, orthopedic and joint

problems, and pulmonary issues which obstruct sleep and breathing (Table 2). Childhood obesity is linked to adverse complications previously seen only in adults, including cardiovascular disease, chronic inflammation, hypertension, and Type II diabetes mellitus (Ebbeling et al., 2002; Lakshman, Elks, and Ong, 2012). Overweight and obese children and adolescents have 5.4 times higher risk of Type II diabetes and 2.7 times higher risk for hypertension, compared to normal weight children (Juonala et al., 2011). A half-unit increase in BMI among overweight and obese youth was associated with a 55% higher risk of developing metabolic syndrome (OR: 1.55, 95% CI: 1.16-2.08) (Weiss et al., 2004).

Table 2. Comorbidities and adverse outcomes associated with overweight and obesity, adapted from Daniels et al., (2005).

Type of comorbidity	Examples of comorbidities
Metabolic	Type II diabetes mellitus Metabolic syndrome Inflammation
Cardiovascular abnormalities	Hypertension Atherosclerosis Dyslipidemia Left ventricular hypertrophy
Psychological	Depression Poor quality of life Social isolation
Orthopedic	Slipped capital femoral epiphysis Blount's disease
Neurological	Pseudotumor cerebri
Hepatic	Nonalcoholic fatty liver disease Nonalcoholic steatohepatitis
Pulmonary	Obstructive sleep apnea Asthma (exacerbation)
Renal	Proteinuria

Obesity also has psychosocial consequences. Overweight and obese adolescents aged 12-14 years had approximately three times higher risk of being depressed (OR: 3.04, 95% CI: 1.19-7.76; and OR: 2.83, 95% CI: 1.25-6.41, respectively) compared to

other age groups (Swallen et al., 2005). In a 4-year longitudinal study on 1,540 adolescents aged 13-14 years, overweight and obesity was associated with decreased self-esteem ($p=0.05$), and with increased feelings of sadness ($p<0.001$), loneliness ($p<0.001$), and nervousness ($p<0.05$) (Strauss, 2000). These issues have long-lasting effects on lifelong health and can severely affect quality of life, physical health, and mental health during all stages of life (Daniels et al., 2005).

Higher BMI during childhood and adolescence is also associated with increased morbidity and mortality in adulthood (Alberga et al., 2012; Guo et al., 1994). Compared to children who are normal or underweight, obese and overweight children had a 70% increased rate of being overweight or obese as adults (Torgan, 2005). A significant proportion of chronic diseases in adulthood have been shown to associated with obese BMI, including 42% of diabetes in women and 30% of hypertension in men (Kearns et al., 2014). Obese women had a 2.9 times (95% CI: 2.3-3.6) higher risk for hypertension, compared to normal weight women (Kearns et al., 2014). According to the Nurse's Health Study that followed 114,000 registered nurses over 14 years, overweight and obese women were 8.1 times (95% CI: 6.2 to 10.5) and 27.6 times (95% CI: 22.7-33.5) more likely to develop diabetes than normal weight women (Colditz et al., 1995). A one-unit decrease in BMI was associated with 26 and 28 fewer chronic disease incidences per 1,000 men and women, respectively (Kearns et al., 2014). These poor health outcomes lead to individual and population level economic burdens.

Obese individuals spend an average of $3,000 more on medical costs per year compared to non-obese individuals (Cawley & Meyerhoefer, 2012). On average, obese individuals have 36% higher annual healthcare costs, 105% greater costs for prescription

medications, and approximately 40% higher primary care costs (Hammond & Levine, 2010). At the population level, total estimated obesity-related medical costs have increased from approximately $78.5 billion a year in 1998, to $147 billion a year in 2008, to upwards of $210 billion a year in 2016 (Hammond & Levine, 2010; The State of Obesity, 2016). Childhood obesity alone accounts for $14 billion of these healthcare dollars (Marder & Chang, 2006).

In sum, childhood and adolescent obesity lead to major health and economic consequences at the individual and population levels. Further, the adolescent age group seems to be at disproportionate risk given the trends in overweight and obesity rates and the excess risk for negative psychosocial outcomes (Gonzalez-Suarez et al., 2009). As such, there is a clear need for evidence-based obesity prevention strategies among key age groups that focus on factors that most influence risk.

1.2.3 Determinants of obesity

Obesity is multi-factorial in etiology, with most key determinants being modifiable. Environmental, socioeconomic, and behavioral factors contribute strongly to overweight and obesity risk, but are inter-related such that it is difficult to study any individual variable in isolation, as discussed above. A vast literature indicates that these factors act independently and in conjunction to determine risk. This section highlights obesity risk related to nutrition and dietary variables in the context of these modifiable factors, including individual-level factors such as education, knowledge, and skills.

Factors such as availability and accessibility of fresh fruits and vegetables, food choices and dietary behaviors, and basic cooking skills and nutrition literacy all significantly impact obesity risk (Barlow, 2007; Frederick et al., 2013; Hilmers et al.,

2012). Lower availability and access to fresh fruits and vegetables among residents of low-income neighborhoods impact food choices and dietary behaviors (Hilmers et al., 2012). A study on 7,514 Los Angeles County residents determined that individuals who lived within one mile of a grocery store were 25% more likely to consume four or more servings of fruits/vegetables per day and 14% were more likely to consume five or more servings (Robinson et al., 2013). The United States Department of Agriculture estimates that 29.7 million people in the country live in low-income areas where the only options for grocery shopping are limited to convenience stores, gas stations, and fast food restaurants which often lack access to fresh fruits and vegetables (Ploeg et al., 2012).

Furthermore, residents of low-income neighborhoods have less access to health education and nutrition services, which impact food choices and dietary behavior, both strong predictors of risk for overweight and obesity (Hilmers et al., 2012). In a study conducted on 5,658 adults, low-income adults were less successful at recognizing diseases related to high sodium, low fiber, and excessive cholesterol intake, compared to high-income individuals (52% vs. 59%, 40% vs. 63%, and 69% vs. 83%, respectively) (Gleason, Rangarajan, & Olson, 2000). Low-income adults also had less knowledge compared to high-income adults on fat/cholesterol content of foods (55% vs. 65%) and the recommended servings for food groups (45% vs. 50%). Lack of knowledge about nutrients and their impact on health can impede these and other individuals from making healthier dietary choices (Fitzgerald & Spaccarotella, 2009). These factors, in addition to a deficit in basic cooking skills have been strongly implicated in the etiology of obesity (Hersch, Perdue, Ambroz, & Boucher, 2014).

Nutrition knowledge alone is not enough to improve dietary behaviors, and should be coupled with building cooking skills (Ternier, 2010). Knowledge about nutrition and food preparation has been positively associated with more healthful dietary behaviors, including meeting food guideline requirements (Story, Neumark-Sztainer, & French, 2002). Decline in food preparation in the home and declining culinary skills are associated with increased reliance on convenience and fast foods (Monsivais, Aggarwal, & Drewnowski, 2014). In a study performed on 1,710 young adults, individuals who reported frequent food preparation at home were less likely to consume frozen or fast food, and more likely to meet dietary requirements for fat ($p<0.001$), calcium ($p<0.001$), fruit ($p<0.001$), vegetables ($p<0.001$), and whole grains ($p=0.003$) (Larson et al., 2006). In a study of 3,699 middle school and high school adolescents between the ages 11-18 years, involvement in helping to prepare family meals at least once a week was associated with increased intake of fruits and vegetables, and decreased intakes of fried foods and carbonated beverages ($p<0.01$ for both) (Larson et al., 2006). A cross-sectional study performed on 1,049 subjects assessed food-related outcomes in learning cooking skills at different ages. Compared to adults and adolescents between the ages of 13-18 years, children ages 12 or younger showed greater improvements in safe food handling, time invested in cooking on weekdays and weekends, interest in eating healthily, less frequent consumption of convenience food, using fresh ingredients for meal preparation, and significantly higher fruit intake per day ($p<0.05$ for all) (Lavelle et al., 2016).

The data above underscores the multi-factorial nature of obesity etiology and highlights some of the factors that may contribute to decreased obesity risk among young people. According to these studies, individual-level modifiable risk factors that may have

the greatest impact on youth include nutrition education and culinary skills development (Hersch et al., 2014; Larson et al., 2006; Lavelle et al., 2016; Story et al., 2002). The following sections will highlight the implementation of obesity prevention programs that incorporate nutrition education and culinary skills in the school setting, with a focus on afterschool programs. The literature indicates that afterschool-based obesity prevention programs benefit from flexibility in their organization and implementation, and are associated with positive participant outcomes including improvements in knowledge, skills, and dietary behaviors.

1.3 School-Based Obesity Prevention Programs

School-based prevention programs for combatting obesity can target the wide population of children and adolescents who spend a large portion of their days at school (Fahlman et al., 2008). A primary goal of early nutrition interventions is to help adolescents understand that their lifestyle and dietary choices impact their lifelong health. According to the World Health Organization, adolescence is a formative age for learning and skill development. During this key period of physical and cognitive development, adolescents also establish independence and self-sufficiency (World Health Organization, 2015). The knowledge gained and habits formed during this developmental period will likely persist into adulthood (Fahlman et al., 2011). For minority or low-income adolescents who are at a higher risk of developing obesity due to SES and racial/ethnic disparities during these ages, school-based prevention programs can provide beneficial knowledge and skills-learning they may not have access to otherwise (Kumanyika & Grier, 2006).

Intervention methods include providing healthy food options in cafeterias, incorporating health and physical activity lessons at schools, and implementing nutrition education curricula in classrooms (Gonzalez-Suarez et al., 2009). Programs also advocate for the adoption of healthy food-related habits such as consuming recommended quantities of fruits and vegetables, preparing family meals, eating breakfast, using appropriate portion sizes, and eating a balanced diet (Barlow, 2007). A meta-analysis of 19 school-based intervention programs targeting childhood obesity between 1995 to 2007 found that programs had a significantly protective effect against overweight and obesity among participants compared to control (OR: 0.74, 95% CI: 0.60, 0.92) (Gonzalez-Suarez et al., 2009). Long-term effects of programs have been associated with a mean decrease in BMI by 0.42 points over a year post-intervention (95% CI: -0.69, -0.14) (Gonzalez-Suarez et al., 2009). Overall, school-based nutrition education programs have shown promise when incorporated into adolescents' classroom lessons and school sites, but they should not be limited to regular school hours alone. In 2014, 10.2 million children, nearly 18% of children and adolescents living in the U.S., participated in afterschool programs (Afterschool Alliance, 2014). Because of their widespread use, the afterschool setting offers a valuable setting for providing nutrition education to participating youth in the nation.

1.4 Afterschool-Based Obesity Prevention Programs

Nutrition education and obesity prevention programs in the afterschool setting are a key factor for bridging the gap between nutrition knowledge and student learning. Afterschool programs exist in a variety of settings, including public schools, Boys & Girls Clubs, YMCAs, private schools, and religious organizations (Afterschool Alliance,

2014). In a survey conducted on 13,709 households in the United States, 82% of parents believe that afterschool programs can excite children about learning (Afterschool Alliance, 2014). Afterschool programs have greater flexibility in organization, implementation, time, and development of strategies for mitigating obesity (Veugelers & Fitzgerald, 2005). Because they are not delivered during school, lessons are not constrained to meet state health education standards and can focus on a variety of objectives and strategies of a program's choosing (Veugelers & Fitzgerald, 2005). Additionally, programs help alleviate the numbers of adolescents who are unsupervised afterschool. In 2014, 19% of middle schoolers, or 2.2 million students, did not have adult supervision when the school day ended (Afterschool Alliance, 2014). According to parents of adolescents not enrolled in afterschool programs, 41% of them would be enrolled in an afterschool program if it were available (Afterschool Alliance, 2014). The demand for afterschool programs is higher among low-income households (20%), Hispanic/Latino youth (29%), and African American youth (24%) (Afterschool Alliance, 2014). These populations are all at higher risk for developing overweight and obesity as previously mentioned (Frederick et al., 2013; Kumanyika & Grier, 2006; Ogden et al., 2012). For these reasons, afterschool programs provide a growing opportunity for implementing obesity prevention programs to help students establish healthy behavioral outcomes.

In 2006, the Children's Aid Society in New York City started Go!Chefs Kids Cooking Classes to provide hands-on cooking and nutrition education curriculum for adolescents aged six years old and above. These classes focused on introducing youth to basic cooking skills and food preparation using fresh fruits and vegetables at community

schools and centers (The Children's Aid Society, 2017). Each year, the program culminated with an Iron Go!Chefs competition where the elementary school and middle school students worked together to create their own original recipes for judging. Participants were also quizzed on nutrition concepts emphasized throughout the course to test their knowledge (The Children's Aid Society, 2017). In 2008, the Children's Aid Society expanded their program to pilot Fun Food, Smart Food, a 12-week technical assistance and culinary training program targeted specifically towards middle school students (The Children's Aid Society, 2017). This program empowered participants to learn new and more advanced cooking skills, and gain motivation for making healthier food choices through a passion for cooking (The Children's Aid Society, 2017). While no specific data was released, strategies similar to those employed in Go!Chefs have been extensively studied in the literature.

Involvement in obesity prevention programs has been associated with positive participant outcomes. As part of the Detroit Healthy Youth Initiative, the eight-lesson Michigan Model Nutrition Curriculum was implemented into middle school health courses to educate 576 students on various nutrition topics (Fahlman et al., 2008). A total of 11 intervention schools implemented the classroom curricula, while seven control schools did not. Teachers charged with implementing the nutrition lessons were required to complete an 8-hour long in-service training on the Michigan Model curriculum. The 40-minute lessons covered topics such as food groups, nutrition literacy and label reading, advertising, and strategies for healthy eating at school and in restaurants. Matched pre- and post- program surveys were used to assess students' knowledge about nutrition and their healthy eating behaviors. Results from the 8-week long study indicated

that students who participated (n=407) in the Michigan Model lessons improved intake of fruit ($p<0.05$) and vegetables ($p=0.02$), and increased nutrition knowledge by 17% ($p<0.01$), when compared to students in the control groups that did not participate (n=169) (Fahlman et al., 2008). Longer-term mental health and social outcomes have also been implicated six-weeks after participating in the program, such as improved social and emotional health ($p<0.001$) and drug refusal skills ($p<0.001$), but the long-term effects on nutrition have yet to be evaluated (O Neill, Clark, & Jones, 2011).

Cooking up Energy is an afterschool 10-lesson cooking and nutrition education program for children ages 7 to 11 years in Long Island, that primarily serves Hispanic/Latino children (Isoldi & Dolar, 2016). Participants (n=51) received basic culinary training, prepared healthy recipes, and discussed nutritional aspects of the meals and ingredients during each lesson. The goals of the program included reducing body weight in overweight and obese participants, improving fruit and vegetable intake, increasing frequency of meal preparation in the home, and improving self-efficacy with cooking. Outcome assessment through pre- and post-measurements indicated a significant reduction in BMI percentiles (0.44%) among the 27 overweight and obese participants ($p<0.05$) (Isoldi & Dolar, 2016). Analyses revealed significant reductions in daily calorie intake following program participation (567 calories, $p<0.05$), but no discernable changes in fruit and vegetable consumption. Additionally, 83% of participants reported an increased desire to cook more frequently at home, and 74.5% indicated a desire to cook the recipes they learned during the program at home with their families (Isoldi & Dolar, 2016).

Los Angeles Sprouts (LA Sprouts) is a 12-week afterschool gardening, nutrition, and cooking intervention program that was developed for 4th and 5th grade Latino students in Los Angeles, California (Davis et al., 2011). Thirty-four participants already enrolled in an existing afterschool care program, LA's BEST, received weekly 90-minute interactive classes, while 70 participants not enrolled in LA's BEST served as control. Lessons incorporated a 45-minute hands-on cooking and nutrition education lesson with a 45-minute gardening lesson. Each lesson emphasized increasing fruit and vegetable intake, culturally relevant foods, and the growing and harvesting of organic fruits and vegetables. Post-intervention data revealed that LA Sprouts participants (n=34) increased their dietary fiber intake, compared to non-participating peers in the control group (+22% vs. -12% respectively, p=0.04) (Davis et al., 2011). Participants also had a 16% greater increase in vegetable preference compared to control subjects (P=0.009) (Gatto, Ventura, Cook, Gyllenhammer, & Davis, 2012). In a subsequent study, LA Sprouts participants (n=134) showed improved scores for identifying vegetables compared to the control group (+11% vs. +5% respectively, p=0.001), as well as increased nutrition and gardening knowledge (+14.5% vs. -5.0%, p=0.003) (Davis, Martinez, Spruijt-Metz, & Gatto, 2016). Continuing research on this program participation shows many positive short-term effects, but the longer-term effects have yet to be assessed.

1.4.1 Evaluating intervention programs

Program components and human contributions should be considered when designing an obesity prevention program for most effective outcomes. Several factors that have may impact the success of these programs include program duration and the content and strategies emphasized within them (Gonzalez-Suarez et al., 2009; Haerens et

al., 2006; Weepie & Mccarthy, 2002; Zenzen & Kridli, 2001). The literature has yet to establish the minimum program duration required for best outcomes. However, programs as short as five weeks and as long as a year have shown benefits. Eighty-nine elementary school students received five 35-minute long nutrition lessons covering food groups, serving sizes, and nutrients in foods over the course of five weeks (Weepie & Mccarthy, 2002). While knowledge on these concepts increased by 3.1 points at follow-up compared to baseline ($p<0.001$), researchers acknowledged the brevity of the program may have impacted their findings (Weepie & Mccarthy, 2002). Researchers hypothesize that programs with longer intervention lengths or program durations may have more significant long-term impacts compared to shorter programs. In a year-long intervention targeting healthy eating behaviors for middle school students through interactive classroom lessons, 447 female participants exhibited a greater decrease in fat intake compared to 340 females in the control group who did not receive the lessons (14.8 g/day vs. 4.2 g/day respectively (Haerens et al., 2006). Following two years of program participation, female students reported even more significant decreases in fat intake compared to control (19.9 g/day vs. 10.1 g/day; $p<0.05$) (Haerens et al., 2006). Further research is necessary to address finding a more specific optimal program length, as this, along with program strategies, can impact outcomes.

A meta-analysis performed by Gonzales-Suarez et al. indicated that of the 19 total interventions examined, the more successful intervention programs did not emphasize dietary restrictions, but rather targeted increasing intake of high-nutrient dense foods such as fruits and vegetables (2009). Increases in fruit and vegetable consumption following program participation (3.8 servings, $p<0.03$) has been correlated with lower intakes of

high-fat or high-sugar foods, including sugar-sweetened beverages (4.2 servings, $p<0.001$) (Epstein et al., 2001). Dietary interventions also had a higher impact when they targeted foods readily available and accessible to children in their environment (Haire-Joshu & Nanney, 2002). Researchers note that a variety of factors may influence types of foods prevalent in the home, including geographic location, cultural or regional preferences, and food availability (Haire-Joshu & Nanney, 2002; Kirby et al., 1995). In Missouri, 304 participants received eight nutrition lessons and healthy eating tips that were specifically tailored towards their most frequently consumed fruits and vegetables. Mean servings of fruits and vegetables increased following this intervention (0.75 servings, $p<0.001$; and 0.03 servings, $p=0.3$, respectively) (Nanney et al., 2005). Highlighting less familiar fruits and vegetables children did not significantly impact participants' dietary intakes ($p=0.4$ and $p=0.7$ respectively) (Nanney et al., 2005). Researchers also have noted the role of families and their impact on children's eating behaviors, as parents play a key role in purchasing of fruits and vegetables for the home (Zenzen & Kridli, 2001).

Attempting to change children's habits or lifestyle without addressing families may be less effective than including other family members. A combination of healthy lifestyle education and parental involvement is essential to achieve successful program outcomes (Zenzen & Kridli, 2001). A study performed on 1,704 third to fifth-grade students combined a 12-week classroom nutrition curriculum with a "family-involvement component" that included an interactive discussion forum, take-home materials and recipes, and family cooking events at schools (Caballero et al., 2003). Researchers indicated their desire to create a supportive environment for students to establish healthy

eating behaviors. Students reported a mean decrease in daily energy intake and fat intake following the intervention (265 calories and 2.5%, respectively), as well as increased nutrition knowledge ($p<0.001$) (Caballero et al., 2003). In addition to parents having control over the types of foods available in the home, 22.6% of fruit and vegetable intake in parent-adolescent pairs can be attributed to the other's level of intake (Dwyer et al., 2017). Increased motivation to eat healthily by a parent was associated with higher intake in the adolescent, and vice versa ($p<0.001$ for both) (Dwyer et al., 2017). Because parents can influence their children's dietary habits in several ways, it is important to include at least one parent in obesity prevention programs (Epstein et al., 2001; Zenzen & Kridli, 2001).

Overall, obesity prevention programs have shown benefits on participants' dietary behaviors and nutrition knowledge when these programming and family-related factors are taken into consideration. While further research is necessary to establish the long-term outcomes of programs and best practices for optimal efficiency, program instructors are also key contributors that determine the success of programs (Young et al., 2008).

1.5 Instructor Training Mechanisms

1.5.1 Importance of instructor aptitude

Instructor aptitude is crucial to the success of program implementation and student learning (Resnicow et al., 1998). An analysis performed on the "Cooking and Active Leisure" Program in Spain identified teachers' motivation and training as critical quality control points and impact factors for effectiveness of nutrition programs (Roura et al., 2014). Program instructors should be confident in their abilities to relay course information and demonstrate course objectives effectively to students (Jones &

Zidenberg-Cherr, 2015). Instructors (n=30) who participated in an 8-hour comprehensive in-service nutrition training reported increased confidence in teaching these topics compared to control instructors (n=29) who did not receive training (20.8 points vs. -1.0 points, respectively, p=0.001) (Fahlman et al., 2011). Sixty-three percent of instructors acknowledged that participation in training or in-service nutrition education sessions would increase their likelihood and motivation to teach nutrition topics (Jones & Zidenberg-Cherr, 2015). Undergoing training focused on nutrition or dietary behavior significantly increased the likelihood of instructors incorporating at least 4 hours of instruction on those topics into classroom curricula compared to instructors who did not receive training (OR: 1.1, 95% CI: 0.6, 2.0) (S. E. Jones, Brener, & Mcmanus, 2004).

Community-based educators often lack formal health and nutrition education, but if properly trained, can effectively incorporate childhood obesity prevention strategies into their programs (Eck et al., 2016). In a survey performed on 102 educators, 44% indicated a lack of nutrition knowledge as a barrier for their ability to teach others (Jones & Zidenberg-Cherr, 2015). The BeHealthy Charities Aid Foundation Program in Russia emphasized the importance of comprehensive training for teachers before allowing them to facilitate lessons and cooking courses geared towards on healthy eating behaviors in public schools (Mukhina & Novikova, 2014). The absence of appropriate training leads to a cycle of suboptimal instructor motivation and decreased program effectiveness (Roura et al., 2014). These issues highlight the need for train-the-trainer models in nutrition education programs, especially trainings that are specifically tailored for each individual nutrition education program.

1.5.2 Train-the-trainer (TTT) model

A train-the-trainer (TTT) model is defined as the development of "community-based trainers to deliver a specific program, who may or may not have direct experience with the content being delivered" prior to the training (Sanders et al., 2015). During the development and implementation of a state-wide TTT model for Join the Healthy Boat, a primary school-based health promotion and nutrition program in Baden-Württemberg, Germany, a process evaluation of the training program was performed (Wartha et al., 2013). Between 2009-2010, 453 teachers completed 6 preparatory training courses and completed questionnaires regarding their satisfaction with the training sessions and their self-perceived competency in teaching program curricula post-training. Overall, all 453 participating teachers felt either "very well" or "well" prepared to teach others, indicating the TTT model would be useful for other school-based prevention programs as well (Wartha et al., 2013).

Successful TTT models applied in the school setting also include training medical students and high school students to provide nutrition education to elementary school-aged children through the Improving Meals and Physical Activity in Children and Teens (IMPACT) Program (Muth et al., 2008). Nine students from a rural North Carolina high school were trained on topics covered in the 12-lesson IMPACT curriculum and leadership skills required for program delivery (Muth et al., 2008). Fourth grade students at a neighboring elementary school were randomized into an intervention group to receive IMPACT program education by these trained instructors (n=38) and a control group (n=37) for 12 weeks (Muth et al., 2008). After program intervention, elementary school students who received instruction on the food groups, nutrients, and sugary

beverages from trained IMPACT instructors showed increased fruit and vegetable intake by 0.85 servings/day ($p<0.05$), as well as improved knowledge on food groups and appropriate servings ($p<0.01$) compared to the control group (Muth et al., 2008).

The HealthMatters Program, a 12-week long exercise and nutrition health education program based in Illinois, also offered Train-the-Trainer Certified Instructor workshops for instructors of the program (Marks et al., 2013). On-site training included 6 hours of evidence-based interactive workshops tailored to cover health topics, program components, and delivery procedures for HealthMatters program material. Through this training, participants became Certified Instructors to teach core concepts of the program curriculum in the state (Sisirak, 2014). A total of 32 participants in the intervention group received instruction led by HealthMatters Certified Instructors while 35 control participants received instruction from non-trained instructors. The intervention group showed improvements in self-efficacy and confidence in making healthy food choices at follow-up, compared to the control group (1.6 points vs. -0.4, respectively, $p<0.01$ for both) (Marks & Sisirak, 2012). Overall nutrition knowledge and skills also improved for the intervention group compared to the control group (1.9 points vs. 0.4 points, respectively, $p<0.01$) (Marks & Sisirak, 2012). A subsequent study indicated that fruit and vegetable intake increased in the intervention group ($n=28$) compared to the control group ($n=30$) (0.71 points vs. -0.16 points, respectively, $p<0.01$) (Marks et al., 2013). Overall, completing the HealthMatters training platform is associated with several positive outcomes, including increased nutrition-related knowledge and skills, and improvements in dietary intake for participants who took classes led by trained instructors.

A multidisciplinary TTT approach was also used in the Nutrition Detectives program designed to improve food label literacy in 3rd grade students in four public elementary schools in Connecticut (Sanders et al., 2015). One hundred and forty-five graduate students from different disciplines were trained on the Nutrition Detectives curriculum and activities in a 3-hour formal training session. The program curriculum included topics on reading food labels, recognizing marketing deceptions, and understanding ingredient content in foods (Sanders et al., 2015). Following completion of the training, instructors delivered programming to 110 3rd grader students. Nutrition knowledge and food label literacy scores increased in these students by 25.2% ($p<0.01$) from baseline scores following participating in Nutrition Detectives (Sanders et al., 2015).

In addition to elementary and high school students, TTT models have also been useful for nutrition programs targeted at middle school students. Teachers who implemented the aforementioned Michigan Model (MM) Nutrition Curriculum participated in an 8-hour long in-service professional development session designed for the Middle School Nutrition module in the MM curriculum. Compared to the teachers who did not participate in the in-service training (n=29), participating teachers (n=30) showed increased confidence in their knowledge and ability to teach topics including general nutrition information ($p=0.023$), food groups and the food pyramid ($p=0.018$), health benefits of each food group ($p=0.030$), serving sizes ($p=0.026$), how to read food labels ($p<0.001$), eating healthy at a fast food restaurant ($p=0.016$), understanding health claim contents ($p=0.027$), and comprehending the necessary skills required to teach nutrition and health-related topics ($p=0.013$) (Fahlman et al., 2011).

Results from the MM study also revealed that instructors who completed training reported higher expectations that their instruction would lead to better student health outcomes, such as consuming at least five fruits and vegetables per day (p=0.030), eating more whole grains (p=0.001), increased nutrition literacy (p=0.001), and reducing unhealthy eating habits (p=0.001) (Fahlman et al., 2011). Professional development and training increased intervention instructors' confidence and competency, as they scored higher in nearly all areas compared to control instructors. This study highlights the benefits of providing teachers with all the necessary tools needed throughout the program ahead of time, including all curriculum materials and any associated instructional or supplementary resources (Fahlman et al., 2011).

Evidence indicates that instructor participation in training programs designed specifically for nutrition programs can adequately prepare them to deliver nutrition information covered in program curricula (Fahlman et al., 2011; Marks & Sisirak, 2012; Muth et al., 2008; Sanders et al., 2015; Wartha et al., 2013). The positive behavioral outcomes among students of all ages highlights the necessity of appropriately trained instructors. While the literature highlights the benefits of traditional methods for training instructors, the rise of technology may offer an equally effective and more convenient training modality.

1.5.3 Online TTT programs

Online training mechanisms have emerged as a viable alternative method for in-person training for community nutrition educators (Cohen et al., 2008). A study performed on over 1,000 online learners, ranging from the highly experienced online learner to individuals who have never taken an online course before, revealed similar

rates amongst those who enjoy online learning less, more, or the same as a traditional classroom (Muilenburga & Bergeba, 2005). Additionally, of respondents who had studied online before, 22.8% feel they learned better online, 33.2% believed they could not learn as well online, and 44.0% did not perceive a difference (Muilenburga & Bergeba, 2005). A meta-analysis performed on empirical studies of online learning from 1996 to 2008 revealed that online learning produced stronger student learning compared to face-to-face instruction (mean effect=0.20, $p<0.001$) (Means et al., 2010).

Improvements in online learning mechanisms can decrease barriers that may contribute to negative perceptions of these services. Effective learning cannot occur through online nutrition education training by simply posting traditional learning methods such as textbook readings, lectures, or exams, online (Cohen et al., 1999). Instead, developers of the training mechanisms should consider interactive elements and activities to promote additional learning opportunities and further understanding of the material (Cohen et al., 2008). Online teaching tools should include skill-based visual education, such as demonstrative videos and step-by-step instructions (Stotz et al., 2017).

A factor analysis study performed on 423 online learners determined that perceived barriers to online learning include the length of online time required, interruptions that may disrupt the learning environment, a need for infrastructure and support services, levels of motivation, perception of required prerequisite skills to participate, technical mastery of online software, and social factors (Muilenburga & Bergeba, 2005). These barriers to online learning reflect individual differences in technological ability and environmental factors, rather than the integrity and design of online training mechanisms themselves. Furthermore, because substantial progress has

been made in designing effective in-person nutrition education TTT models, adapting these training mechanisms to an online format may efficiently disseminate nutrition training to a wider audience and population.

There are several advantages to online education models. Web-based tailored nutrition education has become more popular in the past decade with the development of new technologies, and has been shown to have effects on changing participants' health-related behaviors (Kreuter et al., 2000). Despite mixed reviews on preferred learning styles, online education can be a powerful incentive for motivating individuals to learn about nutrition by increasing convenience and reducing barriers for learning for a larger population. An advantage of online training programs over traditional methods of learning is the reduction in costs associated with printed materials, learning space, and transportation (Young et al., 2008). Online courses are self-contained, can be available and accessed at any time, and do not require an instructor for course delivery which also makes it a more cost-effective option (Morrison et al., 2013). Results from a pilot program for an online instructor certification program for employees of the Supplemental Nutrition Assistance Program-Education and Expanded Food and Nutrition Education highlighted that the online training saved an estimated $16,000 in costs to train 22 employees compared to traditional face-to-face training used by the organization (Christofferson et al., 2012).

Online learning overcomes time and distance barriers, allowing learners the ability to work at their own pace and from any location of their choosing (Cohen et al., 2008). Students spend an average longer length of time on online learning courses compared students receiving in-person instruction, and these online students performed

modestly better than students in face-to-face instruction courses (mean effect=0.45 vs. 0.18, p=0.06) (Means et al., 2010). Online nutrition education can enhance learning opportunities for limited-resource learners in rural communities or populations who have limited motivation in seeking formal nutrition education (Case, Cluskey, & Hino, 2011). Computer-based programs provides the opportunity to reach larger groups of people than in-person education programs can accommodate (Oenema, Brug, & Lechner, 2001).

In addition to reaching larger audiences, advancements and improvements in technology allow for the tailoring of online programs to fit the needs of different populations and nutrition education program objectives. Tailored interventions are more appreciated and are rated as more personally relevant than general nutrition information (Oenema et al., 2001). Web-based TTT models can be tailored for each specific nutrition education program, but can also be further personalized for instructors of different backgrounds, geographic locations, and levels of computer literacy for more successful outcomes (Harris et al., 2011). The ease of technology also allows fast and efficient methods to score and assess participant learning, using practice problems, quizzes, and tests to provide instant feedback (Hubackova, 2011). The high level of accessibility, advancements in data transmission, and cost-effectiveness of online learning makes online nutrition education training mechanisms a potentially powerful tool for preparing instructors to facilitate health promotion and obesity prevention programs (Harris et al., 2011).

1.5.4 Online nutrition education and training outcomes

The delivery of online nutrition education services can lead to positive and favorable nutrition-related changes for learners lacking formal nutrition education. An

online nutrition education program developed using Kolb's Learning Styles and Experiential Learning Model was implemented in 14 low-income counties in Indiana from April to December 2010 (Neuenschwander et al., 2013). Three educational lessons on fruits and vegetables, reading nutrition labels, and whole grains were distributed to low-income adults online (n=57) and in-person (n=66). Following the program, more individuals in the online group reported using Nutrition Labels when shopping than the control in-person group (1.0 vs. 0.67 points, $p<0.004$) (Neuenschwander et al., 2013). The online group reported greater increases in several nutrition-behavior scores at follow-up compared to the online group, including higher frequency of using grocery lists to shop (0.55 vs. 0.27 points, $p=0.11$), whole grain intake (0.95 vs. 0.41 ounces, $p=0.3$), and fruit intake (1.26 vs. 0.96 cups, $p=0.6$) (Neuenschwander et al., 2013). Furthermore, 83% of online participants also reported willingness to use the online website again, indicating a preference for this mode of learning (Neuenschwander et al., 2013).

The impact of online vs. traditional in-person delivery of the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) nutrition education has also been extensively studied. Objectives of a 2005-2007 study focused on the promotion of adequate fruit and vegetable intake for a balanced diet among 692 women at 15 Michigan WIC clinics (Bensley et al., 2011). Both the online (n=56) and traditional learning (n=63) groups reported improvements in fruit consumption scores (0.32 and 0.59 points, $p=0.1$), and with more significant differences observed in vegetable intake (0.59 vs. 0.20, $p=0.04$) (Bensley et al., 2011). Among the women who received the online nutrition education, 82% reporting preferring the online learning compared to in-person education offered at WIC (Bensley et al., 2011). The effects of

online and in-person nutrition education on healthy breakfast behaviors and salt intake was assessed in Los Angeles, California WIC clinics in 2014 and 2015 (Au et al., 2017; Au et al., 2016). Breakfast-related objectives included reducing frequency of breakfast skipping and promoting healthy breakfast options for parents and children. Online participants (n=359) and in-person controls (n=231) reported reductions in barriers to eating breakfast, including time constraints, difficulty with preparation, and lack of foods in the home (Au et al., 2016). Intervention parents and their children reported increased frequency of breakfast eating at follow-up (0.36 points, $p<0.001$; 0.87 points, $p=0.01$, respectively) compared to those in the control group (0.09 points, $p=0.3$; 0.01 points, $p=0.9$, respectively) (Au et al., 2016). Salt-focused lessons highlighted limiting salt intake, assessing salt content in foods, and tips for substituting salt with herbs and spices (Au et al., 2017). Online intervention (n=257) and in-person control (n=257) groups both reported increased self-efficacy in reducing salt intake ($p<0.05$), less salt used in cooking ($p<0.0001$), and eating fewer foods with added salt ($p<0.001$). Adults who participated in the online education reported a 5-point greater increase in nutrition knowledge scores at follow-up compared to those who participated in in-person education ($p<0.05$) (Au et al., 2017).

Online nutrition education is not only associated with improvements in eating behaviors and knowledge among participants, but may increase participants' confidence in relaying nutrition information to others. A six-week online continuing education course for nutrition professionals, Preventing Childhood Obesity: An Ecological Approach, was assessed to determine the impact of the course on participants' knowledge, skills, and self-efficacy (Stark et al., 2011). No significant changes were seen

in the control group who did not participate (n=37), while individuals who completed the course (n=105) showed improvements in scores for knowledge and skills (1.16 points, $p<0.001$), self-efficacy (1.18 points, $p<0.001$), and creating action plans for nutrition education using the knowledge learned from training (1.19 points, $p<0.001$). Ninety-one percent of participants reported that they intended to apply prevention strategies from the online course following the training session (Stark et al., 2011). These findings, along with the positive implications of train-the-trainer models, suggest that incorporating online instructor training platforms into obesity prevention programs will extend positive outcomes for both instructors and their students.

The efficacy of an online training course on saturated fat, with the objective of preparing librarians to help patrons find health- and nutrition related resources, was tested (Turner-McGrievy & Campbell, 2009). The online course utilized short videos to highlight topics on the role of fat in health, saturated fats, and resources for reducing fat intake. Post-training increases were reported in nutrition knowledge ($p<0.001$), self-efficacy and confidence in ability to deliver information ($p<0.001$), and expectancies in ability to help library patrons with their questions ($p<0.001$) (Turner-McGrievy & Campbell, 2009). After 6 months, 39% of the librarians used information they learned from the online training to find appropriate resources for patrons with health and nutrition-related questions. Additionally, 82% of librarians used this information to help friends and family members (Turner-McGrievy & Campbell, 2009).

The interactive online training certification program designed for nutrition educators of the Supplemental Nutrition Assistance Program-Education and Expanded Food and Nutrition Education (SNAP-Ed) Program was assessed in Utah (Christofferson

et al., 2012). Program objectives included preparing instructors on effective teaching, presentation, and demonstration skills, as well as nutrition-related lessons on MyPyramid, macro- and micro-nutrients, metabolism, menu planning and smart food shopping, nutrition during pregnancy and childhood, and food safety (Christofferson et al., 2012). Participating instructors (n=22) reported increased knowledge on being effective teachers ($p<0.001$), with 40% of employees strongly agreeing and 60% agreeing that they were better prepared as nutrition educators post-training (Christofferson et al., 2012).

An evaluation of a childhood obesity prevention online training certificate program for community family educators who lacked formal health and nutrition education revealed favorable training outcomes for this population (Eck et al., 2016). The training program focused on childhood obesity-related concepts like appropriate portion sizes, physical activity, and feeding practices, and tested participant knowledge with quizzes or tests throughout the training program (Eck et al., 2016). Educators who completed the training (n=68) showed significant improvements in childhood obesity-related concepts like nutrition knowledge ($p<0.001$), as well as increased intentions to promote obesity prevention behaviors (Eck et al., 2016). Overall, participants reported being very satisfied with the training program and feeling comfortable with the knowledge and skills they gained (Eck et al., 2016).

Interactive online training platforms can effectively train educators on concepts related to each program's specific objectives and increase their comfort with delivering this information to others (Christofferson et al., 2012; Eck et al., 2016; Stark et al., 2011). Pink and Dude Chefs, an adolescent obesity prevention program, takes advantage of an

online training mechanism to train instructors without formal nutrition education and prepares them to deliver a comprehensive nutrition and culinary curriculum to students.

1.6 Pink and Dude Chefs (PDC) Program

Pink and Dude Chefs (PDC) is an afterschool nutrition education and culinary skills program for middle-school students between the ages 11 to 14 years. It was designed in 2008 by researchers at the Center for Solutions Through Research In Diet and Exercise (STRIDE) at California Polytechnic University San Luis Obispo with the aim of combating childhood obesity through improving nutrition and culinary knowledge and promoting healthy eating behaviors. Past iterations of the PDC program have targeted adolescents mostly from low socioeconomic backgrounds. The 12-lesson Phase 1 "Let's Get Started" curricula divides lessons between a 40-minute classroom portion, a 60-minute hands-on culinary practicum, and 20-minute clean-up session. Lessons were designed for a once-weekly 2-hour meeting over the course of 12 weeks, but could also be organized to twice-weekly meetings over the course of 6 weeks.

From 2008-2016, 93 adolescents participated in PDC programming implemented in California and Tennessee. Cumulative data suggests participation in PDC programs improved middle school students' culinary self-efficacy ($n=22$, $p=0.005$; Chessen, 2008), cooking skills ($n=16$, $p=0.02$; Lockhart, 2014), and fruit preferences ($n=23$, $p=0.01$; Sheehan, 2013). Program participation was also associated with increased nutrition knowledge within cohorts conducted in 2014 ($n=16$, $p<0.0001$; Lockhart, 2014) and in 2016 ($n=32$, $p=0.002$; Bierlich-Wesch, 2016). Longer term program outcomes included maintenance of healthy eating habits and cooking knowledge gained through PDC participation ($n=8$) 12 weeks following program completion (Gentry, 2017).

1.6.1 PDC online TTT mechanism

Instructors charged with implementing the PDC program at their respective sites are required to complete the online training course prior to program. The training is separated into three modules that encompass the following comprehensive topics: Finances, Personnel, Other Expenses, Partnerships and Sites, Preparing for a Lesson, Classroom Control, Kitchen Control, Culinary Terms and Skills, and Kitchen and Food Safety. Instructors are required to pass a total of nine quizzes (one per topic) and one cumulative final exam with perfect scores before they receive their PDC training certification. Quizzes and the final exam may be attempted as many times as necessary to pass. Lessons were designed to accommodate instructors lacking prior nutrition education or formal culinary training, as it was assumed that PDC program instructors would be laypeople with no nutritional or culinary background. To date, the efficacy of the PDC online training has not been evaluated. More information on the online training mechanism can be found in Section 2 "Materials and Methods."

1.6.2 Outcomes of PDC participants

Results from PDC cohorts showed some improvements across multiple program objectives during PDC cohorts, but results were mixed. The pilot stage of the Phase 1 "Let's Get Started" curriculum was developed in 2008 to combat childhood obesity through interactive nutrition education and teaching basic cooking skills. Program goals of increasing middle school participants' (n=22) self-efficacy for cooking and building knowledge for establishing healthful dietary practices were assessed at two locations in Oceano and Arroyo Grande, California (Chessen, 2008). Average self-efficacy scores measured participants' confidence in their ability to cook using basic or new ingredients,

follow simple recipes, safely use knives and demonstrate proper knife skills, and plan low-cost meals. Overall self-efficacy scores increased by an average of 2.0 points from baseline measurements following programming (p=0.005) (Chessen, 2008). Improvements were also observed in participants' nutrition knowledge or dietary behaviors, but were not significant (Figure 2). However, evidence suggested that increasing self-efficacy for cooking and increasing repetition to new foods, fruits, and vegetables were important for overcoming barriers and establishing healthy eating behaviors (Chessen, 2008).

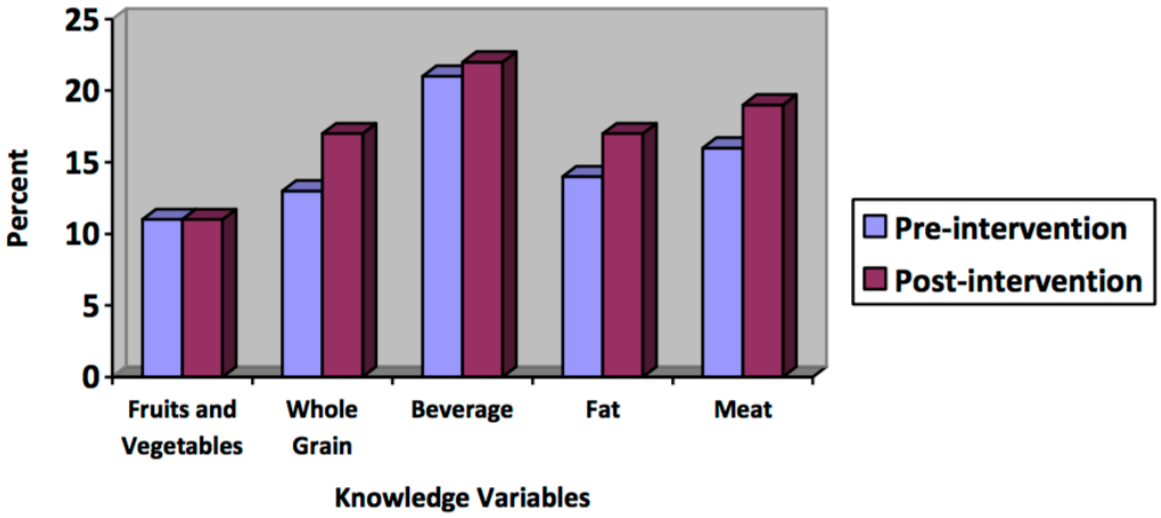

Figure 2. Students' pre- and post-intervention knowledge scores from Oceano and Arroyo Grande PDC cohorts in 2008, extracted from Chessen, 2008.

The Phase 1 curriculum was also implemented at several sites in Arroyo Grande and Carpinteria, California in 2013. These cohorts focused on using the nutrition and hands-on cooking components of the PDC curriculum to facilitate dietary behavior changes for participants to apply to their daily lives and within their homes (Sheehan, 2013). Following programming, participating students (n=23) showed increased mean fruit and vegetable preference (3.0 points, p=0.01; and 2.5 points, p=0.5, respectively)

(Figure 3). While vegetable preference did not increase significantly, increases were observed for 16 out or 20 vegetables and suggested willingness to eat these vegetables after participation in the program (Sheehan, 2013). Because fruit and vegetable preferences track into adulthood, these behavioral changes have practical implications. Targeting dietary behaviors during adolescence increases the potential for establishing lifelong sustainable eating habits that improve health outcomes (Kelder et al., 1994). Mean culinary confidence, nutrition knowledge, and culinary self-efficacy scores also improved after PDC participation by 0.05 points (p=0.9) 0.80 points (p=0.1), and 0.05 points (p=0.8), respectively (Sheehan, 2013). An inability to detect statistically significant associations for these variables was attributed to the small sample size of the study, indicating a need for higher statistical power through larger sample sizes in future studies (Sheehan, 2013).

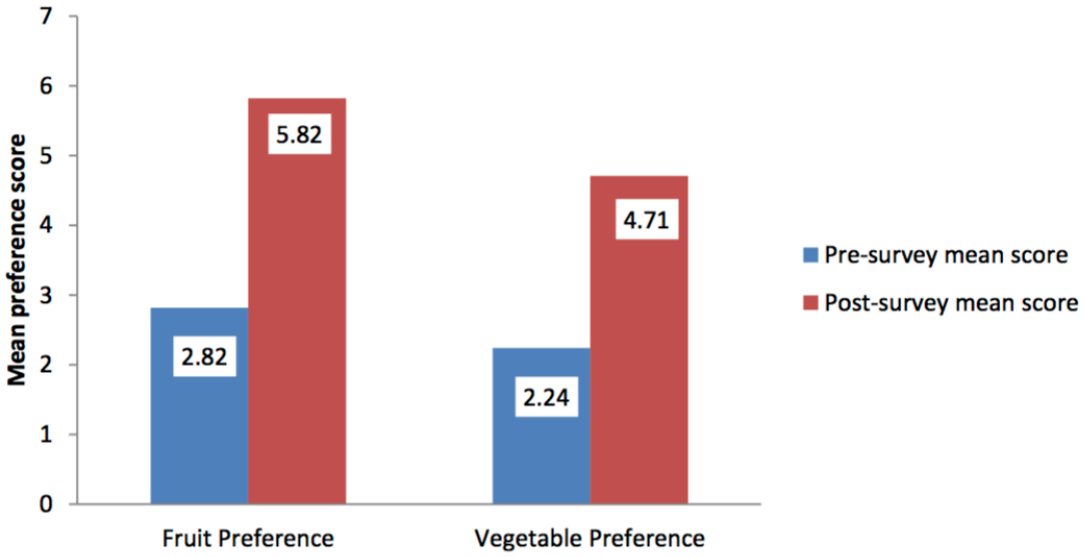

Figure 3. Pre- and post-survey fruit and vegetable preference scores for Arroyo Grande and Carpinteria PDC cohorts in 2013, extracted from Sheehan, 2013.

From Spring 2014 to Fall 2014, the "Let's Get Started" curriculum was also implemented in Arroyo Grande, California and expanded to Nashville, Tennessee. Collaboration with two community sites in Tennessee aimed to determine whether the benefits of PDC programming could be generalized to other populations. Following program participation, participants in Arroyo Grande and Nashville (n=32) increased their nutrition knowledge scores from baseline measurements (1.3 points, p=0.0002) (Figure 4), with the greatest changes observed in knowledge on calcium (0.2 points, p=0.02), fats (0.5 points, p=0.002), and plant protein (0.2 points, p=0.02) (Bierlich-Wesch, 2016). Overall mean fruit preference increased by 4.2% (1.1 points, p=0.1), (Bierlich-Wesch, 2016). The mean overall vegetable preference scores in both locations also increased by 9.8% (3.8 points, p=0.1), with a significant increase detected in asparagus preference scores (0.5 points, p=0.06) (Bierlich-Wesch, 2016). Notable differences between cohorts in the two states included greater changes in nutrition knowledge in the Tennessee participants (46.8%, p=0.005), and more significant change in mean vegetable preference scores for California participants (21.1%, p=0.08) (Bierlich-Wesch, 2016). However, one-way ANOVA analysis suggested these differences could have been due to random variation, rather than differences between site locations (Bierlich-Wesch, 2016). Some improvements in mean fruit and vegetable intake scores were observed (10.1%, p=0.2; and 2.8%, p=0.8, respectively), although not statistically significant (Bierlich-Wesch, 2016). Potential underlying factors these results include accessibility of fruits and vegetables in the home, as limited availability of produce is common among low-income populations (Kratt, Reynolds, & Shewchuk,

2000). PDC participants in these cohorts showed improvements in multiple areas, including nutritional knowledge and dietary and behavioral outcomes.

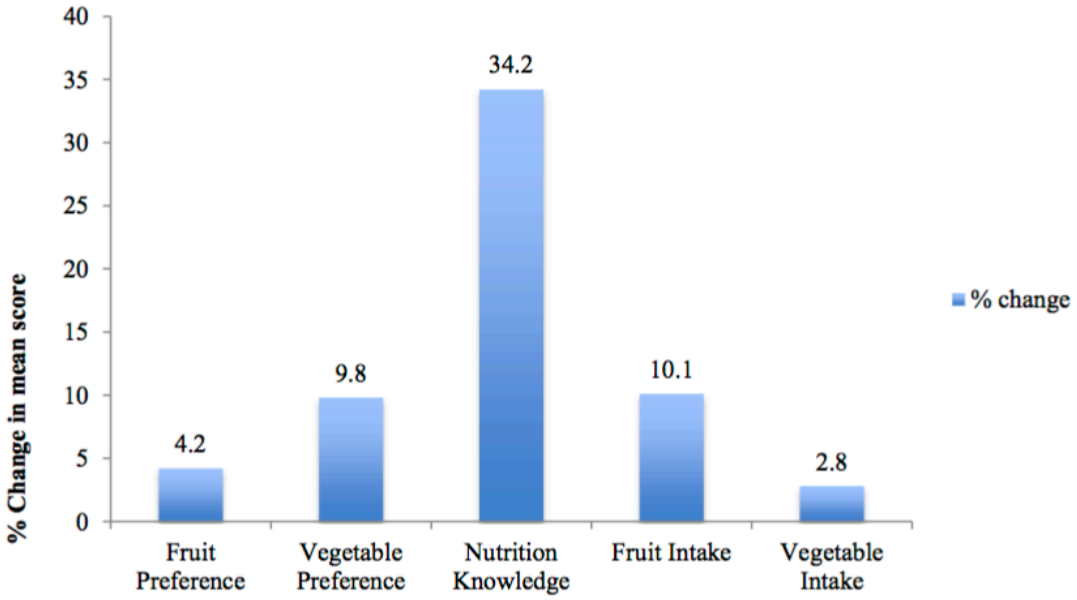

Figure 4. Percent change in pre- and post-survey preference, knowledge, and intake scores for Arroyo Grande and Nashville PDC cohorts in 2014, extracted from Bierlich-Wesch, 2016.

The sustainability of the knowledge and skills participants gained through PDC was also assessed among the Nashville, Tennessee participants (n=8) through qualitative interviews 12 weeks post-intervention (Gentry, 2017). These interviews aimed determine whether PDC participants continued to cook at home post-intervention, sustained the cooking skills learned in the program, and reported healthier eating habits. All participants reported that they thought about PDC when cooking at home, felt confident in their cooking skills, and helped out with food preparation at home in the months following PDC completion. All participants reported making changes to their dietary habits, including substituting recipe ingredients for healthier alternatives, while almost two-thirds of participants (62.5%) reported that they thought about PDC when making

food choices (Gentry, 2017). These preliminary findings suggest that short-term outcomes associated with PDC may be sustained over time and may contribute to the establishment of lifelong healthy behaviors, although more quantitative data is necessary.

The main objective of the PDC program is to provide middle school-aged adolescents with nutrition knowledge and culinary skills necessary to prepare healthy foods and establish healthful eating behaviors as part of the effort to prevent childhood obesity. Overall, research to date suggests that participation in the PDC program increases nutrition knowledge, fruit and vegetable intakes and preferences, cooking skills, and culinary self-efficacy (Bierlich-Wesch, 2016; Chessen, 2008; Gentry, 2017; Lockhart, 2014; Sheehan, 2013). As with similar programs, the combination of classroom-based nutrition education and hands-on culinary training within the PDC program increases the likelihood of establishing healthy behaviors that may alleviate the burden of childhood obesity. However, these studies have been limited by small sample sizes, a lack of long-term follow up data, mixed results, and diversity in site locations.

1.7 Adolescent Obesity in Northern Santa Barbara County, California

The current rate of obesity in adolescents aged 10-17 years in the state of California has remained stable at 15.1% over the past 6 years (The State of Obesity, 2016). Rates in Northern Santa Barbara County, CA are much higher than state levels, as 34.4% of teenagers were considered overweight or obese in 2009 (County of Santa Barbara Public Health Department, 2011). This may be attributed to ethnic and socioeconomic disparities between the county's population and the population of the state.

1.7.1 Racial and socioeconomic disparities

The population of Santa Barbara County is predominantly White (45.4%) and Hispanic/Latino (44.8%) (United States Census Bureau, 2015), but the population of Santa Maria, CA is 70.4% Hispanic/Latino and 21.7% White, while the population of Guadalupe, CA is 86.2% Hispanic/Latino and 8.8% White (United States Census Bureau, 2015). The median income in Santa Barbara County overall ($63,985) is higher than the national median ($53,889). However, the median incomes in Santa Maria, CA and Guadalupe, CA are $50,433 and $43,710 per year, respectively (United States Census Bureau, 2015).

Obesity disproportionately affects lower-income and Hispanic/Latino populations in the county. In 2009, 73% of Latino adults in Santa Barbara County were considered overweight or obese, compared to 49% of White adults (County of Santa Barbara Public Health Department, 2011). Also in 2009, the National Pediatric Nutrition Surveillance System reported that 45.5% of the county's lower-income adolescents between ages 12 to 19 were overweight or obese (California Department of Health Care Services, 2009). In 2010-2011, 43% of lower-income preschool and kindergarten children were overweight or obese (County of Santa Barbara Public Health Department, 2011). These high rates suggest a need to implement appropriate intervention strategies, such as PDC, for combatting obesity in this county.

1.8 Summary and Rationale

Childhood and adolescent obesity contributes to a high risk of poor health and economic consequences. Disparities in obesity rates and determinants highlight gaps in nutrition education, knowledge, and skills. Afterschool programs have shown promise in

reducing risk, but the literature on online TTT models and instructor impact on participant outcomes is limited. Data suggest that when instructors are appropriately trained, afterschool-based nutrition programs may have positive outcomes on health and eating behaviors among youth. Results from previous iterations of the PDC program have been somewhat hampered by low statistical power, indicating the need for assessment of the program on a larger sample size. Additionally, the impact of the PDC online training mechanism on program instructors and downstream effects on student outcomes has not yet been evaluated. Because PDC instructors lack formal nutrition training, it is critical to assess the training mechanism to ensure effective program delivery and student outcomes. The current project sought to address these critical gaps in the PDC and broader nutrition education and training literature, with the aim of creating the most effective intervention model.

1.9 Research Questions

- **Objective #1 (Instructors):** Determine the efficacy of the PDC online training mechanism for three program instructor outcomes: 1) food and kitchen safety knowledge (FKSK), 2) program knowledge (PK), and 3) overall instructor knowledge (OIK).
    - Hypothesis #1: Scores for all three training components will increase after participating in the PDC online training.
- **Objective #2 (Students):** Determine the impact of participation in the PDC program for three student outcomes: 1) food and kitchen safety knowledge (FKSK), 2) nutrition knowledge (NK), and 3) overall student knowledge (OSK).
    - Hypothesis #2: Scores for all three participation components will increase after participation in the PDC program.
- **Objective #3 (Instructor impact on students):** Assess the impact of instructor aptitude on changes in student outcomes.
    - Hypothesis #3: Change in overall instructor knowledge (OIK) scores will be positively associated with changes in all three student outcomes.

CHAPTER 2

MATERIALS AND METHODS

2.1 Program Development

2.1.1 Program coordinators

Two nutrition graduate students from California Polytechnic State University San Luis Obispo oversaw and coordinated Pink and Dude Chefs (PDC) program implementation for this project. The two PDC program coordinators were responsible for site selection, management of the instructor online training process, and delivery of lesson materials prior to the start of each site's programming. Program coordinators offered continued support to program instructors during training and PDC implementation at all sites. Support included frequent telephone and email updates, as well as multiple on-site visits during each cohort.

Program coordinators also oversaw all aspects of data collection, including the development of quantitative surveys for the instructors and student participants, delivery of surveys, and data coding. They also helped assist the thesis supervisor in statistical analysis of the collected data.

2.2 Program Recruitment

2.2.1 Site selection

Northern Santa Barbara County, California was targeted for this project based on the funder's focus on serving low-income underserved adolescents (see more information in "Funding"). The cities of Santa Maria, Guadalupe, and New Cuyama, California met this funding criteria, with their predominantly Hispanic/Latino populations (70.4%, 86.2%, and 70.8%, respectively) (United States Census Bureau, 2015). A high proportion

of residents in these cities are adolescents and many live in poverty. In Santa Maria, 31.4% percent the city's population are under the age of 18 years and 21.2% of residents live below the federal poverty line (United States Census Bureau, 2015). 34.2% of residents in Guadalupe are under the age of 18 years, and 18.9% of the population lives under the federal poverty line (United States Census Bureau, 2015). In New Cuyama, 42.1% of the city's residents are under the age of 18 years, and 31.9% of live under poverty lines (United States Census Bureau, 2015).

The program coordinators reached out to potential sites in these cities who were interested in implementing the PDC program. Program sites needed to be accessible to middle school-aged students after school hours. Sites were required to have a classroom space for each week's nutrition lesson, as well as a working kitchen for each lesson's cooking practicum. Each kitchen was required to contain a sink, oven, stove, and counter-space, at minimum, to qualify as a working kitchen.

Following the vetting process, the program coordinators identified five nonprofit afterschool sites that met all of the aforementioned requirements. PDC programming was conducted at these five sites in Northern Santa Barbara County, California from September 2015 to August 2016: Two community centers in Santa Maria, the Santa Maria Valley Boys and Girls Club, Kermit McKenzie Junior High School in Guadalupe, and the Cuyama Valley Family Resource Center in New Cuyama.

2.3 Program Implementation

2.3.1 Program timeline

PDC programming was implemented at the five targeted sites during Fall 2015, Winter 2016, and Spring 2016. Two sites implemented the program once and three sites ran programming twice for a total of eight PDC cohorts, as outline in Table 4 below.

Table 3. Site locations and program cohort dates.

Site	Fall 2015	Winter 2016	Spring 2016
Santa Maria Community Center #1	X		X
Santa Maria Community Center #2			X
Santa Maria Valley Boys and Girls Club			X
Kermit McKenzie Junior High School	X	X	
Cuyama Valley Family Resource Center		X	X

2.3.2 Instructor recruitment

Each site was responsible for identifying an instructor to undergo mandatory online training in order to teach the PDC curriculum. Instructors were required to be over the age of 18 years, but were not obligated to have prior nutrition education or culinary training. Only one trained instructor was required to lead each cohort. Some sites chose to train more than one instructor to help with program delivery and some instructors taught more than one PDC cohort over the course of program implementation.

2.3.3 Student recruitment

Instructors at each site were charged with recruitment of middle school participants between the ages of 11 to 14 years for each cohort (see Table 3 for timeline). Informational flyers were circulated to middle school students who participated in each site's afterschool programs and their families to generate interest. Recruitment was also aided by students informing their peers about the program during implementation,

resulting in some students starting programming a few weeks after initiation. Due to the smaller population of interested middle school students at the rural sites, some participants also enrolled in programming more than once. Written informed consent was collected from parents/guardians prior to program participation, as was student written assent.

2.4 PDC online training curriculum for instructors

2.4.1 Online training program structure

Site instructors were required to complete the PDC online training program prior to the start of program implementation at each site. The training course included training videos focused on PDC background information and objectives, demonstration of proper culinary techniques, and relevant nutrition knowledge associated with each lesson. Topics also included macro- and micro-nutrients, tips for shopping for ingredients, proper food and kitchen safety, and how to maintain proper classroom control (Table 4). Important program components for involving students' families were discussed, including the use of weekly goal sheets containing two nutrition-related goals for student participants to try at home each week and keep their families updated with their progress. Also highlighted was the Family Fiesta- a culminating celebration for families to come together to celebrate the skills students learned throughout the program and enjoy a family-style meal prepared by the students themselves.

2.4.2 Online quizzes and final exam

Instructor comprehension and learning of each topic was tested through online quiz modules following each section of the training. The training modules were designed such that instructors could not access the next module unless they passed each quiz with a

score of 100%. There was no limit on the number of quiz attempts. Table 4 outlines the topics covered in the three training modules. The PDC training program concludes with a cumulative final exam designed to test instructors' mastery of all program topics.

Table 4. Overview of PDC online training module topics.

Module	Topics
1	• Finances • Personnel • Other Expenses • Partnerships and Sites
2	• Preparing for a Lesson • Classroom Control • Kitchen Control
3	• Culinary Terms and Skills • Food and Kitchen Safety
Cumulative Final Exam	

Instructors could not access the final exam until they completed and passed the quizzes for all learning modules. Table 5 highlights the topics and examples of questions covered in each quiz. Instructors were expected to pass the final exam with a score of 100% to complete the training. Following training completion, each instructor was awarded full access to the online PDC lesson materials, as well as the instructor manual, student workbooks, and all necessary kitchen equipment and utensils to successfully run programming.

Table 5. Quiz topics and example questions covered in the PDC online training.

Quiz	Topic	Example Questions
1	Finances	Which of these are inevitable costs needed to run a successful Pink and Dude Chefs program? (mark all that apply) a. Employee pay, if not volunteers b. Cooking equipment c. Computer d. Printer, printer paper, ink e. Transportation f. Food
2	Personnel	Which of these is the responsibility of a Pink and Dude Chefs Program Coordinator? (mark all that apply) a. Contact site for program implementation b. Coordinate with community food organizations c. Coordinate food shoppers and shopping times d. Prepare/gather all materials for each lesson e. Revise any lessons following evaluation f. Plan Family Fiesta
3	Other Expenses	Which of these are strategies for saving money on food costs? (mark all that apply) a. Contact your local food bank to request food donations b. Purchase additional items at a lower-priced grocery store c. Skip the cooking portion of every other lesson
4	Partnerships and Sites	Which of these strategies will help with recruiting participants in the Pink and Dude Chefs program? (mark all that apply) a. Be enthusiastic b. Bring fun recruitment flyers detailing the program c. Speak only about nutrition and health topics d. Inform students of all the yummy food they will be making e. Remind students that they will need these skills when they move out of their parents' homes and live independently
5	Preparing for a Lesson	How often do the aprons and chef hats need to be washed? a. After every other lesson b. Once during the program c. At the beginning and end of the program d. After every lesson
6	Classroom control	One way that we mentioned to handle a more difficult teen, is to: a. Reprimand them in front of the other Pink and Dude Chefs. The embarrassment will cause them to behave. b. Assign the student a specific task, tell the student that the task is important, and provide positive feedback c. Make the student stand in the corner d. Ignore them. You do not want to give this kind of bad behavior any attention
7	Kitchen Control	The kitchen is not a place to play and we named some dangers to avoid in the kitchen. Choose all the dangers that we mentioned.

		a. Mishandling knives b. Running in the kitchen c. Playing with cell phones d. Yelling loudly e. Not wearing an apron f. Heat from oven and stoves
8	Culinary Terms and Skills	Which of the following are tips we gave to hold a knife properly? (mark all that apply) a. Grasp the handle with three fingers and put your forefinger and thumb on opposite sides of the blade b. Use your other hand to feed the food you are cutting toward the knife c. Keep fingers extended for better grip on the food you are feeding to the knife d. Curl your fingers in and use your fingertips to grasp and move the food toward the knife
9	Food and Kitchen Safety	You should wash your hands for _____ to ensure the removal of all harmful bacteria. a. 10 seconds b. 30 seconds c. 1 minute d. 15 seconds e. 20 seconds

2.5 PDC program curriculum for student participants

2.5.1 Program structure

The PDC program curriculum consisted of 12 lessons, two-hours long each. Each lesson was split up into two portions: a 40-minute classroom lesson and a 60-minute kitchen practicum. Approximately 20 minutes at the end of each lesson were designated for kitchen clean up and reflection. During the classroom session, instructors delivered lessons covering a different nutrition topic each week and provided students with necessary background information required for the cooking portion. Following the nutrition lesson, students practiced their culinary skills in the kitchen by creating relevant recipes designed to increase comprehension of the week's nutrition topic.

2.5.2 Classroom nutrition lessons

Each lesson was designed to cover a specific nutrition topic, including USDA MyPlate, food and kitchen safety, how to read nutrition labels, as well as macronutrients. Instructor manuals outlined the information to be covered each lesson, weekly goals, and the specific timing of each activity. Instructors were expected to cover different objectives to achieve specific learning outcomes in each lesson (Table 6). Participants were provided with their own personal copy of the student workbook to follow along with. Student workbooks included each week's handouts, associated activities, goal sheets, and recipes.

Table 6. Lesson topics, objectives, and corresponding recipes for PDC programs.

Lesson	Topic	Learning Objectives	Recipes
1	Introduction	This lesson: • Introduces "Pink and Dude Chefs" program and learning nutrition through cooking • Establishes classroom and food safety rules	Yogurt Parfait, Personality Pie
2	How To Read A Recipe	Participants learn to: • Properly extinguish a kitchen fire • Properly read and follow recipes from beginning to end • Correctly identify measurement tools for wet and dry ingredients	Blueberry Muffins
3	Cutting Edge	This lesson teaches: • Knife safety and knife skills • Cutting techniques: dicing, chopping, slicing, julienne, chiffonade, and mincing	Rainbow Stir-fry
4	MyPlate	This lesson teaches participants: • The components of MyPlate food groups and portion sizes • Use MyPlate to balance food groups and promote healthy eating	MyPlate Pizza
5	"Get the Facts"	This lesson focuses on: • Reading a Nutrition Facts Label • Comparing food products using Nutrition Facts Labels • Substituting alternative ingredients to create "healthier" versions of recipes	White Bean Macaroni and Cheese
6	Carbohydrates	Participants will understand: • The difference between simple vs. complex and refined vs. unrefined carbohydrates • Whole grains and components of a grain • Fiber and its dietary importance • How to incorporate dietary whole grains	Apple Crisp
7	Protein	Participants recognize: • Different types of protein sources: animal vs. plant proteins	Tofu Scramble

		• The importance of diversifying dietary protein sources	
8	Fats	This lesson focuses on: • Different types of dietary fats: unsaturated, saturated, and trans fats • The importance of dietary fat and healthier alternative cooking methods using fats	Baked Chicken Strips, Sweet Potato Fries, Black Bean Brownies
9	Breakfast	Participants learn about: • The physiological, cognitive, and nutritional benefits of eating breakfast • Simple and quick breakfast options	Scrambled Egg Patties, Healthy Egg Sandwich
10	Calcium	This lesson emphasizes: • Different sources of calcium: dairy vs. non-dairy • The benefits of eating calcium to build strong bones • Teaching participants to create a meal plan to meet the daily 1300 mg calcium requirement	Kale Chips with Asian Marinade, Quinoa and Black Bean Salad
11	Nutrition Trivia	This lesson incorporates: • An interactive nutrition trivia game to quiz participants on information presented during the first 10 lessons	Prep for Family Fiesta
12	Family Fiesta	Participants showcase: • Their acquired teamwork and time-management skills to prepare a meal for their families and friends • Their culinary skills and cumulative nutrition information taught throughout the program	3 recipes of students' choice

2.5.3 Kitchen practicum

Following the classroom component of each lesson, students moved to the kitchen to prepare recipes relevant to each week's nutrition topic. Instructors were required to

shop for recipe ingredients before each lesson. Participants were required to follow proper food and kitchen safety protocols always, starting with proper handwashing and donning appropriate kitchen attire (ie. aprons, chef's hats, closed toed shoes) before entering the kitchen. Instructors were required to set up kitchen stations and recipe ingredients prior to the start of each lesson, as well as demonstrate any culinary skills or techniques at the beginning of each practicum. Participants were then split into pairs or groups and allowed to begin the recipe. Through these lessons, participants were guided through proper measurement techniques, knife safety and skills, and recipe reading. Participants were also allowed to use the stove and oven with instructor supervision to practice a variety of cooking techniques, including stir frying and baking. At the end of each lesson, participants were encouraged to share leftovers with their families, and to practice creating the recipes at home using the recipe sheets provided in their student workbooks.

2.5.4 Family Fiesta

At the end of each curriculum, the last lesson (Lesson 12) was a culminating celebration called "Family Fiesta" where participants could showcase their newly acquired skills as student chefs to their families, friends, and community members. Participants were charged with preparing and cooking a three-course meal for their invited guests. This opportunity allowed students to make the executive decision on which three PDC recipes they wanted to execute using the skills and techniques they learned over the course of PDC. The program instructor was charged with adjusting the recipes to a larger scale according to the number of expected guests. After preparing the meal, participants helped with kitchen clean up and served the meal to their guests. An

awards ceremony was also held to acknowledge each student's individual accomplishments during the program and award them with a Culinary Certificate of Completion. Prizes were given out to award the student at each cohort who turned in the most goal sheets during the program. Some sites also decided to give out prizes to the students who had perfect attendance during all 12 lessons.

2.6 Program Evaluation

2.6.1 Data collection and surveys

Baseline and follow-up data was collected on the instructors and student participants of each program cohort. The program coordinators conducted all instructor surveys over the telephone or in-person at each site. The program coordinators were also on-site to collect student data during the first and last lessons of cohorts. The program coordinators trained site instructors on proper data collection to help facilitate data collection on these days.

2.6.2 Instructor survey

A quantitative survey was designed to assess instructor knowledge on PDC program knowledge, and food and kitchen safety knowledge, before and after completion of the online training mechanism (Appendix A). Baseline surveys were conducted over the telephone prior to giving instructors access to the online training. Follow-ups were conducted by telephone after the instructors successfully completed the online training program. The survey contained questions covering three main themes: nutrition knowledge, food and kitchen safety, and PDC program knowledge. Instructor surveys also collected data on sociodemographic factors such as age, sex, geographic location, highest level of education completed, and prior kitchen experience.

Table 7. Example questions covered in the instructor baseline and follow-up survey.

Topic	Example Question
Food and Kitchen Safety	When is it **not** necessary to wash your hands to avoid contamination? a. After touching raw meat b. After scratching your face c. After cracking eggs d. After flipping through your workbook e. It is always necessary to wash your hands
Program Knowledge	Which of the following is **not** a core objective of the Pink and Dude Chefs curriculum? a. Educating students on proper food handling and kitchen safety b. Fostering students' confidence in their cooking abilities c. Exposing students to new ingredients they wouldn't have access to at home d. Providing students with basic nutrition knowledge to make healthier food choices

Table 8. Examples of demographic questions included in the instructor baseline and follow-up survey.

Demographic Variable	Example Question
Race/ethnicity	What is your race/ethnicity? a. White b. Hispanic or Latino c. Black or African American d. Native American or American Indian e. Asian/Pacific Islander f. Mixed heritage/two or more
Education	What is the highest level of education you've completed? a. Less than high school b. High school graduate c. Associates or technical degree d. Some college e. College graduate or higher
Prior Kitchen Experience	Have you ever worked in a trained kitchen setting (i.e. restaurant, Starbucks, food truck, Meals on Wheels, etc.) a. Yes b. No

2.6.3 Student survey

A quantitative survey was used to assess student learning and behavioral outcomes among student participants in the program (Appendix B). The same survey was applied to participants during the first lesson (Lesson 1) and the last lesson (Lesson 12) to assess baseline measurements and follow-up outcomes, respectively. Each participant was instructed to fill out the survey questions to the best of their ability, and were given the choice to leave questions blank if they preferred not to answer. Surveys included sections on: nutrition knowledge, kitchen safety, cooking skills, confidence, willingness to try different food items, and food frequency questionnaires assessing weekly fruit and vegetable intake. Sociodemographic data was also collected on sex and geographic location.

Table 9. Example questions covered in the student baseline and follow-up survey.

Topic	Example Question
Food and Kitchen Safety	How can you avoid cross-contamination? a. Use the same knife for raw fish and fruit b. Mix cooked beef with raw beef c. Wash your hands after handling raw chicken d. Rinse cutting boards under water
Nutrition Knowledge	The serving size of _____ is equivalent to the size of a smartphone or a deck of cards. a. Carbohydrates b. Dairy c. Protein d. Fat

2.6.4 Data coding

The identities of all instructors and student participants were coded to maintain confidentiality. Double data entry was performed on Microsoft Access by both Nutrition

Graduate student program coordinators and cross-referenced for quality control. The data was cleaned and extracted on Microsoft Excel spreadsheets for statistical analysis using STATA.

2.6.5 Statistical analysis

Instructor and student baseline and follow-up surveys that contained complete data and were matched were included in the analysis. For the students that participated in the programming more than once, only data taken from their first cohort was included.

The independent variables of interest were instructor participation in the PDC online training mechanism and student participation in the PDC program. The main outcomes of interest (dependent variables) were:

1. Three instructor outcomes: food and kitchen safety knowledge (FKSK), program knowledge (PK), and overall instructor knowledge (OIK).
2. Three student outcomes: food and kitchen safety knowledge (FKSK), nutrition knowledge (NK), and overall student knowledge (OSK).

Potential cofounders of interest were instructors' highest level of education completed, site location, and prior kitchen experience. Paired t-tests and one-way analysis of variance (ANOVA) analyses were used to measure the overall mean, standard deviation, difference in mean scores, and p-values. Stratified analyses, as opposed to adjusted analyses, were conducted due to the small number of instructor participants.

One-way ANOVA analysis was also used to assess the impact of follow-up and change in overall instructor knowledge (OIK) on change in the three student outcomes: student food and kitchen safety knowledge (FKSK), nutrition knowledge (NK), and overall student knowledge (OSK). Follow-up OIK scores were split into binary

categories: high follow-up scores vs. low follow-up scores, based on the median score of all instructors. A high score was defined as a follow-up OIK score ≥14 points, and a low score was follow-up OIK score <14 points. Change in OIK scores were split into binary categories: high OIK scores vs. low OIK scores. High OIK scores were defined as change in OIK scores greater than or equal to 5 points, and low OIK scores as change in OIK scores less than 5 points. Calculations were performed using STATA and Excel 2016.

2.7 IRB

The Institutional Review Board (IRB) at California Polytechnic State University approved all aspects and phases of this project. Program instructors and parents/guardians provided written informed consent and student participants provided written informed assent to partake in this study.

2.8 Funding

This project was funded by the Orfalea Foundation. Funding provided the instructor manuals, student workbooks, necessary cookware, and kitchen supplies required for each site. Each individual site was required to fund lesson ingredients for each cohort. Sites were encouraged to ask for donations and utilize community Food Banks as necessary to obtain ingredients as a way of building community based partnerships for sustainability.

CHAPTER 3

RESULTS

3.1 Instructors

3.1.1 Instructor demographics

Beginning in Fall 2015, a total of 12 adult instructors completed the PDC online training program prior to cohort implementation. From Fall 2015 to Spring 2016, 11 of these instructors led eight PDC cohorts in Northern Santa Barbara County, California. Pairs of baseline and follow-up surveys from these 11 instructors were included in the statistical analysis. Data from one instructor was not included due to the instructors' inability to continue working with the PDC program following completion of the baseline survey. Five instructors led cohorts at rural sites located in Guadalupe, CA and New Cuyama, CA, and six instructors led cohorts at urban sites located in Santa Maria, CA (Table 10).

All PDC program instructors that completed the training and facilitated programming were females. The age range of instructors ranged from <20 years to 51-55 years, while highest level of completed education ranged from high school graduate to college graduate or higher. Overall, the majority of instructors identified as Hispanic/Latino (n=8), with the rest identifying as White or Mixed heritage. Nine out of eleven instructors reported having trained kitchen experience, while two reported a lack of experience. Trained kitchen experience was defined as having worked in a trained kitchen setting (ie. restaurant, Starbucks, food truck, Meals on Wheels, etc.) prior to participation in the PDC training mechanism.

Table 10. Baseline socio-demographic characteristics of Pink and Dude Chef program instructors.

Variable	Number of Instructors (n)
Location	
Rural	5
Urban	6
Age	
<20 years old	1
21-25 years old	3
31-35 years old	3
41-45 years old	1
46-50 years old	2
51-55 years old	1
Race/ethnicity	
White	1
Hispanic/Latino	8
Mixed heritage/two or more	2
Education	
High school graduate	2
Associates/Technical degree	4
Some college	3
College graduate or higher	2
Trained kitchen experience	
Prior kitchen experience	9
No prior kitchen experience	2

3.1.2 Food and kitchen safety knowledge

Baseline and follow-up surveys were implemented to assess instructors' food and kitchen safety knowledge (FKSK). Appendix C shows mean baseline, follow-up survey, and difference in instructors' scores achieved on the 11 FKSK assessment questions. Instructors' mean (SD) FKSK scores improved by 45% following training (Figure 6). Scores increased by 2.5 points (SD 2.1), p=0.002, from a mean baseline score of 5.5 points (SD 2.3) to follow-up score of 8.0 points (SD 1.2) (Figure 5).

When stratified by location, highest level of education, and trained kitchen experience, some patterns emerged (Table 11). For instructors from rural sites, mean

FKSK scores increased by 28% from baseline to follow-up (1.8 points, p=0.2). Instructors from urban sites showed a 68% improvement in mean follow-up FKSK scores when compared to baseline (3.2 points, p=0.003). Between these sites, the difference was 2.5 points, p=0.3.

Results for education were suggestive but did not achieve statistical significance. Mean change in FKSK scores of high school graduates, those with Associates/Technical degrees, those with some college, and those with college degrees were 1.5 points (21%, p=0.7), 2.0 points (33%, p=0.2), 2.7 points (54%, p=0.09), and 4.5 points (128%, p=0.07), respectively (p for trend=0.15).

Compared to baseline, mean follow-up FKSK scores improved by 3.1 points (62%, p=0.007), and 0.0 points (0%, p>0.9), respectively, for instructors with and without trained kitchen experience prior to PDC online training. Between these two groups of instructors, the difference was 3.1 points, p<0.05. However, in these and all analyses of instructors, it is worth noting that low power resulting from an overall sample size of 11 may have precluded detection of statistical significance.

Table 11. Mean food and kitchen safety knowledge scores for instructors, stratified by site location, highest level of education completed, and trained kitchen experience.

Location	N	Mean (SD) Baseline Score	Mean (SD) Follow-up Score	Difference in Mean (SD)	% Increase	p-value within groups*
Rural	5	6.4 (3.0)	8.2 (1.3)	1.8 (2.6)	28%	0.2
Urban	6	4.7 (1.2)	7.8 (1.2)	3.2 (1.5)	68%	0.003
			p-value between groups**			0.3
Highest level of education completed	**N**	**Mean (SD) Baseline Score**	**Mean (SD) Follow-up Score**	**Difference in Mean (SD)**	**% Increase**	**p-value within groups***
High school graduate	2	7.0 (2.8)	8.5 (0.7)	1.5 (3.5)	21%	0.7
Associates/Technical degree	4	6.0 (2.8)	8.0 (1.8)	2.0 (2.2)	33%	0.2
Some college	3	5.0 (1.7)	7.7 (0.6)	2.7 (1.5)	54%	0.09
College graduate or higher	2	3.5 (0.7)	8.0 (1.4)	4.5 (0.7)	128%	0.07
			p-value for trend***			0.1
Trained kitchen experience	**N**	**Mean (SD) Baseline Score**	**Mean (SD) Follow-up Score**	**Difference in Mean (SD)**	**% Increase**	**p-value within groups***
Prior experience	9	5.0 (2.2)	8.1 (1.3)	3.1 (1.8)	62%	0.007
No prior experience	2	7.5 (2.1)	7.5 (0.7)	0.0 (1.4)	0%	>0.9
			p-value between groups**			<0.05

*p-values obtained using paired t-tests
**p-values obtained by one-way ANOVA
***p-value obtained for trend

3.1.3 Program knowledge

The baseline and follow-up surveys were also used to assess instructors' program knowledge (PK). Appendix D shows mean baseline, follow-up survey, and difference in instructors' scores achieved on the ten PK assessment questions. Mean (SD) PK scores for the 11 instructors increased by 63% following training (Figure 6). Scores improved by

2.5 points (SD 2.7), p=0.01, from a mean baseline score of 4.0 points (SD 2.0) to follow-up score of 6.5 points (SD 2.7) (Figure 5).

Some variations in mean PK scores were observed when stratified by location, education, and trained kitchen experience (Table 12). Mean PK scores improved from baseline to follow-up by 36% (1.8 points, p=0.2) for instructors at rural sites, and 94% (3.0 points, p=0.04) for instructors at urban sites. Between these sites, the difference was 1.2 points, p=0.5.

When stratified by highest level of education completed, results did not achieve statistical significance. Mean change in PK scores from baseline for high school graduates, those with Associates/Technical degrees, those with some college, and those with college degrees were -2.0 points (-29%, p=0.3), 2.8 points (40%, p=0.07), 4.3 points (187%, p=0.04), and 3.5 points (100%, p=0.09), respectively (p for trend=0.08).

Additionally, instructors with trained kitchen experience prior to PDC training improved mean PK scores from baseline by 94% (3.2 points, p=0.002), while mean PK scores decreased for instructors that did not have prior experience by 15% (-1.0 points, p=0.7). Between these groups, the difference was 2.2 points, p=0.04.

Table 12. Mean program knowledge scores for instructors, stratified by site location, highest level of education completed, and trained kitchen experience.

Location	N	Mean (SD) Baseline Score	Mean (SD) Follow-up Score	Difference in Mean (SD)	% Increase	p-value within groups*
Rural	5	5.0 (1.6)	6.8 (1.6)	1.8 (2.9)	36%	0.2
Urban	6	3.2 (1.5)	6.2 (1.3)	3.0 (2.6)	94%	0.04
			p-value between groups**			0.5
Highest level of education completed	**N**	**Mean (SD) Baseline Score**	**Mean (SD) Follow-up Score**	**Difference in Mean (SD)**	**% Increase**	**p-value within groups***
High school graduate	2	7.0 (2.8)	5.0 (1.4)	-2.0	-29%	0.3
Associates/Technical degree	4	4.0 (1.4)	6.8 (1.7)	2.8 (2.1)	40%	0.07
Some college	3	2.3 (0.6)	6.7 (1.2)	4.3 (1.5)	187%	0.04
College graduate or higher	2	3.5 (0.7)	7.0 (1.4)	3.5 (0.7)	100%	0.09
			p-value for trend***			0.08
Trained kitchen experience	**N**	**Mean (SD) Baseline Score**	**Mean (SD) Follow-up Score**	**Difference in Mean (SD)**	**% Increase**	**p-value within groups***
Prior experience	9	3.4 (1.3)	6.7 (1.5)	3.2 (2.1)	94%	0.002
No prior experience	2	6.5 (3.5)	5.5 (0.7)	-1.0 (2.8)	-15%	0.7
			p-value between groups**			0.04

*p-values obtained using paired t-tests

**p-values obtained by one-way ANOVA

***p-values obtained for trend

3.1.4 Overall instructor knowledge

Combining the mean FKSK scores and mean PK scores obtained from the baseline and follow-up surveys, instructors' mean overall instructor knowledge (OIK) scores were calculated as the sum of the two. Mean (SD) OIK scores increased by 53% following training. Scores improved by 5.0 points (SD 3.8), p=0.002, from a mean baseline score of 9.5 points (SD 3.9) to follow-up score of 14.5 points (SD 1.9) (Figure 5).

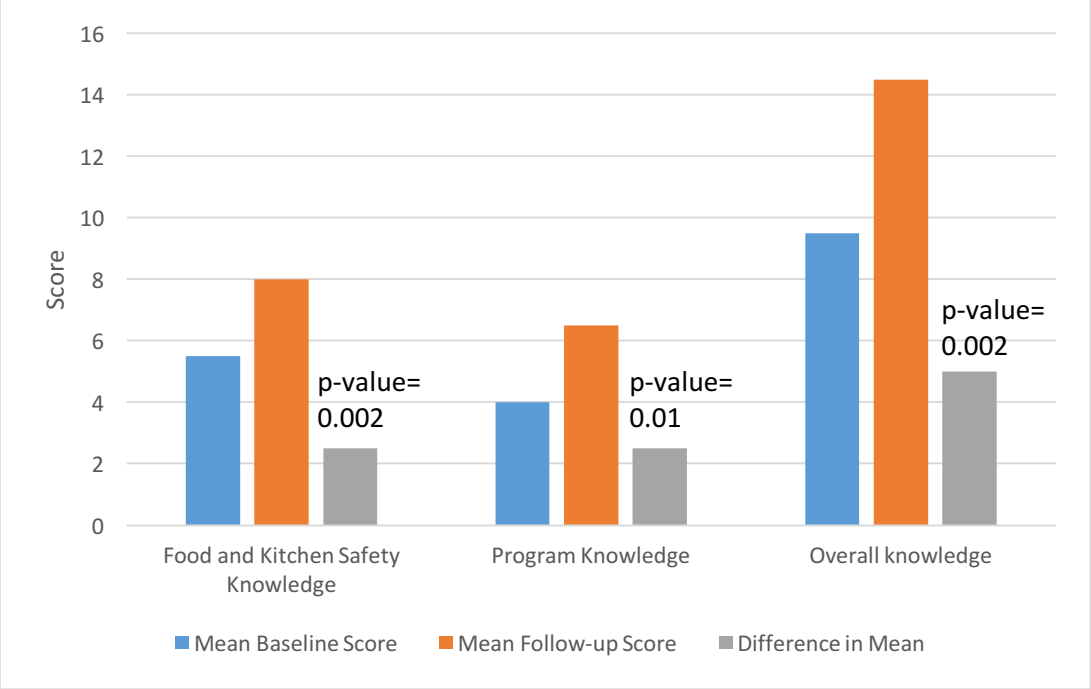

Figure 5. Mean baseline, follow-up, and difference in instructors' food and kitchen safety knowledge, program knowledge, and overall knowledge scores.

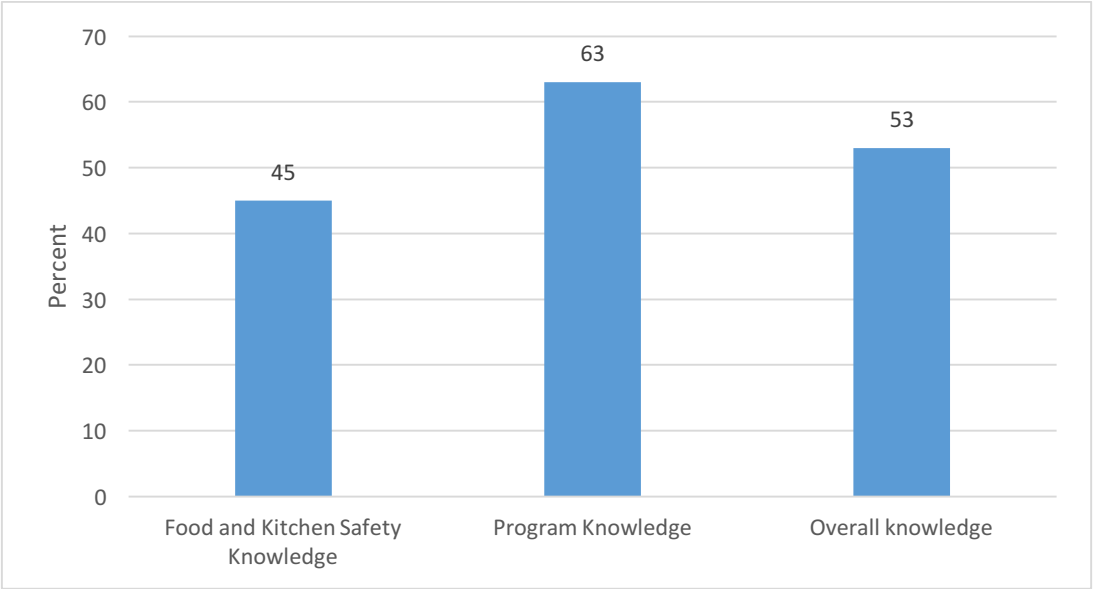

Figure 6. Percent change in instructor scores following participation in the PDC online training mechanism.

When stratified by site location, highest level of education, and trained kitchen experience, some variation in scores appeared (Table 13). Mean OIK scores improved from baseline to follow-up for instructors at rural and urban sites by 32% (3.6 points, p=0.2) and 79% (6.2 points, p=0.002), respectively. Between these sites, the difference was 2.6 points, p=0.3.

Results for education were varied and achieved some statistical significance for some education levels. Mean change in OIK scores for high school graduates, instructors with Associates/Technical degrees, some college, and college graduates were -0.5 points (-4%, p=0.9), 4.8 points (48%, p=0.02), 7.0 points (96%, p=0.06), and 8.0 points (114%, p<0.001), respectively (p for trend=0.01).

Compared to baseline scores, mean OIK scores for instructors with and without trained kitchen experience improved at follow-up by 75% (6.3 points, p<0.001), and

decreased by 7% (-1.0 points, p=0.8), respectively. Between these groups, there was a difference of 5.3 points, p-value=0.006.

Table 13. Mean overall knowledge scores for instructors, stratified by site location, highest level of education completed, and trained kitchen experience.

Location	N	Mean (SD) Baseline Score	Mean (SD) Follow-up Score	Difference in Mean (SD)	% Increase	p-value within groups*
Rural	5	11.4 (4.9)	15.0 (215)	3.6 (5.0)	32%	0.2
Urban	6	7.8 (2.0)	14.0 (2.3)	6.2 (2.5)	79%	0.002
			p-value between groups**			0.3
Highest level of education completed	**N**	**Mean (SD) Baseline Score**	**Mean (SD) Follow-up Score**	**Difference in Mean (SD)**	**% Increase**	**p-value within groups***
High school graduate	2	14.0 (5.7)	13.5 (0.7)	-0.5 (4.9)	-4%	0.9
Associates/Technical degree	4	10.0 (3.7)	14.8 (3.1)	4.8 (2.2)	48%	0.02
Some college	3	7.3 (2.3)	14.3 (1.5)	7.0 (3.0)	96%	0.06
College graduate or higher	2	7.0 (0)	15.0 (0)	8.0 (0)	114%	<0.001
			p-value for trend***			0.01
Trained kitchen experience	**N**	**Mean (SD) Baseline Score**	**Mean (SD) Follow-up Score**	**Difference in Mean (SD)**	**% Increase**	**p-value within groups***
Prior kitchen experience	9	8.4 (3.0)	14.8 (1.9)	6.3 (2.3)	75%	<0.001
No prior experience	2	14.0 (5.7)	13.0 (1.4)	-1.0 (4.2)	-7%	0.8
			p-value between groups**			0.006

*p-values obtained using paired t-tests
**p-values obtained by one-way ANOVA
***p-value obtained for trend

3.2 Students

3.2.1 Student demographics

From Fall 2015 to Spring 2016, a total of 68 male and female participants aged 11-14 years in 6th-8th grade participated in eight PDC cohorts in Northern Santa Barbara

County, California. Of these 68 participants, ten participants were lost to attrition during programming.

A total of 58 pairs of baseline and follow-up surveys had complete data and were included in the statistical analysis. Twenty-six male participants and 32 female participants completed PDC programming in the eight program cohorts. An equal distribution of students enrolled at rural sites and urban sites (n=29 for both) during programming.

3.2.2 Food and kitchen safety knowledge

Students' food and kitchen safety knowledge (FKSK) was assessed using baseline and follow-up surveys during the first and last lessons of each PDC cohort. Appendix E shows the baseline, follow-up, and difference in students' scores on the six FKSK assessment questions. Students' mean (SD) FKSK scores increased by 14% following participation in PDC (Figure 8). Scores improved by 0.6 points (SD 1.3), p=0.001, from a mean baseline score of 4.2 points (SD 1.5) to follow-up score of 4.8 points (SD 1.3) (Figure 7).

When stratified by location and sex, results did not achieve statistical significance (Table 14). For students who participated in rural site programming, difference in mean FKSK scores increased by 10% (0.4 points, p=0.1) from baseline to follow-up. Mean FKSK scores for students at urban sites increased significantly by 16% (0.7 points, p=0.004) from baseline. Between these sites, the difference in scores was 0.3 points (p=0.4).

Additionally, improvements in mean FKSK scores for male and female PDC participants from baseline surveys were 0.4 points (10%, p=0.1) and 0.7 points (16%,

p=0.003), respectively. The difference in mean FKSK scores between genders was 0.3 points, p=0.7.

Table 14. Mean food and kitchen safety knowledge scores for students, stratified by site location and sex.

Location	N	Mean (SD) Baseline Score	Mean (SD) Follow-up Score	Difference in Mean (SD)	% Increase	p-value within groups*
Rural	29	4.2 (1.6)	4.6 (1.3)	0.4 (1.3)	10%	0.1
Urban	29	4.3 (1.4)	5.0 (1.2)	0.7 (1.2)	16%	0.004
			p-value between groups**			0.4
Sex	**N**	**Mean (SD) Baseline Score**	**Mean (SD) Follow-up Score**	**Difference in Mean (SD)**	**% Increase**	**p-value within groups***
Male	26	4.2 (1.7)	4.6 (1.6)	0.4 (1.4)	10%	0.1
Female	32	4.3 (1.3)	4.9 (0.8)	0.7 (1.2)	16%	0.003
			p-value between groups**			0.7

*p-values obtained using paired t-tests
**p-values obtained by one-way ANOVA

3.2.3 Nutrition knowledge

Students' nutrition knowledge (NK) scores were also assessed using the PDC baseline and follow-up participant surveys. Appendix F shows the baseline, follow-up, and difference in students' scores on the eight NK assessment questions. Mean NK scores increased by 33% following program participation (Figure 8). Scores improved by 1.3 points (SD 1.6), p<0.001, from a mean baseline score of 3.9 points (SD 1.6) to follow-up score of 5.2 points (SD 1.8) (Figure 7).

Changes in students' NK scores were suggestive when stratified by location and sex (Table 15). Mean NK scores increased from baseline to follow-up by 23% for students from rural sites (0.9 points, p=0.006), and even more, by 46% for students at urban sites (1.8 points, p<0.001). When assessing differences between sites, the observed 0.9 point difference between rural and urban sites was statistically significant (p=0.04).

Mean follow-up NK scores for male and female participants increased by 1.0 point (25%, p=0.004) and 1.6 points (42%, p<0.001), respectively. The difference in improvement between male and female participants was not statistically significant (0.6 points, p=0.2).

Table 15. Mean nutrition knowledge scores for students, stratified by site location and sex.

Location	N	Mean (SD) Baseline Score	Mean (SD) Follow-up Score	Difference in Mean (SD)	% Increase	p-value within groups*
Rural	29	3.9 (1.6)	4.8 (1.7)	0.9 (1.6)	23%	0.006
Urban	29	3.9 (1.6)	5.7 (1.7)	1.8 (1.5)	46%	<0.001
			p-value between groups**			0.04
Sex	**N**	**Mean (SD) Baseline Score**	**Mean (SD) Follow-up Score**	**Difference in Mean (SD)**	**% Increase**	**p-value within gorups***
Male	26	4.0 (1.6)	5.1 (1.9)	1.0 (1.7)	25%	0.004
Female	32	3.8 (1.6)	5.4 (1.6)	1.6 (1.6)	42%	<0.001
			p-value between groups**			0.2

*p-values obtained using paired t-tests
**p-values obtained by one-way ANOVA

3.2.4 Overall student knowledge

Mean overall student knowledge (OSK) scores were calculated using the sum of mean student FKSK scores plus mean PK scores. Mean OSK scores increased by 23% following PDC participation (Figure 8). Scores improved by 1.9 points (SD 2.3), p<0.001, from a mean baseline score of 8.1 points (SD 2.3) to follow-up score of 10.0 points (SD 2.7) (Figure 7).

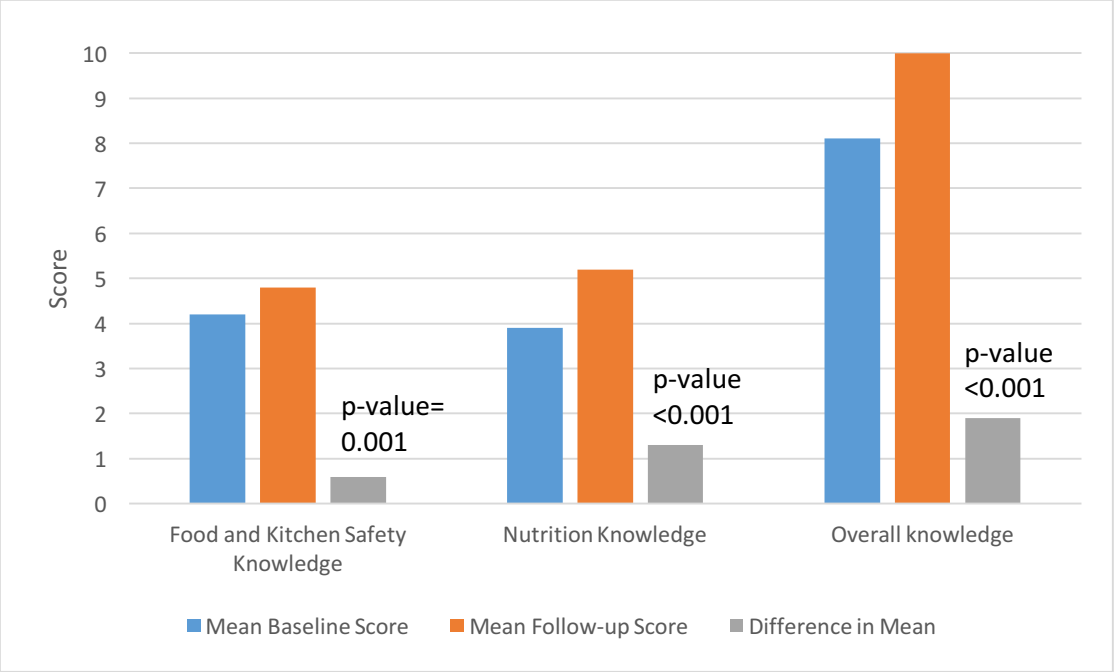

Figure 7. Mean baseline, follow-up, and difference in students' food and kitchen safety knowledge, nutrition knowledge, and overall knowledge scores.

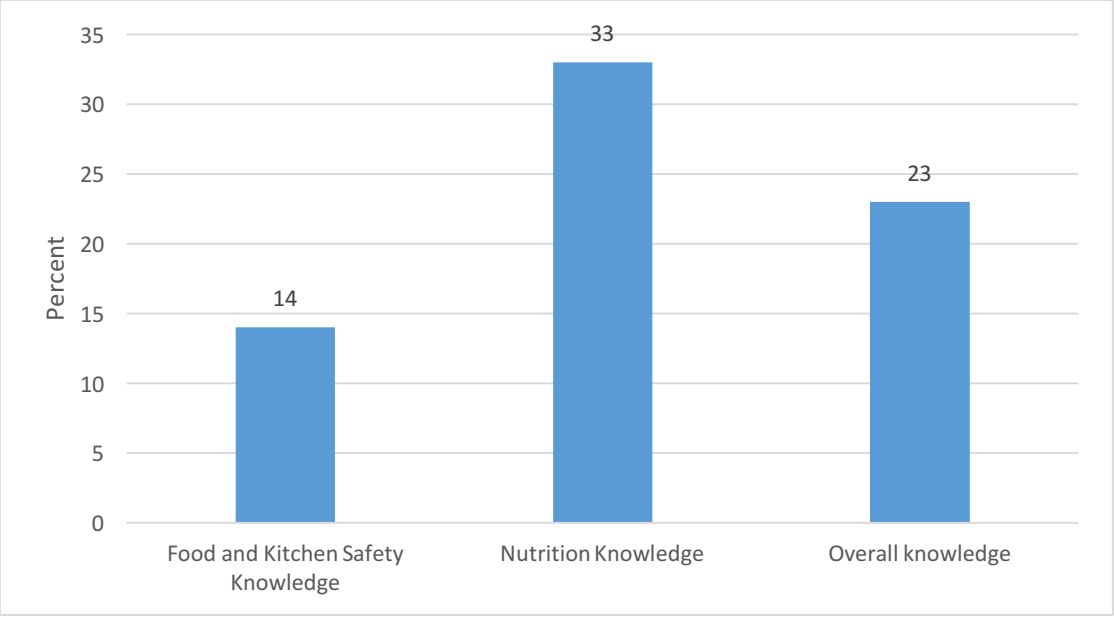

Figure 8. Percent change in student scores following participation in the PDC program.

Stratification of OSK scores by location and sex revealed noteworthy results across both variables (Table 16). Students enrolled in rural sites showed an 16% increase in mean OSK scores at follow-up (1.3 points, p=0.005) while students at urban sites improved by 30% (2.5 points, p<0.001). The difference observed between sites achieved statistical significance (1.2 points, p=0.04).

Furthermore, stratification by sex revealed that both male and female participants improved their mean OSK scores from baseline to follow-up, by 18% (1.5 points, p=0.004) and 28% (2.3 points, p<0.001), respectively. The difference between male and female participants was 0.8 points, p=0.2.

Table 16. Mean overall knowledge scores for students, stratified by site location and sex.

Location	N	Mean (SD) Baseline Score	Mean (SD) Follow-up Score	Difference in Mean (SD)	% Increase	p-value within groups*
Rural	29	8.1 (2.8)	9.3 (2.5)	1.3 (2.3)	16%	0.005
Urban	29	8.2 (2.6)	10.7 (2.7)	2.5 (2.2)	30%	<0.001
			p-value between groups**			0.04
Sex	**N**	**Mean (SD) Baseline Score**	**Mean (SD) Follow-up Score**	**Difference in Mean (SD)**	**% Increase**	**p-value within groups***
Male	26	8.2 (2.8)	9.7 (3.3)	1.5 (2.3)	18%	0.004
Female	32	8.1 (2.6)	10.3 (2.1)	2.3 (2.2)	28%	<0.001
			p-value between groups**			0.2

*p-values obtained using paired t-tests
**p-values obtained by one-way ANOVA

3.3 Instructor Impact on Student Outcomes

One-way ANOVA analysis was performed to evaluate impact of follow-up and mean change in overall instructor knowledge (OIK) scores on change in student outcomes: food and kitchen safety knowledge (FKSK), nutrition knowledge (NK), and overall student knowledge (OSK). Follow-up OIK scores were split at the median into

binary categories: high follow-up scores (≥14 points) vs. low follow-up scores (<14 points). Non-significant differences were observed between improvements in students' mean FKSK, NK, or OSK scores for students taught by instructors with high vs. low follow-up OIK scores (0.08 points, -13%, p=0.8; 0.5 points, 56%, p=0.2; and 0.6 points, 40%, p=0.3, respectively) (Appendix G).

Results indicated that mean change in overall instructor knowledge (OIK) significantly and positively impacted NK and OSK, but not FKSK, score changes among participants. Change in OIK scores were split into binary categories: high OIK score (≥5 points) vs. low OIK scores (<5 points). A 34% difference was observed between mean FKSK scores of students with instructors having high OIK vs. low OIK scores (0.7 points vs. 0.5 points, respectively, p=0.6) (Table 17). Students with high OIK instructors had a greater increase in mean NK scores from baseline (1.8 points) than students with low OIK instructors (0.6 points) (200% difference, p=0.004). Additionally, a significant 150% difference was observed between OSK scores for students with high OIK instructors vs. low OIK instructors (2.5 points vs. 1.0 points, respectively, p=0.01).

Table 17. Comparison between student scores for instructors with high vs. low overall knowledge scores.

Overall Instructor Knowledge (OIK) Score

	High OIK Score+	Low OIK Score++	Between Groups	
Student Score	**Difference in Mean (SD)**	**Difference in Mean (SD)**	**Percent Difference***	**p-value****
Food and kitchen safety knowledge	0.7 (1.1)	0.5 (1.5)	34%	0.6
Nutrition knowledge	1.8 (1.4)	0.6 (1.8)	200%	0.004
Overall knowledge	2.5 (2.1)	1.0 (2.3)	150%	0.01

Students taught by instructors with high overall score (n=33), students taught by instructors with low overall score (n=25-27)

+High OIK score= mean difference in OIK score ≥5

++Low OIK score= mean difference in OIK score <5

*Percent difference calculated for difference in mean scores for students with high OIK instructors relative to students with low OIK instructors

**p-value obtained by one-way ANOVA

CHAPTER 4

DISCUSSION

This study assessed the efficacy of a comprehensive online training mechanism and program outcomes for instructors and students of the Pink and Dude Chefs (PDC) program. Results indicated that mean scores improved for all three instructor outcomes, food and kitchen safety knowledge (FKSK), program knowledge (PK), and overall instructor knowledge (OIK), following participation in the PDC comprehensive online training. Mean student scores improved for all three student outcomes, food and kitchen safety knowledge (FKSK), nutrition knowledge (NK), and overall student knowledge (OSK). Additionally, students taught by instructors with high OIK scores showed greater improvement in the three student learning outcomes compared to students taught by instructors with low OIK scores.

4.1 Instructors

Instructors' mean FKSK, PK, and OIK scores improved by 45% (2.5 points, p=0.002), 63% (2.5 points, p=0.01), and 53% (5.0 points, p=0.002), respectively, at follow-up (Figures 5 and 6). Survey questions were derived from quizzes and the final exam from the PDC online training program. All 11 instructors failed to answer one question correctly at both baseline and follow-up: "When is it not necessary to wash your hands to avoid contamination?" Instructors were asked to choose from the following choices: after touching raw meat, after scratching your face, after cracking eggs, after flipping through your workbook, and it is always necessary to wash your hands. The correct answer "after flipping through your workbook" was covered in training, but instructors may have been erring on the side of caution when they all chose "it is always

necessary to wash your hands." They were not necessarily incorrect since extraneous handwashing can be useful for preventing contamination (Centers for Disease Control and Prevention, 2016), so this question should be re-examined for future PDC projects and instructor training. The handwashing question was included in all analyses and did not likely impact the findings, as there was no heterogeneity of responses at baseline or follow-up.

On the other hand, all instructors answered correctly at baseline and follow-up the question: "Which of the following are important safety measure that reduce the risk of foodborne illness?" Instructors accurately chose "all of the above" when given a list of safety measures highlighted in the online training. Proper training has been shown to be effective in preparing instructors lacking formal nutrition education to lead obesity prevention and other similar programs (Jones & Zidenberg-Cherr, 2015; Mukhina & Novikova, 2014; Roura et al., 2014). It is possible that this information was common knowledge prior to participation in the training. However, it could also indicate that the training adequately iterated this issue because instructor scores increased on all questions except "Which of the following is true regarding the Family Fiesta?" Fewer instructors correctly identified "The Family Fiesta involves more preparation time and ingredients than a regular class" at follow-up. Despite this, instructors continually asked questions about preparing for Family Fiesta in every cohort well ahead of the last lesson. They seemed well-aware of the effort it would require and made preparation a priority.

The decrease in scores for this question at follow-up could be attributed to this question being the last question on the 26-question long survey. While the surveys took no longer than 10-15 minutes to complete, questionnaire length and cognitive fatigue

have been shown to impact responses (Snyder et al., 2007; Ware, Kosinski, & Keller, 1996). Research indicates that decreasing the amount of questions in a survey by two-thirds can deliver responses as reliable as the original survey length (Ware et al., 1996). An evaluation of 2,333 completed 36-item Short-Form Health Surveys (SF-36) and condensed SF-12 surveys showed that SF-12 scores accurately reflected 91.1% and 91.8% of the Physical and Mental Component summary scores observed on SF-36 (Ware et al., 1996). Shorter questionnaires accurately capture data while decreasing amount of time required by participants (Rolstad, Adler, & Rydén, 2011; Snyder et al., 2007). Therefore, it may be useful to reconsider and test number of questions included in the PDC survey. Also, instead of placing the five demographic questions at the beginning of the survey, a better practice would be to put them at the end to alleviate mental fatigue (Schaeffer et al., 2010). This could be useful to test in future iterations of the PDC training and instruction assessments.

Stratification by location revealed improvements for both urban and rural instructors for all three outcomes of interest (Tables 11-13). Although differences between sites were marginal, urban instructors showed more significant improvements (68%, 94%, and 79% for FKSK, PK, and OIK, respectively) compared to rural instructors (28%, 36%, and 32%, respectively) (Tables 11-13). This suggests that urban instructors learned more than rural instructors over the course of the training. However, rural instructors started with higher baseline knowledge compared to urban instructors (Tables 11-13). This may be attributed to the demographic characteristics of the two groups. Five out of the six urban instructors (83.3%) and three of the five rural instructors identified as Hispanic/Latino (60%). Educational disparities including academic test performance and

college enrollment exist between Whites and racial/ethnic minorities (Snyder & Dillow, 2012). Two out of the five rural instructors had college degrees or higher (40%). None of the urban instructors were college graduates, and one was a high school graduate. Research suggests that having a college degree confers core knowledge and skills that those without degrees do not possess (Center for Education Statistics, 2012). In a study assessing understanding of nutrition labels, participants with a high school education or less were 1.9 times more likely than college graduates to report confusion about the nutrition information presented (Levings et al., 2015). The differences observed among instructor learning could be attributed to a greater proportion of rural instructors having more advantageous backgrounds, linked to higher levels of knowledge and education (Levings et al., 2015; Snyder & Dillow, 2012).

When assessing food and kitchen safety knowledge, instructor backgrounds do not explain why education did not significantly impact change in FKSK scores. It is likely that other variables such as trained kitchen experience affected FKSK knowledge, which is consistent with the literature (Adesokan et al., 2015). Mean PK and OIK scores improved for instructors of all education levels (between 2.8 to 4.3 points for PK, and 4.8 to 8.0 points for OIK), with the exception of the high school graduate who exhibited a decrease in scores (-2.0 points and -0.5 points, respectively) (Table 13). Older instructors may have had informal exposure to nutrition-related topics prior to training which could have affected their learning. However, it should be noted that education levels for the 11 instructors were categorized into four categories (high school graduate, Associates/Technical degree, some college, college graduate or higher), leading to few

instructors in each category (n=2, 4, 3, 2, respectively). Increasing instructor sample size would have increased the possibility of detection of significant statistical differences.

The literature indicates that food safety training was associated with improved knowledge, and those who received refresher training courses were more likely to demonstrate significantly higher knowledge (OR: 45, 95% CI: 3.47-584.3, $p<0.001$) and follow safe practices (OR: 13.5, 95% CI: 2.01-90.7, $p=0.003$) compared to those who did not (Adesokan et al., 2015). This is consistent with our findings that instructors who had previous trained kitchen experience showed greater changes in all three outcomes on average compared to non-trained instructors (62% vs. 0% for FKSK; 94% vs. -15% for PK; and 75% vs. -7% for OIK) (Tables 11-13). However, because only a small number of instructors did not have prior kitchen experience (n=2), future studies should seek to identify differences in outcomes when employing trained versus untrained instructors, with the aim of developing the training curriculum such that outcomes are standardized regardless of background. Additionally, the survey did not ask instructors with prior trained kitchen experience to specify when they received training or how much experience they had, so this variable should be included on the instructor survey and analyzed in future cohorts.

4.2 Students

Students' mean FKSK, NK, and OSK scores improved by 14% (0.6 points, $p=0.001$), 33% (1.3 points, $p<0.001$), and 23% (1.9 points, $p<0.001$) at follow-up (Figures 7 and 8). These results are congruent with previous research that hands-on cooking courses can improve participants' knowledge and cooking abilities (Beets et al., 2007). Survey questions were derived from student surveys applied and tested in prior

PDC projects. The only questions showing decreases in score were "If a fire in the kitchen happens, you should do which of the following?" and "How can you avoid cross-contamination?" The correct answers were "use a fire extinguisher" and "wash your hands after handling raw chicken," respectively. Students were shown the location of the fire extinguisher during Lesson 1, but were also directed to let the instructor know if a fire occurs. Because they had no personal knowledge on how to use the fire extinguisher themselves, the students may have eliminated this answer choice as being irrelevant (Muehle, 2004). This finding suggests the importance of emphasizing fire safety in PDC lessons, since two out of every five home fires (43%) in the United States starts in the kitchen (National Fire Protection Association, 2016). Between 2010-2014, an annual average of 166,100 home cooking-related fires resulted in $1.1 billion in direct damage, 480 civilian deaths, and 5,540 civilian injuries (National Fire Protection Association, 2016). Showing students how to properly extinguish a fire during the first safety lesson via a safety demonstration or educational video may have positive impacts on survey performance and practical implications as an important life skill, especially relevant to kitchen environments.

Handling raw chicken is covered in Lesson 8, when students learn to cook Baked Chicken Strips. However, perhaps due to this lesson being the only lesson in which chicken is utilized, this concept may not have been emphasized as thoroughly. Some students might have missed this lesson as well as it was in the middle of the curriculum, which is a limitation discussed below. Mishandling of raw chicken is associated with an annual $365 million spent on foodborne illnesses related to *Salmonella* bacteria, which accounts for 1.2 million illnesses, 23,000 hospitalizations, and 465 deaths each year

(Sjölund-Karlsson et al., 2013). Earlier exposure to handling poultry in the PDC program, as well as incorporating chicken into more than one lesson may better prepare students to adhere to proper safety guidelines and minimize physical and economic health costs.

Regardless of sex and location, adolescence is a critical age for establishing nutrition knowledge and skills to help make healthful choices that will carry on into adulthood (Fahlman et al., 2008; World Health Organization, 2015). Stratification by sex revealed no significant differences in FKSK, NK, and OSK scores (10 vs. 16%; 25 vs. 42%; and 18 vs. 28%, respectively) (Tables 18-20). This reinforces previous PDC research that showed PDC strategies effectively enforced behavioral changes for participants of both sexes (Bierlich-Wesch, 2016; Chessen, 2008; Gentry, 2017; Lockhart, 2014; Sheehan, 2013). In the most recent iterations of PDC programming, no significant differences were observed between male and female students' changes in fruit and vegetable preference ($p=0.6$ for both), nutrition knowledge ($p=0.6$), or fruit and vegetable intakes ($p=0.6$ and $p>0.9$, respectively) (Bierlich-Wesch, 2016). While research indicates that gender is a key variable that may increase obesity risk, gender does significantly impact observed increases in nutrition knowledge scores ($p<0.01$) among obesity prevention program participants (Sanders et al., 2015; Warren et al, 2003). This finding highlights that both male and female students may equally benefit from these programs and their associated outcomes, including improvements in knowledge and culinary skills, increased likelihood of positive behavior changes, and making healthier dietary choices (Bierlich-Wesch, 2016; Chessen, 2008; Gentry, 2017; Lockhart, 2014; Sheehan, 2013).

Research indicates that nutrition education programs are effective revenues for increasing nutrition knowledge (Fahlman et al., 2008; Gonzalez-Suarez et al., 2009). Consistent with the literature, this project found that nutrition knowledge scores increased significantly for both urban and rural students, revealing students had enhanced knowledge following program participation independent of location. However, findings also established significant differences in change in NK and OSK scores between urban and rural students (46% vs. 23%; and 30% vs. 16%, respectively) (Tables 15 and 16). The literature shows that effects of interventions may vary based on socioeconomic status (SES) of participants. Among overweight children between ages six to ten years, participation in school-based obesity interventions was more likely to decrease the incidence of overweight in higher SES children compared to lower SES children (OR: 0.26, 95% CI: 0.07 to 0.87) (Plachta-Danielzik & Pust, 2007). Researchers noted these differences may have been due to several modifiable factors discussed in the literature, such as inconsistency in family involvement with programming, strategies that targeted inaccessible food items for these participants, or economic barriers towards behavior change (Zenzen & Kridli, 2001). Programs targeted at low socioeconomic populations were most effective when they employ a variety of strategies to demonstrate the benefits of cooking and establishing healthy dietary behaviors (Davis et al., 2016). PDC utilizes evidenced-based nutrition and culinary strategies tailored specifically for middle school students and their sociodemographic backgrounds, as discussed in "Strengths" below. Since children of lower SES are at greater risk for overweight and obesity, it is important to build more focus intervention programs, like PDC, on this target population (Gonzalez-Suarez et al., 2009).

4.3 Instructor Impact on Student Outcomes

Higher increases in FKSK, NK, and OSK scores among students who were taught by instructors with high OIK scores were observed (34%, 200%, and 150%, respectively) (Table 17). These results are consistent with the literature. Instructor expertise in the content and teaching strategies used in a program are key factors in effectiveness of program delivery and behavioral outcomes for participants and instructors (Auld et al., 2014). Adequate instructor training prior to program implementation has been linked with increased knowledge, ability to deliver nutrition-related information, and promoting healthy behaviors to students (Christofferson et al., 2012; Eck et al., 2016; Turner-McGrievy & Campbell, 2009). Instructors who are trained via train-the-trainer (TTT) platforms for nutrition education programs, like PDC instructors, develop better knowledge on nutrition as well as increased confidence in their abilities to teach nutrition topics to others (Fahlman et al., 2011; Marks & Sisirak, 2012; Muth et al., 2008; Martha J. Sanders et al., 2015; Wartha et al., 2013). In addition, students who were taught by instructors who complete TTT trainings exhibit better outcomes, including increased knowledge and improved dietary behaviors, compared to students who are taught by untrained instructors (Marks et al., 2013; Muth et al., 2008; Sanders et al., 2015). As expected, in this project, students with instructors who had a high OIK score showed greater improvements in NK (200% higher, $p=0.004$) and OSK (150% higher, $p=0.01$) following program participation compared to students taught by low OIK instructors (Table 17).

Change, as opposed to follow-up, in OIK scores were used for impact analyses for several reasons. A follow-up OIK score indicates the level of instructor knowledge after

completion of the PDC online TTT mechanism. While follow-up scores may have differed between instructors, those scores may not reflect the knowledge they actually gained in training. Since instructors were required to pass all of the training quizzes and the final exam with perfect scores, it follows that all instructors would have had all necessary knowledge going into program implementation, at least in the short-term. With this training, the instructors would presumably have had all necessary skills required to implement PDC lessons and effectively teach students the topics covered in the curriculum, as mentioned earlier. Therefore, there should be no differences in student outcomes FKSK, NK, or OSK for students taught by high scoring vs. low scoring instructors. To evaluate the homogeneity in instructor knowledge after completion of training, instructors' follow-up scores were separated at the median (score of 14 points) into binary categories: high vs. low follow-up OIK scores. One-way ANOVA analysis was performed on high OIK vs. low OIK instructor's follow-up scores to determine if there were any differences in student outcomes between the groups. Results indicated insignificant differences in student outcomes (FKSK, PK, and OSK) for these two groups of instructors (-13%, 0.08 points, p=0.8; 56%, 0.54 points, p=0.2; and 40%, 0.58 points, p=0.3, respectively). This indicated that instructors' follow-up score was not the most sensitive indicator to test change in student knowledge, but that the amount an instructor learned during training, i.e. change in score, may be more sensitive.

The same analysis performed on change in instructor OIK scores revealed more significant differences in student FKSK, NK, and OSK change scores (34%, 0.17 points, p=0.6; 200%, 1.3 points, p=0.004; and 150%, 1.5 points, p=0.01). These differences were attributed to variables such as education and nutrition-related experience impacting

learning by laypeople instructors, as mentioned above. It would be a limited conceptual model to assume that regardless of instructor background, every instructor would be on the same level playing field going into PDC implementation. For example, some instructors spent considerably more time (data not shown) on the PDC training modules and quizzes than other instructors, as they were encouraged to learn at their own pace and could not move onto new modules without passing each quiz with 100% accuracy. Since repetition of learning concepts is associated with the development of new knowledge or skills (Rothschild & Gaidis, 1981), instructors who looked over the training information multiple times may remember the information better than others. Similarly, individuals who received refresher training courses on food and kitchen safety were much more likely to improve their safety knowledge (OR: 45, 95% CI: 3.47-584.34) and behaviors (OR: 13.5, 95% CI: 2.01-90.69) compared to those who did not (Adesokan et al., 2015). These differences in learning styles and prior knowledge going into the program, in addition to differences in instructor backgrounds, contribute to changes in instructor knowledge, which have a significant downstream impact on some student learning outcomes.

Measuring the change in instructors' OIK scores has practical applications for the future of PDC research and implementation. Results suggest the importance of providing sufficient instructor support during the training period so they learn the most possible from their baseline knowledge. Providing ongoing support to the nutrition educators amplifies positive health outcomes for them and their students they deliver the nutrition education to (Centers for Disease Control and Prevention, 1996). PDC program coordinators assisted every instructor with program and training-related questions during

training and program implementation to optimize instructors' training experiences. Results indicated that instructors who learned more overall, independent of post-training knowledge, had better student outcomes. Improvements in nutrition knowledge are important constructs for increasing the occurrence of healthful eating behaviors (Glanz, Rimer, & Viswanath, 2008). In prior PDC research, potential explanations for differences in student program outcomes were attributed to instructors' teaching skills improving over time and the possibility that prior cooking classes also emphasized nutrition-related concepts (Lockhart, 2014). These results are congruent with research indicating that longer duration of nutrition education programs, increased exposure to nutrition concepts, and higher quality of instruction are associated with positive outcomes on adolescents' nutrition-related skills, knowledge, and eating behaviors (Jones & Zidenberg-Cherr, 2015; Zenzen & Kridli, 2001).

4.4 Strengths

As part of ongoing Pink and Dude Chefs research, this project was built upon previous research focused on PDC student participants. These studies found that participation in PDC increased nutrition knowledge, culinary self-efficacy, cooking skills, and fruit intake for middle school-aged students (Bierlich-Wesch, 2016; Chessen, 2008; Lockhart, 2014; Sheehan, 2013). The California After School Resource Center advocates for helping children learn to navigate the food environment, cooking simple meals for their families, and preparing healthy snacks in afterschool nutrition education programs (California Department of Education, 2017). Many afterschool nutrition programs not only emphasize topics such as adequate fruit and vegetable consumption, but also focus on improving participants' culinary skills and cooking abilities to help students achieve

these competencies (Davis et al., 2011; Fahlman et al., 2008; Gatto et al., 2012; Isoldi & Dolar, 2016). PDC benefits from using a combination of classroom education with culinary skills training, to reinforce various nutrition topics. Interventions that focus on increasing knowledge and enhancing cooking skills have been shown to have positive effects on behavior changes and dietary habits (Davis et al., 2016; Fahlman et al., 2008; flipany.org, 2017; The Children's Aid Society, 2017). Additionally, with the larger sample size included in this study, findings from this project further reinforce outcomes observed in previous PDC studies.

Adolescent obesity impacts low socioeconomic (SES) and racial and ethnic minorities at higher rates, indicating the need for obesity prevention programs targeted at these groups (Frederick et al., 2013; Lee et al., 2014; Ogden, Carroll, Fryar, & Flegal, 2011). This study focused on a primarily Hispanic/Latino and low SES population in Northern Santa Barbara County. Previous iterations of Pink and Dude Chefs targeted populations of mostly low SES and racial/ethnic backgrounds in California and Tennessee (Bierlich-Wesch, 2016; Chessen, 2008; Lockhart, 2014; Sheehan, 2013). Early prevention efforts targeted at minority and low-income adolescents can protect against obesity especially when they are tailored to fit these population's needs (Kumanyika & Grier, 2006). PDC recipes are cost-effective, and utilize widely available ingredients that can either be found at supermarkets or food banks. In the case that specific ingredients could not be found, the PDC program coordinators worked closely with instructors to make necessary and appropriate ingredient substitutions while maintaining the integrity of recipes. Additionally, all recipes are simple, do not require special kitchen equipment, and can be prepared by adolescents and their families at home. While the results from this

study revealed positive effects among this demographic, tailoring or incorporating flexible curriculum/recipe components in future PDC iterations for different locations and cultures may be beneficial. Further research should be conducted on the effects of PDC implementation on diverse populations to fully understand its impact and limitations.

PDC also encourages the participation of students' families in the program. Parents often are involved in grocery shopping or food preparation in the home, and should be a secondary target in adolescent interventions (Beets et al., 2007). Interventions that involve adolescents' families are more successful in establishing behavioral changes in participants (Zenzen & Kridli, 2001). Involvement could range from having family members attending sessions with the adolescents or having take-home educational material for the children to share with their families (Barlow, 2007). Each week, students took their PDC workbooks and recipes they created home to share with their families. Students' families were also invited attend the Family Fiesta to celebrate theirs children's accomplishments at the end of each program. During interviews with families at the Family Fiestas, parents revealed that they enjoyed tasting the different recipes and learning about the topics covered each week from their children. Many parents were pleased that their children were learning new cooking skills and were more excited to help out at home (Bierlich-Wesch, 2016). Prior iterations of PDC indicate that students were more involved in meal preparation at home following program participation (Bierlich-Wesch, 2016; Lockhart, 2014). This is significant as research highlights that spending more time on food preparation is associated with higher intakes of fruit, vegetables, and fiber in adolescents (Larson et al., 2006). While family involvement may

have notable effects on PDC student outcomes, the impact of participants' families has not yet been evaluated and should be studied in future research projects.

Another strength of this project was its focus on assessing the online instructor training platform, which has also not been evaluated in the literature. As instructors of PDC are not expected to have any formal nutrition education before they participate in the online training, it is especially important to assess efficacy of the training infrastructure. The literature indicates that effective online nutrition education TTT models may efficiently disseminate nutrition training and its associated positive outcomes to a wider audience (Bensley et al., 2011; Eck et al., 2016; Neuenschwander et al., 2013; Stark et al., 2011). Train-the-trainer models designed for obesity prevention programs have been successful in increasing instructors' competency for delivering information ($p=0.023$) and comprehension of the skills required to teach nutrition and health topics ($p=0.013$) compared to untrained instructors (Fahlman et al., 2011). Among a study performed on Supplemental Nutrition Assistance Program-Education and Expanded Food and Nutrition Education (SNAP-Ed) program instructors all 22 participating instructors reported gaining knowledge on being effective teachers ($p<0.001$) and feeling adequately prepared as nutrition educators post-training (Christofferson et al., 2012). Nutrition-based training models have shown improvements among participating instructors' in several nutrition-related behaviors including nutrition knowledge (5.0 points, $p<0.05$), self-efficacy (1.18 points, $p<0.001$) and cooking skills (1.18 points, $p<0.001$) compared to untrained instructors (Au et al., 2017; Eck et al., 2016; Stark et al., 2011). Additionally, effective training mechanisms have been associated with positive student outcomes such as increased knowledge (1.9 points, $p<0.01$), nutrition literacy (25.2% increase in scores,

p<0.01), and fruit and vegetable intake (0.85 servings/day, p<0.05) (Marks & Sisirak, 2012; Sanders et al., 2015). As smaller scale implementations of TTT models have been associated with several benefits for program instructors and participants, their scaling and distribution has the potential to reduce the associated risks and consequences of obesity on a larger scale.

Previous PDC research has shown many positive student outcomes, and the findings from the current project may be helpful in determining how to create a more effective program and maximize outcomes for both instructors and students. The lack of longer-term studies among the promising afterschool obesity prevention programs previously mentioned is a gap that should be acknowledged in those programs' future research (Zenzen & Kridli, 2001). PDC has established sustainable outcomes among participants 12 weeks following program participation. Longer-term PDC program research has indicated the program's benefits carry on after the program, with all participants (n=8) reporting still feeling confident with their cooking skills, making healthier food substitutions, and helping out with cooking in their homes (Gentry, 2017). The successes of the PDC program may be carried into future program iterations to continue to improve knowledge, behaviors, and skills of instructors and adolescent participants alike.

4.5 Limitations

The most notable limitation of this study was the small sample size of instructors. Instructor analyses were limited by low statistical power due to only having 11 complete paired surveys, from 12 total instructors. During the developmental stages of this project, it was estimated that a total of about 15 instructors would be trained. Difficulties in

identifying sites that met requirements for program implementation led to a lower than anticipated number of instructors. Program coordinators had no influence over the number of instructors each site decided to train, although each site was encouraged to train as many instructors as possible. Budgetary factors at the sites were the main barrier towards each site not training additional instructors. The number of instructors was also hindered by the number of sites that were included in this project. While many sites were interested in participating, the vetting process eliminated several sites because they did not meet the requirements necessary to participate (i.e. having a kitchen or classroom space). While the results regarding instructor outcomes were promising, future studies should aim to include more instructors and sites to increase statistical power.

All instructors completed the training and presumably had the capabilities to lead lessons, but some instructors shared their duties. A few sites designated "lead program instructors" and "support instructors". Lead instructors presented the classroom nutrition activities and directed the hands-on kitchen practical during each lesson. Support instructors assisted in the facilitation of classroom and kitchen activities, but most did not attend every lesson. Research showing positive outcomes associated with obesity prevention program TTT mechanisms only assessed instructors involved in every program lesson (Fahlman et al., 2011; Marks et al., 2013; Muth et al., 2008; Sanders et al., 2015). Impact analyses were focused on lead program instructors for this reason.

For student outcomes, it should also be noted that some instructors taught one cohort while others taught twice. Due to aforementioned issues in identifying instructors, this could not be avoided in this study. As the long-term goal of this project was to create a sustainable PDC program at the chosen sites, the PDC program coordinators provided

continuous support to instructors during every cohort. Research indicates that providing nutrition educators with ongoing support increases positive outcomes for the instructors and students (Centers for Disease Control and Prevention, 1996). As a result of this support, instructors' program delivery skills may have differed between their first and second cohorts, and potentially affected student learning (Hausman & Ruzek, 1995). Training and ongoing reinforcement of program concepts by instructors who repeated lesson delivery over the course of two years (n=44) is associated with greater feelings of preparedness to teach ($p<0.01$) compared to instructors who taught for one year or less (n=56) (Hausman & Ruzek, 1995). Due to the limited small sample size and duration this project, analyses on first vs. second time instructors was not performed. The benefits associated with including all instructors in the analysis most likely outweighed the consequences in this project, especially given the lack of control program coordinators had over the number of enrolled instructors. Furthermore, since the online training mechanism had never been studied before, it was more important for the purposes of this project to determine whether the training was effective and was associated with positive student outcomes. Given that this project found evidence that the PDC online TTT mechanism is effective, further research assessing the long-term downstream impacts of instructor program delivery can be useful to designing the most effective training framework.

Attendance among the student participants was also inconsistent during programming. Discussions with program instructors revealed that other afterschool programs, such as sports or homework clubs, occurred at the same time as PDC at some sites. Students would sometimes choose to go to those programs on some weeks,

although the instructors were asked to encourage students to attend all PDC lessons for best outcomes. The Go Girls! nutrition education and physical activity program for adolescent females included physical activity, food preparation, and recipe tasting activities in each lesson. Post-intervention analysis revealed a 0.3 point BMI difference ($p=0.01$) among participants who attended >75% (n=23) vs. <75% (n=30) of lessons (Resnicow et al., 2005). Go Girls! participants who attended >50% of lessons (n=26) showed improved nutrition knowledge scores ($p=0.001$) and perceptions of positive dietary changes ($p=0.04$) compared to participants who attended <50% of lessons (n=31) (Resnicow et al., 2000). While these findings suggest that higher attendance leads to better participant outcomes, researchers noted that higher attendance groups reported greater support from family and friends ($p=0.05$) than low attendance groups (Resnicow et al., 2000). This is congruent with research indicating that family support is a key factor in establishing behavioral changes among participants (Zenzen & Kridli, 2001). In previous PDC research, an evaluation of participant attendance revealed 0.0 point and 0.69 point changes in nutrition knowledge scores between participants with 42% and 75% attendance rates, respectively (Chessen, 2008). While the differences between these groups were not statistically significant, high participation was associated with a greater change in knowledge than low participation ($p=0.01$) (Chessen, 2008).

Prior to data analysis, some student surveys were excluded. Some students decided to start PDC after the first lesson already began, so did not complete the baseline survey. Others dropped out of the PDC program during programming, so follow-up surveys could not be collected. Incomplete paired surveys were not included in the final analyses, as occurred in previous PDC studies (Bierlich-Wesch, 2016; Lockhart, 2014).

Additionally, rural sites, which were regions with small populations, reported issues in recruiting new student participants for their second cohorts. Due to the limited number of middle school-aged children in these locations, returning students were not discouraged from participating in PDC a second time. However, allowing students to participate in programming more than once could have been another source of potential error as repetition in learning is associated with greater knowledge and skills development (Rothschild & Gaidis, 1981). To account for this, only data taken from students' first experiences as PDC students was used, for most reliable analyses. Allowing returning students was a positive decision as these students helped recruit new students to the program, increasing the overall sample size and statistical power.

With these limitations in mind, future PDC implementation should include larger sample sizes of instructors and students, which may be consistent with efforts to scale up the program. Furthermore, study designs should also assess the gaps in knowledge on family involvement and the impact of PDC on food preparation and healthy eating in participants' homes. The convenience of the online TTT training platform, which this project showed to be effective, makes the scaling up of PDC programming possible in future program iterations. The widespread dissemination of PDC programming and longer-term outcomes assessments would also be useful for evaluating the long-term impact of the online training and PDC strategies for instructors and students. Overall, the combination of an interactive online training platform for instructors, and nutrition education and hands-on culinary experience for students, are successful mediators for increasing healthy behaviors and skills that may mitigate adolescent obesity.

CHAPTER 5

CONCLUSIONS

Despite the complex and multifactorial nature of obesity, afterschool-based obesity prevention programs and online nutrition train-the-trainer (TTT) platforms have shown promise. These programs and training mechanisms, when implemented separately and in conjunction, increase nutrition and culinary knowledge and skills to facilitate the development of healthy eating behaviors among adult and youth participants. Pink and Dude Chefs (PDC), a nutrition education and culinary skills program that employs an online comprehensive TTT model for instructors, has shown positive learning and behavioral outcomes for both PDC instructors and students. If obesity prevention programs with integrated TTT mechanisms are causally associated with decreasing obesity risk, larger scale efforts may ameliorate the longer-term individual and population-level health and economic consequences of obesity.

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Appendix A: Instructor Survey

PINK AND DUDE CHEFS
INSTRUCTOR SURVEY

Notes for interviewers:

1. Questions must be asked as they are written.
2. If clarification is needed, repeat the question again. Do not deviate because questions should be asked in the same way to each participant.
3. Remind them that we don't expect them to know the answers, and to pick the answer they feel is best.

I. Introduction:

Hello _____, this is ____. How are you today?

Thanks so much for taking the time to help us evaluate our online training. As we discussed in our previous phone call, this conversation will take about 15-20 minutes.

I will be asking you a series of multiple-choice questions. These questions will be used to help us understand who is participating in our online training. It will also be used to determine whether the online training is serving its best purposes for you.

Keep in mind, you most likely won't know all of the answers to these questions, and we don't expect you to know them. If you do not know the answer, make your best guess. There is no penalty for wrong answers. If you need the question repeated, just ask.

Also, everything that you say is confidential. That means that I will not share what you say with other program staff.

If all of that sounds good to you, then let's begin with the survey. Do you have any questions?

1. What is your sex?
    a. Male
    b. Female

2. What is your age?
    g. ≤ 20 years
    h. 21-25 years
    i. 26-30 years

j. 31-35 years
k. 36-40 years
l. 41-45 years
m. 46-50 years
n. 51-55 years
o. 56-60 years
p. 61-65 years
q. > 65 years

3. What is your race/ethnicity?
    a. White
    b. Hispanic or Latino
    c. Black or African American
    d. Native American or American Indian
    e. Asian/Pacific Islander
    f. Mixed heritage/two or more

4. What is the highest level of education you have completed?
    f. Less than high school
    g. High school graduate
    h. Associates or technical degree
    i. Some college
    j. College graduate or higher

5. Have you ever worked in a trained kitchen setting (i.e. restaurant, Starbucks, food truck, Meals on Wheels, etc.)
    a. Yes
    b. No

6. Which of the following should **not** be washed before you start cooking?
    a. Vegetables
    b. Fruits
    c. Raw meats
    d. Your hands
    e. None of the above

7. Which of the following must be cooked to the **highest** internal temperature?
    a. Fish
    b. Chicken and poultry
    c. Beef
    d. Veal

8. In order to be considered safe for consumption, which of the following may be cooked to the **lowest** internal temperature?
    a. Fish
    b. Chicken and poultry

c. Beef
d. Veal

9. To avoid cross contamination, which of the following should be stored on the **lowest** shelf in the fridge?
    a. Raw chicken
    b. Raw beef
    c. Vegetables
    d. Fruit
    e. Bread

10. Which of the following is **not** considered a red meat:
    a. Lamb
    b. Veal
    c. Beef
    d. Pork

11. When is it **not** necessary to wash your hands to avoid contamination?
    a. After touching raw meat
    b. After scratching your face
    c. After cracking eggs
    d. After flipping through your workbook
    e. It is always necessary to wash your hands

12. In order to be fully cooked, chicken needs to be cooked to an internal temperature of (Fahrenheit):
    a. 165 F
    b. 160 F
    c. 145 F
    d. 140 F

13. The temperature danger zone, which is conducive to the growth of bacteria and mold, is:
    a. 60-160 F
    b. 20-120 F
    c. 30-130 F
    d. 40-140 F

14. Which of the following is **not** a core objective of the Pink and Dude Chefs curriculum?
    a. Educating students on proper food handling and kitchen safety
    b. Fostering students' confidence in their cooking abilities
    c. Exposing students to new ingredients they wouldn't have access to at home
    d. Providing students with basic nutrition knowledge to make healthier food choices

15. When recruiting participants for the Pink and Dude Chefs program:
    a. Target adolescents between the ages of 14 to 16 years
    b. Focus on the healthy foods they will learn to make
    c. Highlight that learning to cook will make them more independent
    d. Emphasize that this is a nutrition education program
    e. All of the above

16. Which of the following are important safety measures that reduce the chance of foodborne illness:
    a. Washing aprons and chefs hats after each lesson
    b. Washing hands after leaving the kitchen or using the restroom
    c. Separating raw meat from cooked foods and fruits/vegetables
    d. Strategic placement of raw meats in the refrigerator
    e. All of the above

17. What should you do if there is a grease fire in your pan?
    a. Douse the pan with a bucket of water
    b. Smother the pan with a lid until it is completely cooled
    c. Extinguish the fire with a towel
    d. Utilize a fire extinguisher to stop the fire

18. The first step for cleaning a food processor or blender is:
    a. Submerging it in water
    b. Removing the blade
    c. Disassembling it
    d. Unplugging it

19. A Pink and Dude Chefs program will be most successful if:
    a. Multiple people help with running the program
    b. Instructors revise recipes to save on food costs each week
    c. A minimum of 15 students are enrolled in each session
    d. Instructors arrive 15 minutes early to prepare for each lesson
    e. All of the above

20. In order to follow the budget, instructors may **not**:
    a. Substitute some of the recipe ingredients for cheaper and similar alternatives
    b. Contact local food banks to ask for donations
    c. Cook the recipes themselves without student involvement
    d. Shop at multiple grocery stores to find the best deals

21. Which of the following is **not** a way to help keep control of the classroom?
    a. Say “Pink Chefs” and have students respond with “Dude Chefs” to get their attention

b. Have students help set up appropriate classroom rules when the program begins
c. Assign disruptive students to specific tasks and give them positive feedback
d. Before each lesson, have the students help set up their work spaces
e. After each lesson, require the students to clean up their area

22. What do you do if a fight breaks out between students?
    a. Get their attention by raising your voice
    b. Send the students home without letting them complete the lesson
    c. Lead them outside to resolve the issue so the lesson can continue
    d. Reprimand the students in front of their peers to establish control
    e. Separate the students and assign them to different tasks

23. Which is **not** an expected cost of running the Pink and Dude Chefs Program?
    a. Transportation
    b. Food
    c. Personnel
    d. None of the above

24. At the end of each lesson, what should happen **after** kitchen clean-up is complete?
    a. The students leave with their freshly made food, while the instructors take inventory of the kitchen
    b. The students and instructor all sit down to enjoy the recipes they prepared that day
    c. The instructor facilitates "closure"- a time for students to share what they learned that day with everyone
    d. The instructor facilitates "reflection"- a time for students to write down what they learned in their workbooks

25. For each Pink and Dude Chefs lesson:
    a. 1 volunteer is recommended for every 2 students
    b. 1 volunteer is recommended for every 4 students
    c. 1 volunteer is recommended for every 6 students
    d. 1 volunteer is recommended no matter how many students there are

26. Which of the following is true regarding the Family Fiesta?
    a. The Family Fiesta doesn't require any additional costs compared to a regular class
    b. The Family Fiesta involves more preparation time and ingredients than a regular class
    c. The Family Fiesta is a time for the students to showcase one recipe of their choice to their parents and guests
    d. The Family Fiesta is a time for students to cook with minimal intervention from the instructor using the skills they've learned

That concludes the survey. Thank you for taking the time to help us today. Either myself or Alyssa/Jacqueline will email you with your log-in information to access the online training in the next few days. Please don't hesitate to contact us if you have any questions or need help accessing the training.

Thank you again and have a wonderful day!

Appendix B: Student Survey

Pink and Dude Chefs
Student Survey

Instructions
We would like you to complete this survey. You may skip questions you do not want to answer but we hope that you will answer all of them. Any information about who you are will be kept confidential.

I: Nutrition Knowledge

Check the one best answer you can think of for the following questions.	
1. Fiber is found in which of the following?	
❑ Chicken	❑ Olive oil
❑ Butter	❑ Oatmeal
2. 99% of the calcium in your body is found in your_____.	
❑ Skin	❑ Bones and teeth
❑ Hair	❑ Tongue
3. Based on the USDA MyPlate guidelines, how much of the plate should be made up of fruits and vegetables?	
❑ 1/4 of the plate	❑ 1/2 of the plate
❑ 1/3 of the plate	❑ The whole plate
4. Which of the following is **NOT** found on the nutrition label?	
❑ Calories	❑ Ingredients
❑ Expiration date	❑ Sodium
5. Where can you find the most natural, healthy items in the grocery store?	
❑ The perimeter	❑ The middle
❑ The check-out line	❑ The frozen food aisle
6. The serving size of _____ is equivalent to the size of a smartphone or a deck of cards.	
❑ Carbohydrates	❑ Protein
❑ Dairy	❑ Fat
7. Beans can be an excellent source of _____.	
❑ Fat	❑ Sugar

	❑ Plant protein	❑ Dairy	
8.	Which of the following is a different name for sugar?		
	❑ Fructose	❑ Soybean Oil	
	❑ Rice Flour	❑ Citric Acid	

II: Kitchen Safety

Check the one best answer you can think of for the following questions.	
9. If a fire in the kitchen happens, you should do which of the following?	
❑ Use a fire extinguisher	❑ Throw flour on the fire
❑ Attempt to move a burning pan	❑ Cover the stove with a towel
10. When using a knife in the kitchen you should only cut on _____.	
❑ The stove	❑ A cutting board
❑ A paper towel	❑ A frying pan
11. How much time should you spend washing your hands?	
❑ 5 seconds	❑ 15 seconds
❑ 10 seconds	❑ 20 seconds
12. How can you avoid cross-contamination?	
❑ Use the same knife for raw fish and fruit	❑ Wash your hands after handling raw chicken
❑ Mix cooked beef with raw beef	❑ Rinse cutting boards under water
13. In order to avoid burns, you should _____.	
❑ Be careful using your bare hands	❑ Leave an item in an open oven until it is cool
❑ Use a pot holder or oven mitt	❑ Never cook anything over 100 degrees
14. If a knife falls off a table, you should _____.	
❑ Grab it quickly before it touches the floor	❑ Ignore it
❑ Let it fall and get out of the way	❑ Pick it up and use it immediately

III: Cooking Skills

Check the one best answer you can think of for the following questions.

15. Which of the following shows a **diced** carrot?

❑ 

❑ 

❑ 

❑ 

16. Which of the following should be used to measure liquids?

❑ 

❑ 

❑ 

❑ 

17. What cooking method is used to cook small pieces of vegetables in a small amount of oil?

❑ Stir-fry
❑ Poaching
❑ Simmering
❑ Steaming

18. When baking, what is the first step of the recipe?

❑ Preheat the oven
❑ Combine wet and dry ingredients
❑ Mix dry ingredients
❑ Turn on the stove

19. Chopped vegetables should be _____.

❑ Very tiny pieces
❑ Bite-sized
❑ Cut into strips
❑ Shredded

20. In what order should you use the ingredients listed in a recipe?

- ❑ It doesn't matter
- ❑ Whatever the directions say
- ❑ In alphabetical order
- ❑ From top to bottom

IV: Confidence

Right now, how sure or confident are you that you can . . .		No way I can do this	I can barely do this	I can sort of do this	I can mostly do this	I can totally do this
21.	Help an adult family member prepare a dish or a meal using fruits, vegetables or other fresh ingredients	❑	❑	❑	❑	❑
22.	Suggest a healthy item for the family's grocery list	❑	❑	❑	❑	❑
23.	Follow a simple recipe to make a dish	❑	❑	❑	❑	❑
24.	Put out an oil or grease fire on the stove	❑	❑	❑	❑	❑
25.	Cook a dish or a meal using fresh fruits, vegetables, meats or other raw ingredients from scratch	❑	❑	❑	❑	❑
26.	Identify key facts on a nutrition label	❑	❑	❑	❑	❑
27.	Use a kitchen knife to safely slice or dice an ingredient	❑	❑	❑	❑	❑
28.	Accurately measure the right amount for a recipe (teaspoon, tablespoon, 1/3 cup, 16 ounces)	❑	❑	❑	❑	❑
29.	Find healthy items in a grocery store	❑	❑	❑	❑	❑

V: Would you try different food items?

Are you willing to try these foods?		No way!	Yes, maybe a little	Yes, somewhat	Yes, probably willing	Yes, for sure!	Don't know what this is
							
30.	Almond Butter	❑	❑	❑	❑	❑	❑
31.	Vegetable stir-fry	❑	❑	❑	❑	❑	❑
32.	Whole Wheat Flour	❑	❑	❑	❑	❑	❑
33.	Quinoa	❑	❑	❑	❑	❑	❑
34.	Kale Chips	❑	❑	❑	❑	❑	❑
35.	Tofu	❑	❑	❑	❑	❑	❑

VI: Your Food and Beverage Choices

These questions are about the foods you eat. Think back over the <u>past week, which is the past 7 days,</u> and try to describe what you have eaten. Please provide your best guess.

36. In the <u>past week, which is the past 7 days,</u> how many times do you eat these fruits?		**Not at all**	**Once**	**Twice**	**3 times**	**4 times**	**5 or more times**
a.	Apple	❑	❑	❑	❑	❑	❑
b.	Banana	❑	❑	❑	❑	❑	❑
c.	Berries (blueberries, strawberries, raspberries)	❑	❑	❑	❑	❑	❑
d.	Cherries	❑	❑	❑	❑	❑	❑
e.	Grapefruit	❑	❑	❑	❑	❑	❑
f.	Melons (honeydew, cantaloupe, watermelon)	❑	❑	❑	❑	❑	❑
g.	Orange	❑	❑	❑	❑	❑	❑
37. In the <u>past week, which is the past 7 days,</u> how many times do you eat these vegetables?		**Not at all**	**Once**	**Twice**	**3 times**	**4 times**	**5 or more times**
a.	Asparagus	❑	❑	❑	❑	❑	❑
b.	Avocados	❑	❑	❑	❑	❑	❑
c.	Bell Peppers	❑	❑	❑	❑	❑	❑
d.	Broccoli	❑	❑	❑	❑	❑	❑
e.	Cabbage	❑	❑	❑	❑	❑	❑
f.	Carrots	❑	❑	❑	❑	❑	❑
g.	Cauliflower	❑	❑	❑	❑	❑	❑
h.	Corn	❑	❑	❑	❑	❑	❑
i.	Green Beans	❑	❑	❑	❑	❑	❑
j.	Greens (spinach, kale, lettuce)	❑	❑	❑	❑	❑	❑
k.	Mushrooms	❑	❑	❑	❑	❑	❑
l.	Onion	❑	❑	❑	❑	❑	❑
m.	Peas	❑	❑	❑	❑	❑	❑

n.	Potatoes (do NOT count fries or chips)	❑	❑	❑	❑	❑	❑
o.	Sweet Potatoes (do NOT count fries)	❑	❑	❑	❑	❑	❑
p.	Tomatoes	❑	❑	❑	❑	❑	❑
q.	Squash (examples: acorn, butternut, zucchini, yellow squash)	❑	❑	❑	❑	❑	❑

Appendix C: Mean baseline, follow-up survey, and difference in instructors' food and kitchen safety knowledge scores.

Survey Question	Question Topic	Mean (SD) Baseline Score	Mean (SD) Follow-up Score	Difference in Mean (SD)	p-value*
6	Hygiene	0.36 (0.5)	0.82 (0.4)	0.45 (0.5)	0.02
7	Highest internal cooking temperature	0.54 (0.5)	0.91 (0: .3)	0.36 (0.7)	0.1
8	Lowest internal cooking temperature	0.73 (0.5)	0.54 (0.5)	-0.18 (0.4)	0.2
9	Avoiding cross contamination	0.27 (0.5)	0.91 (0.3)	0.63 (0.5)	0.002
10	Red meats	0.54 (0.5)	0.82 (0.4)	0.27 (0.5)	0.08
11	Proper handwashing procedures	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	-
12	Chicken and poultry	0.36 (0.5)	0.72 (0.5)	0.36 (0.7)	0.1
13	Temperature danger zone	0.54 (0.5)	0.54 (0.5)	0.0 (0.4)	>0.9
16	Reducing foodborne illness	1.0 (0.0)	1.0 (0.0)	1.0 (0.0)	-
17	Handling grease fires	0.54 (0.6)	0.82 (0.4)	0.27 (0.6)	0.2
18	Proper cleaning procedures	0.54 (0.5)	0.91 (0.3)	0.36 (0.5)	0.04
	Total	**5.5 (2.3)**	**8.0 (1.2)**	**2.5 (2.1)**	**0.002**

n=11

*p-values obtained using paired t-tests

Appendix D: Mean baseline, follow-up survey, and difference in instructors' program knowledge scores.

Survey Question	Question Topic	Mean (SD) Baseline Score	Mean (SD) Follow-up Score	Difference in Mean (SD)	p-value*
14	Core PDC objectives	0.64 (0.5)	0.91 (0.3)	0.27 (0.5)	0.1
15	Participant recruitment	0.18 (0.4)	0.45 (0.5)	0.27 (0.6)	0.2
19	Running a successful PDC program	0.27 (0.5)	0.63 (0.5)	0.36 (0.5)	0.04
20	Program budget	0.72 (0.5)	1.0 (0.0)	0.27 (0.5)	0.08
21	Classroom control	0.18 (0.4)	0.45 (0.5)	0.27 (0.6)	0.2
22	Fighting between students	0.7 (0.5)	0.72 (0.5)	0 (0.8)	>0.9
23	Expected PDC program costs	0.54 (0.5)	1.0 (0.0)	0.45 (0.5)	0.02
24	Lesson closure	0.18 (0.4)	0.36 (0.5)	0.18 (0.8)	0.4
25	PDC volunteers	0.09 (0.3)	0.54 (0.5)	0.45 (0.7)	0.05
26	Family Fiesta celebration	0.45 (0.5)	0.36 (0.5)	-0.09 (0.5)	0.6
	Total	**4.0 (2.0)**	**6.5 (1.4)**	**2.5 (2.7)**	**0.01**

n=11

*p-values obtained using paired t-tests

Appendix E: Mean baseline, follow-up survey, and difference in students' food and kitchen safety knowledge scores.

Survey Question	Question Topic	Mean (SD) Baseline Score	Mean (SD) Follow-up Score	Difference in Mean (SD)	p-value*
9	Kitchen and fire safety	0.79 (0.4)	0.74 (0.4)	-0.05 (0.5)	0.4
10	Proper knife handling	0.84 (0.4)	0.93 (0.3)	0.09 (0.4)	0.1
11	Proper handwashing techniques	0.66 (0.5)	0.93 (0.3)	0.27 (0.5)	0.002
12	Avoiding cross-contamination	0.64 (0.5)	0.59 (0.5)	-0.05 (0.7)	0.6
13	Avoiding burns	0.69 (0.5)	0.76 (0.4)	0.07 (0.5)	0.3
14	Knife safety	0.63 (0.5)	0.90 (0.3)	0.27 (0.4)	<0.001
	Total	**4.2 (1.5)**	**4.8 (1.3)**	**0.6 (1.3)**	**0.001**

Differences in mean were calculated for n=56-59 students
*p-values obtained using paired t-tests

Appendix F: Mean baseline, follow-up survey, and difference in students' nutrition knowledge scores.

Survey Question	Question Topic	Mean (SD) Baseline Score	Mean (SD) Follow-up Score	Difference in Mean (SD)	p-value*
1	Fiber	0.58 (0.5)	0.76 (0.4)	0.19 (0.6)	0.02
2	Calcium	0.75 (0.4)	0.85 (0.4)	0.10 (0.5)	0.1
3	MyPlate food groups guidelines	0.43 (0.5)	0.74 (0.4)	0.31 (0.6)	0.002
4	Reading nutrition labels	0.43 (0.5)	0.59 (0.5)	0.16 (0.6)	0.04
5	Shopping at grocery stores	0.26 (0.4)	0.40 (0.5)	0.14 (0.6)	0.09
6	Appropriate serving sizes	0.47 (0.5)	0.52v (0.5)	0.05 (0.7)	0.6
7	Protein sources	0.57 (0.5)	0.74 (0.4)	0.17 (0.6)	0.03
8	Sugars	0.48 (0.5)	0.69 (0.5)	0.21 (0.5)	0.004
	Total	**3.9 (1.6)**	**5.2 (1.8)**	**1.3 (1.6)**	**<0.001**

Differences in mean were calculated for n=56-59 students
*p-values obtained using paired t-tests

Appendix G: Comparison between student scores for instructors with high vs. low follow-up knowledge scores.

Follow-up Instructor Knowledge (OIK) Score

	High follow-up score[+]	Low follow-up score[++]	Between Groups	
Student Score	**Difference in Mean (SD)**	**Difference in Mean (SD)**	**Percent Difference***	**p-value****
Food and kitchen safety knowledge	0.6 (1.3)	0.6 (1.3)	-13%	0.8
Nutrition knowledge	1.5 (1.7)	1.0 (1.8)	56%	0.2
Overall knowledge	2.1 (2.4)	1.5 (2.3)	40%	0.3

Students taught by instructors with high follow-up score (n=34), students taught by instructors with low follow-up score (n=24-26)

[+]High score= follow-up OIK score ≥14

[++]Low score= follow-up OIK score <14

*Percent difference calculated for difference in mean scores for students with high OIK relative to students with low OIK instructors

**p-value obtained by one-way ANOVA