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UTILIZATION OF WEB-BASED APP TO TARGET OBESOGENIC FACTORS IN RURAL KENTUCKY COUNTIES WITH HIGH RATES OF OBESITY

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THESIS

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science in Nutrition and Food Systems in the College of Agriculture, Food and Environment at the University of Kentucky.

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ABSTRACT OF THESIS

UTILIZATION OF WEB-BASED APP TO TARGET OBESOGENIC FACTORS IN RURAL KENTUCKY COUNTIES WITH HIGH RATES OF OBESITY

Due to socioeconomic disparities and geographic isolation, rural Kentucky residents bear a greater burden of poor health compared to national averages. Specifically, rural Kentucky residents are at greater risk of becoming obese and suffering from comorbidities of obesity such as type 2 diabetes, hypertension and cardiovascular disease. The purpose of the present study was two-fold. First, we the barriers to nutrition and physical activity unique to rural Kentucky counties which high proportions of obese adults (<40%) were examined and extrapolated. Second, this information was used to develop a health and wellness app tailored to rural Kentucky counties. The objective was met via a formative assessment regarding causes for obesity in three rural Kentucky counties using focus groups. From these discussions, two major themes arose: barriers to good nutrition and physical activity, and desired web-app features. From this assessment, FitFaceoff was developed and released into the same counties. Usage and user interaction were assessed using GoogleAnalytics™ software. Analysis revealed poor user liking and unsuccessful implementation of FitFaceoff, however further qualitative research is needed to evaluate poor user reception of FitFaceoff and possible future directions.

KEY WORDS:Technology-based interventions, Rural Communities, Obesity, Kentucky, Physical Activity, Nutrition

Erin Casey
May 18, 2018

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Introduction

One of the greatest social and practical problems facing the United States today is the high prevalence of obesity and obesity-associated comorbidities. Nearly 36% of adults in the United States are obese. Furthermore, nearly 17% of children and adolescents are obese (Center for Disease Control and Prevention; Ogden, Carroll, Kit and Flegal, 2014). As such, the prevalence of obesity-associated comorbidities, such as cardiovascular disease and type 2 diabetes mellitus, is also on the rise, costing nearly $147,000 annually in associated medical costs (www.cdc.gov). Therefore, obesity and its associated comorbidities are creating a dire public health concern in the United States that needs to be addressed.

In spite of efforts made by researchers, industry professionals and wellness advocates, obesity and chronic disease rates continue to climb. Not surprisingly, some of the regions affected most are rural communities where access to clinically-based efforts and healthcare are often a challenge (Befort et al., 2012). Specifically, Appalachia represents a region with some of the greatest health disparities including high rates of obesity-related deaths and underserved healthcare populations (Schoenberg, 2008; O'Brien, 2013). While several decades of research have been dedicated to understanding obesity-related behaviors, the unique barriers to rural communities, and specifically Appalachia, still remain poorly understood.

Two concepts offer promise in helping to reduce obesity and its associated health risks in rural/Appalachian communities: 1) application of behavior-change theory to weight loss interventions and 2) technology-based interventions. Specifically, health and wellness apps have gained substantial popularity in the past

decade and suggest a promising interface between evidence-based health and weight loss programs and rural populations. However, the majority of health and wellness apps available to date are not evidence-based and often perpetuate the exchange of misinformation. Many interventions in both rural and non-rural communities have found behavioral modalities such as self-monitoring, tailoring and stress management to produce significantly more weight loss than dietary counseling alone. (for review see Lee et al., 2015; Raaijmakers et al., 2015) Several attempts have been made to incorporate these concepts into technology-based interventions, however the majority of these revolve around email correspondence (Lee et al., 2015; Raaijmakers et al., 2015). Despite the prevalence and widespread use of smartphones and mobile technology, it represents an untapped resource in implementing technology-based interventions.

Problem Statement

The health disparities present in rural Kentucky relative to other regions of the U.S. present a unique set of challenges to weight-loss interventions. To effectively address the high rates of obesity and associated chronic disease in these areas, health and wellness interventions need to account for the cultural and social differences unique to the target population. While several app-based weight loss interventions exist, very few are evidence-based leading to inaccuracies in tracking and user confusion. Furthermore, weight loss is only one component of health behavior, which is multidimensional and multifaceted. This complexity warrants the need for theoretically driven health and wellness apps that are based on behavior change and not simply the mechanics of "calories-in vs. calories-out."

Purpose

The continued high rates of obesity and obesity-associated diseases in rural areas, particularly in Kentucky, speaks to the need for more region-specific health and wellness interventions. Similarly, the use of mobile-health interventions have gained popularity as the technology to conduct them has developed, and they hold great promise for reaching populations for which access to conventional interventions is not feasible, such as rural populations. Therefore, the purpose of this study is to examine the feasibility of an evidence-driven health and wellness app in rural Kentucky counties at high risk for obesity and obesity-associated chronic disease.

Research Questions

1) What are the barriers to good nutrition and physical activity among rural Kentucky residents living in counties with a high proportion (>40%) of obese adults?
2) What are the desired features of a health/wellness app among rural Kentucky residents living in counties with a high proportion (>40%) of obese adults?
3) Is it feasible to implement at region-specific health and wellness app, tailored to residents' needs and wants in rural Kentucky counties with high rates (>40%) of obese adults?

Research Hypotheses

1) Common barriers to good nutrition and physical activity will be identified in focus group discussions among participants from rural Kentucky counties with a high proportion of obese individuals.
2) Features desired to address common barriers to good nutrition and physical activity will be revealed in focus group discussions among participants from rural Kentucky counties with a high proportion of obese individuals.
3) The feasibility, as measured by app usage and ratings of ease of use and liking of the app, will be high.

Justification

Nearly 36% of adults in the United States are clinically obese (www.nih.gov). This presents a large health concern due to the increased prevalence of obesity-associated diseases such as cardiovascular disease and type 2 diabetes and cancer. Obesity tends to be more prevalent in rural communities, and especially so in rural Kentucky (Kentucky Institute of Medicine, 2013). Furthermore, the prevalence and death rate due to obesity-associated chronic diseases is higher in Kentucky compared to the national average (cdc.gov).

Technology-based interventions hold promise for improving health disparities in rural areas as they can help reduce barriers such as limited access, affordability and education (Sharp et al., 2014). Expanding these interventions to encompass cultural and region-specific barriers will likely enhance their efficacy. Therefore, it is imperative to understand the unique barriers in these areas where obesity and chronic disease rates are highest in order to better address them.

Review of current literature

Introduction

The epidemic of obesity has continued to escalate over the past several decades, as has the rate of incidence of obesity-associated comorbidities such as hypertension, dyslipidemia and insulin resistance (CDC-2012). For as long as obesity has been a chronic health concern, the gold standard for treatment has been calorie reduction and an increase in physical activity, i.e. "diet and exercise." While many individuals find initial success with a host of diet and exercise paradigms, often weight lost is not maintained, and in fact many individuals manage to regain weight beyond their initial starting weight (MacLean et al., 2015). This trend is alarming and points to the need for more effective weight loss and weight management tools.

Because the need for weight loss often reflects the need for lifestyle changes, altering eating behaviors becomes an extremely complex and multifaceted objective. As such, understanding the drivers of eating behavior and the design of interventions aimed to initiate and maintain weight loss have been the topic of much research over the past several decades. Despite these efforts rates of obesity and obesity-associated disorders continue to climb. These numbers are particularly staggering in rural areas, in particular Appalachia. This area is associated with greater incidence of chronic diseases, poverty, unemployment, underserved healthcare populations and obesity (Barker et al., 2010; CDC-2010). While several attempts have been made to address these disparities, many have failed due to the isolation and inability of the target population to access healthcare resources. To

this end, technology-based interventions hold promise to provide evidence-based interventions to populations that have otherwise been overlooked and forgotten.

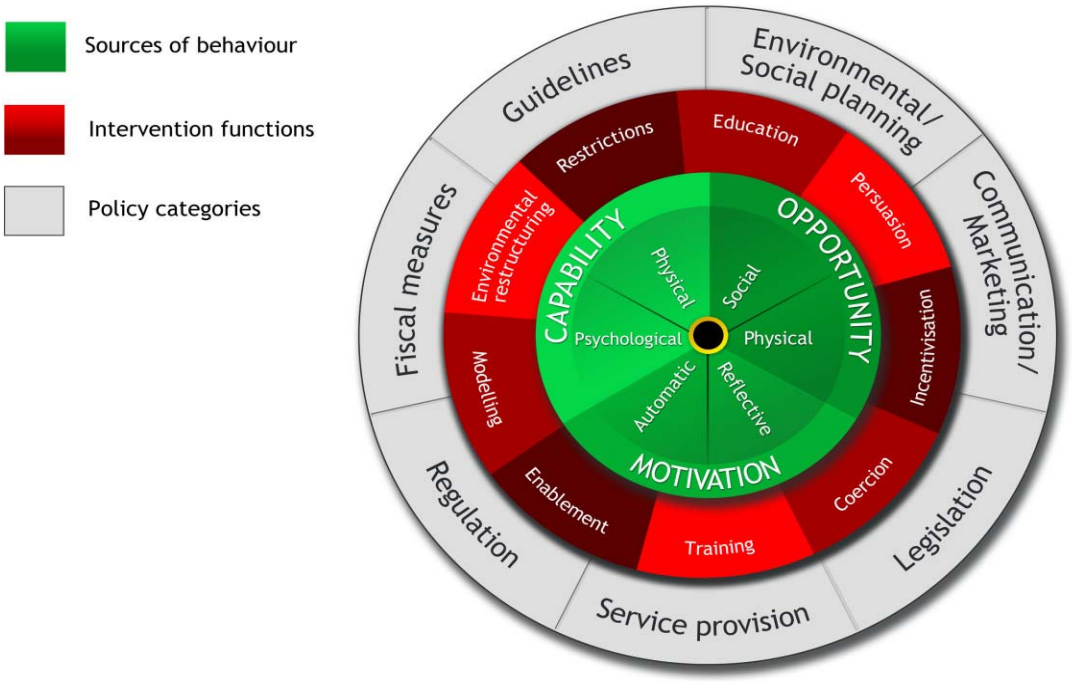
Theoretical Framework

Behavior change theories represent a new trend in the field of dietetics to elicit dietary changes. These theories have lead to counseling approaches that are both common and successful in psychotherapy counseling, and have thus been adopted in the field of nutrition and dietetics.

In 2008, the American Dietetics Association Nutrition Counseling Workgroup conducted a systematic review of the efficacy of behavior change theories in nutritional counseling. The review (Spahn et al., 2010) concluded that goal setting, self-monitoring, motivational interviewing, social support were effective in altering food and nutrition related behaviors in a counseling setting. Additionally, theories such as the health belief model, transtheoretical model and socioecological model have been used successfully in designing nutrition-related interventions (Bauer et al., 2012). Of these, the health belief model and transtheoretical model retains the focus on the individual. The health belief model stipulates that recommendations should be based perception of benefits vs. barriers to behavior change. The transtheoretical model similarly bases recommendations for change upon the clients' readiness for change. Unlike the health belief model or the transtheoretical model, the socioecological model considers the individual as only a small fraction of the factors influencing behavior and behavior change. It focuses largely on factors outside of the individual such as social networks, physical environment and policy. While all of the aforementioned models have their strengths, none connect the

intrinsic (individual) and extrinsic (external to the individual) factors that govern behavior, and therefore behavior change.

The behavior-change wheel (BCW) was developed by Michie et al. (2011) in an attempt to establish a new framework to characterize behavior change interventions and link it to an overarching model of behavior. To do so, they applied "usefulness criteria" to existing behavior change interventions. These criteria consisted of: comprehensiveness (applies to any existing or possible intervention), coherence (different categories that exemplify the same principle are grouped together) and links to an overarching model of behavior. Furthermore they established a nonlinear "wheel-based" model that accounted for the interaction amongst various drivers.

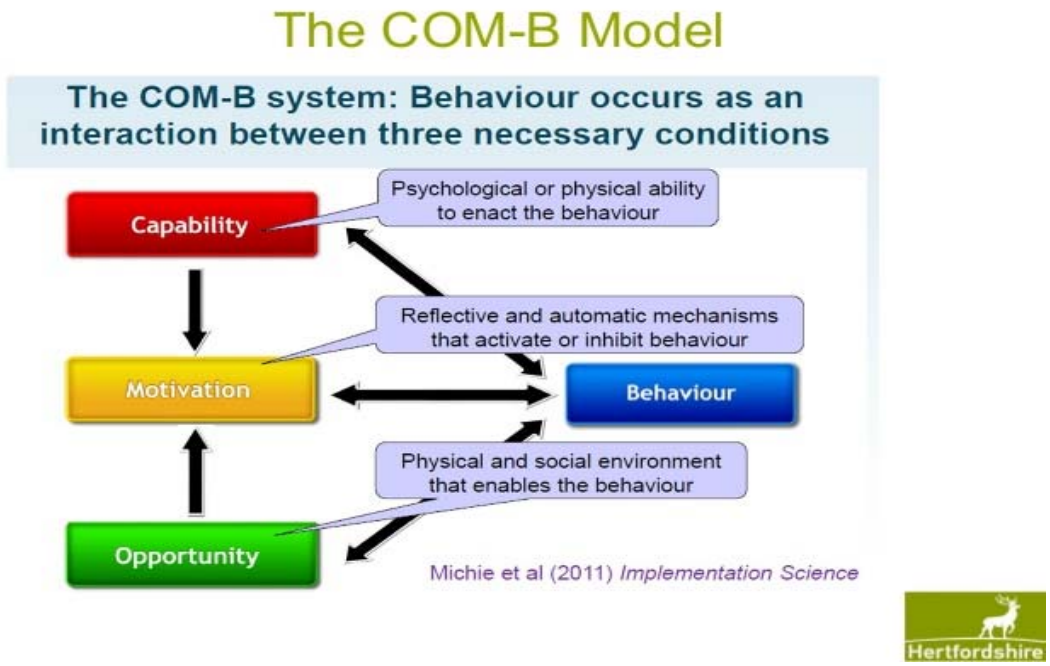


Additionally, Michie et al. (2011) formulated the COM-B "behavior" system for understanding behavior in the context of the BCW framework. COM-B stands for capability, opportunity, motivation, behavior with the following definitions:

Capability= "an individuals psychological and physical capacity to engage in the activity concerned, includes necessary knowledge and skills"

Opportunity= "all of the factors that lie outside the individual that make the behavior possible or prompt it"

Motivation= "all those brain processes that energize and direct behavior, including habitual processing, emotional responding, as well as decision making an goal setting"



This framework will be utilized for both the understanding of barriers to good nutrition and physical activity in rural Kentucky counties, as well as for the design of

an app-based intervention aiming to produce weight loss in counties with high rates of obesity.

Part I: Review of Technology-based Interventions

Perhaps one of the greatest challenges facing the obesity epidemic is the high prevalence of obesity in rural populations. Rural communities, and in particular Appalachia are associated with higher rates of obesity, and greater geographic isolation making face-to-face weight loss programs difficult. Despite geographic isolation and the stereotype that rural areas are isolated and "off the grid," a random digit dial (RDD) survey of rural Kentucky counties indicated that the majority of residents in these areas have access to the internet or a smartphone (Gustafson et al., 2017). Furthermore, in a telephone survey of 400 adults in Appalachian Kentucky indicated that nearly 70% of respondents were interested in losing weight (Webber and Quintilliani, 2011). Several behavioral strategies have proven effective in face-to-face weight loss interventions, However, translating these strategies into technology-based interventions has proven to be a challenge. Here we will review the current literature on technology-based weight loss interventions using the following constructs:

Self-monitoring

Social support

Tailoring

Self-monitoring

Wharton et al. (2014) examined the effects of technology-based self-monitoring with traditional (pen and paper) self-monitoring techniques.

Participants were instructed to record their dietary intake daily for eight weeks using either a pen-and-paper, a popular tracking app “LoseIt!” or a memo recording feature on their smartphone. While there was no change in weight of BMI across any of the groups during the 8-week trial, there was significantly greater entry completion amongst participants who used the app, compared to those who used either the memo recording or the pen and paper. Although the study only worked with a small group of participants (n=57), they were able to achieve meaningful results as they stratified the participants based on age and gender. They also conducted their analyses controlling for age, eliminating any error that could have been generated by younger participants who were more inclined to use smart-phones and apps. One limitation of the study, however, is that it was only conducted for eight weeks. While this short duration might explain the no significant changes in weight or BMI amongst the groups, it also makes it difficult to determine whether or not these self-monitoring behaviors would be sustained for longer periods of time. Many studies have shown that self-monitoring is extremely beneficial in weight-loss interventions (Burke et al., 2011; Tate et al., 2001; Womble et al., 2004).,However, as with many weight-loss behaviors, the weight loss is often not sustained, leading to weight regain. This study provides an excellent launching point for further investigation as to ways in which technology-based tracking may help overcome barriers associated with traditional tracking and ways in which it can be utilized to sustain self-monitoring behaviors.

Social support

A study by Svetkey et al. (2008) contrasted the effects of weight-loss maintenance via "self-directed" (website-based) support compared to personal contact support. All participants underwent an initial weight loss intervention that consisted of 20 weekly group meetings with an interventionist that provided education on calorie reduction, physical activity and reduction of cardiovascular disease (CVD) risk factors. During this period 1029 participants were also instructed to keep food diaries and record physical activity. In the following 30 months, participants were then assigned to a self-directed (no follow-up) technology-based (interactive website) or personal contact weight-loss maintenance intervention. All participants lost weight during the initial weight-loss intervention, however nearly all participants regained about 50% (1-3 kg) of the weight lost. Within the first 18 months of weight-loss maintenance, both the website-based and personal contact interventions showed a significant reduction in weight regain compared to the self-directed (control) group (-2.3 and -1.0 kg respectively, compared to control). However, at the 24 and 30 month time points, these effects were no longer seen. Although the researchers were not able to elucidate the effects they had hoped (contrasting personal contact vs. technology-based weight-loss maintenance interventions), the findings provide valuable insight as to the design for future interventions. For the sake of time and cost, most weight-loss studies do not extend beyond one year of treatment. Furthermore, most weight-loss *maintenance* studies do not extend beyond two years. Had the researchers capped the weight-loss maintenance intervention at one year, they would have likely concluded that both the technology-based and personal contact interventions showed similar efficacy in

preventing weight regain. Their elongated study designed allowed for the results to provide a broader, although disappointing, perspective as to the true nature of weight regain, which opens the door to further investigation as to the true barriers of weight loss maintenance.

Perri et al. (2008) conducted a similar study in rural communities with high rates of chronic diseases that were also deemed "Health Professional Shortage Areas." In their 3-armed study, Perri et al. (2008) enrolled 234 participants into a 6-month weight loss program which included calorie reduction and increased physical activity counseling, as well as education and instruction on goal setting and self-monitoring behaviors such as logs and weigh-ins. After the initial 6-month interventions, participants were randomized into either education-only, telephone or face-to-face extended-care conditions for an additional 12 months. Education only groups received only biweekly educational emails, while the telephone and face-to-face groups underwent biweekly interactions with nutrition counselors to proved problem solving strategies. The goal of the study was to compare the effects of technology based (education control), remote (telephone counseling) and face-to-face counseling on weight loss and weight loss maintenance for the duration of one year. The study result showed that all participants lost weight during the initial 6-month intervention, and similarly most participants regained weight in the following year. However, participants in either the telephone or face-to-face counseling groups regained significantly less weight than participants ($p<0.05$) in the educational control group, suggesting that technology-based extended-care

interventions are less efficacious in preventing weight regain than interventions that involve personal contact.

One limitation to the Perri et al. (2008) study is that the extended-care intervention was only conducted for 12 months. Svetkey et al. (2008) study, initial reductions in weight retain seen at 12 and 18 months post-intervention were eliminated after 24 months. Furthermore, the results from these two studies (Perri et al., 2008; Svetkey et al., 2008) present conflicting results, suggesting that the effects of maintenance counseling on weight regain are far more complex than whether they are delivered in person or via a technology-based medium. In the Perri et al. (2008) study, reductions in weight regain in the telephone and face-to-face interventions was mediated by an increased adherence to self-monitoring behaviors such as dietary and activity logs. All participants in this study were educated on the same self-monitoring techniques during the initial weight-loss intervention, and encouraged to continue these behaviors during the extended-care interventions. Therefore, it is possible that technology-based interventions that provided more tailored feedback toward self-monitoring behaviors may prove more efficacious than ones that provide simply educational materials.

Tailoring

Tailoring behavior change information to the unique needs of individuals has proven an effective method of approach for multiple health-related behaviors (Stretcher et al., 1994) as well as weight-loss (Kreuter et al., 1999). Tate et. al. (2006) examined the effects of tailored email counseling on weight-loss. This three-armed study looked at the effects of tailored, weekly email feedback from either an

automated computer algorithm, a human nutritional counselor or no feedback. Algorithms were based off of diary entries regarding diet and exercise habits, access to which was provided only to the two groups receiving weekly feedback. Weigh-ins at three months showed that participants in both email interventions exuded statistically greater weight loss (-5.3 ± 4.2 kg and -6.1 ± 3.9 kg respectively) than participants in the control group (-2.8± 3.5 kg). Furthermore, weigh-ins at six months showed that only the group receiving human email counseling showed statistically greater weight-loss (-7.3± 6.2 kg) compared to computer generated email (-4.9 ±3.9 kg) and control (-2.6 ± 5.7 kg) groups (Tate et. al., 2006). This simplistic study design allowed for the direct comparison between technology-only based feedback vs. human generated. The design of the algorithm based on diary entries was also extremely complex and dynamic allowing for the multiple facets of eating and weight loss behaviors to be addressed. However, one major limitation was the lack of diary availability to the control group. Many studies have shown that self-monitoring aids in weight loss and diet adherence (Burke et al., 2011; Tate et al., 2001; Womble et al., 2004). Therefore the lack of self monitoring opportunities could be mediating the results seen within the tailored feedback paradigm.

Tessaro et al. (2007) conducted a study to examine the effects of a computer-based nutrition education intervention in a rural community in West Virginia. During their three month study, participants were randomly assigned to a control group which received no counseling, only baseline and follow up interviews, or the intervention group, which was given access to the *Cookin' Up Health* interactive website that contained recipe demonstrations and nutritional information

specifically aimed to increase fruit and vegetable consumption as well as reduce dietary fat intake. Although their study did not find any differences between the groups in terms of fruit and vegetable or fat consumption patterns, they did find that women in the intervention group were significantly more inclined to show readiness (based on the transtheoretical model of behavior change) to consume the recommended five servings of fruits and vegetables than women in the control group. They also exhibited higher scores on knowledge about dietary fats and food labels. One limitation of this study was the fact that the participants were recruited from primary care clinics, meaning that they all had access to health care and presumably, transportation. One of the greatest drivers of health disparities in Appalachia is the lack of access to healthcare (Perri et al., 2008; Schoenburg et al., 2008). Therefore these participants may not be fully representative of their communities at large. Another limitation was simply that the study was conducted with only women, however similar studies have claimed that Appalachian women are the "health gatekeepers" of their households (Schoenberg et al., 2008) so this may have been an intentional design. However, the authors do not explicitly state it as such.

While the study did not produce the behavioral changes that the authors had hoped for, their results do show a change in mentality, which as the authors put, "shows potential as a strategy to begin the process of change." (Tessaro et al, 2007). Tessaro et al. (2007) were also able to identify key barriers to dietary change (lack of availability, high cost, families not wanting to eat them and disagreement that people need five servings of fruits and vegetables in a day), that are perhaps

somewhat region-specific. While the issue of availability and cost of fruits and vegetables are prominent in urban environments as will be discussed in the next section, they are compounded by preconceived notions of what constitutes healthy eating and deeply rooted cultural traditions surrounding food in rural environments, particularly Appalachia (O'Brien et al. 2013; Tessaro et al. 2007). One challenge to addressing health disparities in Appalachia, is the presence of such region-specific barriers. Tessaro et al. (2007) provide strong evidence that technology-based interventions show promise in creating a bridge between education and research and those areas that need it most.

Part II: Description of Target Audience: Rural Kentucky

As previously discussed, there are several barriers to quality nutrition and physical activity that are unique to rural areas, in particular Appalachian Kentucky. The four that will be discussed here are: perceptions of health and obesity-associated health risks, poverty, access to fresh fruits and vegetables, and cultural/traditional values associated with food.

Perceptions of Health and Obesity-associated Health Risks

While the facts and figures of health disparity in Appalachia may seem to speak for themselves, many interventions have failed to place them in the context of the rich history and the deeply-rooted cultural values of this region. Schoenberg et al. (2008) put forth a groundbreaking study in which they sought to gain a better understanding of how the *communities themselves* perceived health disparities in their area. After conducting focus groups in four Kentucky Appalachian counties, they found that most communities were most concerned about drug abuse, followed

by cancer, heart disease/diabetes, smoking, poor diet/overweight/obese and lack of exercise. The ranking of these perceived health threats sheds some light on the fact that perhaps the connection between poor diet, overweight and obesity and lack of physical activity to other chronic diseases such as cancer, heart disease and diabetes is not abundantly clear in these communities. Evidence from these focus groups suggests that interventions designed to educate communities as to the connection between diet quality, physical activity and chronic disease management may in fact prove more effective than those focused on weight loss, nutritional counseling and increasing physical activity. The link between nutrition, physical activity and the prevention of chronic disease is often glossed over by researchers and interventionists as it appears to us as seemingly obvious. Furthermore, the biomedical mechanisms involved are often extremely interwoven and complex. However, if this relationship were to be elucidated somewhat further, it may serve as a motivator for improvements in diet quality and increased physical activity in Appalachian communities. As with Tessaro et al. (2007), limitations include the fact that the study was conducted with all women participants and those women were of higher educational and income status than their community averages, suggesting that they may not be a fully representative sample. Furthermore, they were recruited on a volunteer basis lending to a possible self-selection bias.

Ely et al. (2011) followed up on this notion in a cross-sectional survey study that compared Appalachian perception of health status with objective measures of health such as BMI, frequency of physical activity and fruit and vegetable consumption. Although the study was limited by self-report measures, which are

inherently subjective, nearly 75% of the participants indicated their BMI as overweight or obese. Furthermore, nearly 70% of participants admitted to engaging in no physical activity in the past week, and almost one third indicated that they had not had a fruit or vegetable in the last 24 hours. Ironically, over 70% of respondents also reported that they perceived themselves to be in good health. These findings expand upon those of Schoenberg et al. (2008) in that they speak to the disconnect, not only between diet and exercise habits and chronic disease, but also in the definition of "good" health. Ely et al. (2011) suggest that part of this disparity could be due to the fact that the majority of the population in these areas are obese or in poor health and that this is perceived as "normal." While this explanation seems plausible, further research is needed to fully elucidate the discrepancy between perception of healthy lifestyle choices, what is scientifically known about maintaining good health and the prevention and management of chronic disease in rural Appalachian counties. Furthermore, focus groups conducted by Coyne et al. (2006) amongst rural West Virginians identified a resistance to discuss health and health-related issues with professionals and individuals outside of the family, suggesting a possible reason for such widespread lack of health knowledge. However, this qualitative study presented largely antidotal evidence from a very small region. As such, it cannot be generalized to other regions, nor can it be associated with true dietary and health-related behaviors or health outcomes. In addition to lack of knowledge or misconceptions about healthy lifestyle choices, other barriers include extreme poverty, lack of social support, access to fresh fruits and vegetables and cultural values associated with food and food traditions.

Poverty

Rural areas, in particular Appalachia tend to be associated with increased rates of poverty, unemployment and government assistance (Appalachian Regional Commission, 2009). Therefore, it makes intuitive sense that such low-income households would be restricted in their choices for food purchasing and options for physical activity. Ironically, Brown et al. (2012) found in a study of low-income Appalachian families that it was in fact family role expectations and intra-family power dynamics that governed food choices, rather than cost. Participants were randomly assigned into either a control group that only received handouts and recipes via mail, or experimental group, which attended weekly hands-on cooking instructions. Based on qualitative interviews conducted with participants in each group, the key barriers that affected vegetable choice and vegetable consumption were those more closely tied to rules, role expectations and power dynamics. For example, the authors stated that a common theme amongst both groups was the expectation for a meat and potato base for the meal. Furthermore, food preparers felt the expectation to serve food that everyone in the family would like and often valued the preferences of more powerful family members over nutritional value. Other barriers identified were time/convenience and lack of availability or knowledge as to how to use certain ingredients. While this study conducted extremely thorough qualitative analysis of family dynamics, the analysis was not in any way stratified for income or geographical location, both of which may present mediating variables. An additional limitation is that despite the classification of low-income, the participants in this study all had the time and means of transportation

to attend weekly lessons. This might suggest that they may not be truly representative of the low-income population at large in these areas, that they may or may not have access to transportation and may work multiple jobs to maintain household bills.

Similar to the study conducted by Brown et al. (2012), Rye et al. (2009) examined the perceived barriers to physical activity among low-income Appalachian populations. This cross sectional study collected BMI as well as sociodemographic data of West Virginian women, as well as issued a survey asking about their stage of readiness to change their physical activity patterns as well as perceived barriers to physical activity. Results from the survey indicated that lack of social support and lack of willpower were the primary barriers reported to physical activity. Furthermore, willpower also significantly differed from different stages of readiness to change, suggesting that as willingness to change increases, so does willpower. Taken together, these results suggest that it is the mentality towards physical activity, rather than cost or access to facilities that limit physical activity in these regions. However, this was a cross-sectional study done in older women (aged 40-64). Gender and age differences could play a huge role in attitude towards physical activity, and as such, this sample cannot be generalized to the low-income, Appalachian population at large. Furthermore, as a cross sectional study it only provides a one-time glance as to perceived barriers but does not reflect actual activity nor does it imply habitual behavior or mentalities.

Access to fresh fruits and vegetables

Poverty and lack of access to quality, nutritious food often go hand in hand when discussing barriers to diet quality. These constructs have been studied extensively in urban environments (Morland et al., 2006; Zenk et al., 2005). However, their role in rural environments is still not clearly understood. Gustafson et al. (2012) conducted a secondary analysis of the neighborhood deprivation index (NDI) and the neighborhood retail food environment (RFE) in 14 Appalachian counties. While these indexes have been validated and utilized in other work, their sensitivity has not been widely tested in rural environments. As the analysis points out, these measures are both applicable and sensitive when it comes to "traditional" grocers (supermarkets, grocery stores and super centers), but are far less sensitive when it comes to "non-traditional" grocers (fast food chains, gas stations with food marts and farmer's markets) which are commonplace in rural areas, particularly Appalachia. As such, the study points to the need for better assessment tools to measure the food environment in rural areas, particularly Appalachia. Although the study did not find a significant correlation between neighborhood deprivation and retail food environment, the authors analyzed stratified data by store type and noted a trend for neighborhoods with low levels of neighborhood deprivation were less likely to have supercenters or convenience stores in their neighborhoods compared to neighborhoods with high neighborhood deprivation. While this trend could explain a phenomenon of limited access to, and there for limited consumption of, fresh fruits and vegetables in highly deprived neighborhoods, the lack of an overall association suggests that it is not perhaps the retail food environment in Appalachian communities that leads to poor dietary habits, but rather food

preferences. Furthermore, while the study does assess, to some extent, the food environment in Appalachia, it is limited to geographic data, which does not necessarily reflect food-purchasing or consumption habits.

In another study, Pitts et. al. (2014) surveyed farmer's market patrons in Appalachian areas of North Carolina and Kentucky. The survey contained questions regarding purchasing habits, socio-demographic data and typical fruit and vegetable consumption patterns, as well as perceived barriers to farmers market shopping and these results were compared to results of a random digit dial (RDD) survey conducted in the corresponding counties. They found a positive association between frequency of farmer's markets shopping and self-reported fruit and vegetable consumption. However, this did not correlate to BMI. As with Gustafson et al. (2012), this lack of association could point to dietary preference, rather than access, as a barrier to fruit and vegetable consumption. According to the Pitt et al. (2014) study, commonly reported barriers to farmer's market shopping were market days/times/locations. While the study did a great job of breaking down the themes and identifying some key barriers to farmer's market purchases and likely fruit and vegetable consumption in Appalachia, these measures, as well as the BMI data were all self report, lending to the potential for social desirability bias.

Cultural/traditional values associated with food

While access to fresh fruits and vegetables inevitably plays a role in the dietary habits of Appalachians, as was shown by Gustafson et al. (2012) and Pitts et al. (2014), the association is not abundantly clear. In a recent dimensional analysis of obesity amongst Appalachian women, O'Brien et al. (2013) summarized

Appalachian culture as being rooted in family, tradition, religion and pride. Furthermore, the authors cite several studies that have found a distrust of outsiders and foreigners (Coyne et al., 2006). Similarly food traditions in Appalachia remain a constant theme amongst much Appalachian research. Hhowever, it has received little formal investigation. In 2005, Barbara Shortridge conducted a survey in 201 Appalachian counties in which she asked participants to prepare a meal that was representative of their culture. Overwhelming themes were the use of potatoes, which was apparent in 98% of participating Kentucky counties plus the use of sweetened ice tea. The primary vegetable options were green beans, corn and coleslaw. Taken together these data suggest that food preferences in Appalachian counties are closely tied to a sense of identity and heritage. Furthermore the lack of nutrient quality, while at one time may have been the result of poverty or lack of access, the continued prevalence of these food choices suggests that their cultural and traditional ties are more influential than their nutritional content.

Knowledge Gap

Addressing the epidemic of obesity in rural and Appalachian regions is a dire public health concern. In spite of the knowledge within the scientific communities regarding utility of technology-based weight loss interventions, as well as the social and cultural factors affecting obesity in these areas, little research has been done to connect the two for more efficacious health outcomes.

Research Methods

Target population:

The current study was part of a larger comprehensive study examining the drivers of obesity in rural Kentucky communities (see Gustafson et al., 2017). This largely qualitative study was designed to identify and target obese populations in rural Kentucky counties with a high proportion of obese residents (> 40% of the adult population). Six counties (Elliot, Logan, Martin, Letcher, Lewis, Clinton) were identified based on 2012 data from the Behavioral Risk Factor Surveillance System (BRFSS). With the help of county-based Family and Consumer Sciences (FCS) extension agents, coalitions of community stakeholders were formed in each county. Coalition meetings were conducted in each of these six counties and community members were asked about desired programs and interventions to help reduce the rates of obesity in their communities. after a series of discussions, community members were asked to prioritize intervention options from a menu of options. These options included providing Plate it Up! Recipe cards and demonstrations at farmer's markets, forming liaisons with food retailers to offer discounts on healthy food items, a nutrition and physical activity wellness website or phone app, improvements to the physical activity environment, Better Bites/Snack Smart, gardening programs and VERB Summer Score Card (for extensive list see Butterworth, 2016). Of the six total counties, three (Martin, Logan, Elliot) showed interest in participating in the development of a website and phone-app to help reduce obesity related behaviors and promote weight loss. Within these counties, FCS extension agents recruited participants to participate in the development and testing of a website/phone-app designed to target region-specific barriers and drivers of obesity-related behaviors as well as desired

features for the website/phone-app. Recruited participants were male and female adult community members.

Formative Assessment: Identification of region-specific barriers of good nutrition and physical activity as well as desired features of website and phone app

One focus group was conducted in each of the three counties and each contained 6-10 participants. Participants were informed that participation was voluntary and read an oral consent form (See Appendix). The focus groups were led by a skilled facilitator and followed the focus group guide (See Appendix A). Questions focused on barriers to good nutrition, physical activity and desired features of a website/app aimed to target both. Focus groups lasted approximately 60 minutes in length, and participants were not incentivized to attend the focus groups. At least two researchers were present at each meeting and took notes using the focus group protocol. All sessions were audio recorded for transcription.

Verbatim transcripts were created from audio recordings from all three focus groups and individually coded using Strauss and Corbin (1994) grounded theory methodology. Briefly, each transcript was coded by two coders to generate a codebook. In the case of a discrepancy, a third coder was utilized. Themes and subthemes from the codebook were used to assess the region-specific barriers to good nutrition and physical activity as well as desired features of the website and phone app. All protocols were approved by the University of Kentucky Non-medical Institutional Review Board (IRB).

Development of Web-app

Web-app development was conducted with the assistance of Cornett, a local advertising agency in Lexington, Kentucky. Software development was conducted with the assistance of Apax Software also of Lexington, Kentucky.

Based on the result from the focus group assessment, functions were built into the web-app (FitFaceoff) to address barriers to good nutrition and physical activity, as well as desired features. Briefly, features such as individual or group competitions, recipes, physical activity videos, community calendars and check-in points were unique to FitFaceoff and were based off of the formative assessment of community needs and barriers. Additionally, accurate nutrition tracking was provided using a USDA database. Furthermore nutrition quizzes were provided on a weekly basis to assess nutrition knowledge. Logging nutrition and physical activity as well as completion of weekly quizzes resulted in points scored for individual or team competitions.

Assessment of feasibility of app-based intervention

Upon completion of the build-out, a beta-version of the web app was introduced into the three counties via emailed instructions to FCS extension agents. To evaluate the success of utilizing a formative assessment to address region-specific barriers, FitFaceoff usage data was tracked for the subsequent 4 months (November 2016- February 2017) using Google Analytics ™. User demographic data was also tracked to determine which sub-populations responded best to the web-app and to guide future improvements.

Results

Formative Assessment: Identification of region-specific barriers of good nutrition and physical activity as well as desired features of website and phone app

Predevelopment qualitative analysis consisted of coded transcripts from focus group meetings conducted in each of the three counties. A total of 32 participants participated in the 3 group sessions of which 2 were males and 30 were females. Coding of the transcripts (see Appendix D for codebook used) identified two major themes: barriers to good nutrition and physical activity, and wish-list/desired web-app features (see Appendix D). Barriers to good nutrition and physical activity were categorized under three sub-themes: convenience, availability/knowledge and cultural traditions. Desired web-app features were similarly categorized into three sub-themes: technical function, community engagement and education.

Theme 1: Barriers to good nutrition and physical activity

Subtheme 1.1: Convenience. Many participants stated that busy work schedules, lack of time to prepare meals at home and involvement with children's extracurricular activities took away from time to dedicate to physical activity and good nutrition. Several participants also indicated that due to lack of time, meals and mealtimes were usually not planned in advance. As a result, they often turned to convenient, but unhealthy, food options such as fast or processed foods.

> *What's convenient. And you're not even to the point of thinking about it. You know oh I've missed lunch and its 2 o'clock I'm starving and there's McDonalds (Community member, Logan County).*

Subtheme 1.2: Availability/ knowledge. Many participants expressed frustration with having to drive out of town to find ingredients for many recipes. Similarly, many stated that local grocers do not stock many fresh foods. Several

participants also made the point that many young adults do not know how to prepare foods from scratch, which they felt drove the local food market to supply even more processed or pre-prepared, (less healthy) foods.

> *We were, talking about young people not being able to prepare their food, giving out God's pantry food drop… but there was this young girl, she was probably 16 or 17 and she was with a guy, and she got a roast, a very nice roast, and she came up to me and said "I have no idea how to cook this" and I looked at her and said so I literally got her some carrots, and onion and potatoes and said "put it together." And told her about how long and all of that. And she looked at him and said "I think I can do that" And it was sad. It has stayed with me. (Community member, Elliot County).*

> *I don't think now there's a lot of people that know how to fix those things. We've gone through a generation that of family hasn't done it together so I think that they don't know what to do with that corn on the cob that's still in the husk (Community Member, Elliot County).*

Subtheme 1.3: Cultural traditions. Nearly all participants spoke to the cultural values and traditions surrounding food in their communities. Participants indicated that food was a focal point of social gatherings, and used as an expression of love, affection and gratitude.

> *But in our culture to socialize- we eat. (Community Member, Elliot County).*

> *I think we use food, as our celebrations, eat with friends. Nobody used food for fuel they use it for rewards. (Community Member, Martin County).*

Participants also noted that the kinds of foods often prepared are very deeply tied to traditional norms. Specifically, foods high in starch and prepared using fats

such as butter and lard were identified as staples among most households. Participants also indicated that such foods and recipes had been passed down for generations, and as such carried with them sentimental value.

> *I think we also need to look at food preparation. We like to rely on a lot of starches. We're a potato area….And we've always had them, it's cultural. Potatoes are part of every meal. (Community Member, Elliot County)*

> *Well we eat a lot of fried things too. Instead of baked or grilled, we fry everything. (Community Member, Elliot County).*

Theme 1 Summary: Most participants alluded to the fact that cultural traditions, family recipes and "comfort foods" were the primary driver of food choices. However, many also acknowledge a need to incorporate healthier foods and more physical activity into their lifestyle. Those who expressed a willingness or desire to make such modifications felt that they were unable to due to time restrictions (convenience), lack of availability of healthier foods at local retailers, lack of knowledge as to how to prepare healthier options.

Theme 2: Desired Features

Subtheme 2.1: Technical Functionality. Nearly all participants indicated a desire for a calorie and weight tracking capabilities. Some participants inquired about the possibility of a bar code scanner or using photographs to estimate calorie content rather than using a search engine. Participants also requested having a visual representation, such as a graph, to represent weight gained or lost over time as well as calories consumed/burned throughout the day.

In addition to tracking, many participants requested the use of prompts as either reminders or rewards. While there was some concern about the prompts

becoming overwhelming and annoying, most participants agreed that if they could be customized or set by the individual they would be beneficial. Suggested reminders included meal/snack time reminders, water consumption, fruit and vegetable intake and exercise reminders. Suggested rewards included meeting daily fruit and vegetable intake goals, meeting activity level goals, meeting calorie intake goals and logging for several consecutive days.

> *because a lot of times when I walk in the office the phone starts ringing and I start thinking about everything else I need to do, and if my husband texts me, if I hear my phone do something, I'll stop and I'll look. And if I have that thing "oh have you eaten?" I could say "oh, what time is it? no well I haven't." (Community Member, Logan Co.)*

Subtheme 2.2: Community Engagement. Participants indicated a strong desire to utilize FitFaceoff for community engagement. Most wanted to have a way to communicate with other users via check-ins, recipe reviews, or message boards. It was also suggested to have the app link with the users' Facebook account so that information could be transferred to community members not using the app.

> *One place to find recipes, that are actually quick and easy and do not require you to drive to Nashville to a whole foods store to buy specialty items. We have found, actually through Facebook, meals that you put in a crockpot or a freezer meal, that you put in and you assemble it on Saturday and you put it in your freezer to where you just pull it out and you put it in the oven or you put the bag and the crock pot and you're done. That way when I walk in the door at home for supper, I have supper cooked, and I know I don't have to stop by*

wherever on the way home and pick it up, because we're going to be leaving. If people had easy access to that…and then it could be one that people could go in and say "yes I've tried this" and rate it. Because you can go to allrecipes.com and you can type in what have I got in my pantry, and it will throw up different recipes and people have rated them. (Community Member, Logan Co.)

I think for people who are walking who wouldn't mind having someone to walk with…like if you wanted to go for a walk, and I normally go by myself, and I could just see if there's anyone in here who wants to go with me. (Gwenda Johnson Elliot Co. FCS Extension Agent).

Subtheme 2.3: Education. Most participants indicated the need for an educational component of the web-app. Suggestions included daily tips or food facts. Specifically, "did you know?" prompts were suggested as a way of integrating nutritional information into the app. Nearly all participants indicated a desire for simple, healthy recipes, as well as recipe substitutions for ingredients that may not be available in rural areas, or that are too expensive. Many also suggested family activities or ideas for educating children on healthy food choices. Several participants also requested exercise ideas, workout plans or demonstration videos.

I think you need to add a family, push family connections, like a family night. like Respondent #7 said, our society is different, just like us sitting around this table, there will be one night this week that I will be home. Every other night my kids will be home feeding themselves and doing laundry and all of that stuff, but if you can a family connection, and not everybody may do it, but a family meal, if you could have how can you get the kids cooking certain foods. Because a lot of times families go home and a lot of times will be on their phone. A family activity a long with that family meal to kind of bring every body

together so that its not just homework that everybody hates. (Community Member, Elliot Co.)

Summary of Theme 2: Overall participants expressed a desire for a web-app that functioned like many currently available health and wellness apps, but also contained components unique to their community. Many participants also expressed an interest for accurate resources for health and wellness information

Assessment of success of app-based intervention

The beta-version of FitFaceoff was made publically available in September 2016. At this time FCS extension agents were made aware of its availability, however it was not publically advertised until mid-December 2016. Google Analytics™ software was used to track the success of the web-app in terms of 1) usage and 2) user interaction on a month-by-month basis. Two key variables- number of users and number of sessions- were utilized to determine usage. Number of users is defined as the number of users interacting with web-app during a specified period of time. Number of sessions is defined as the number of individual sessions opened during a specified period of time. Three key variables- average session duration, pages per session, and bounce rate were utilized to determine user interaction. Average session duration is defined as the average duration of individual sessions during a specified period of time, pages per session is defined as the number of pages of the web-app each user interacts with during a single session and bounce rate is defined as percentage of sessions opened without any interaction with the web-app. Table 1 outlines the results of key variables used to assess usage and user interaction. Compiled user demographics indicate that women used the

site more than men, with 67% of all users being female and 33% of all users being male (data not shown). This trend is reflected each month with more women than men using the web-app. As can be seen from Table 1, usage prior to advertisement in mid-December minimal, with only 127 users engaging in 250 sessions. However once advertising began December 26, 2016 use increased to 312 users engaging in 475 sessions. An increase in session use as well as number of users could indicate that not only are more individuals interacting with the web-app, but they are also interacting more often. However user interaction, as measured by average session duration and pages viewed per session the average duration decreased from 2 minutes and 23 seconds to 41 seconds, suggesting that interactions with the web-app grew shorter. Additionally the average number of pages viewed per session decreased from 4.4 to 2.1. This trend is further replicated by a two-fold increase in bounce rate from 40.1% to 81.7%.

Usage, continued to increase in January with 2,252 users engaging in 3,253 sessions. Of these, nearly 2/3 (65.8%) were new users. Age and gender demographics remained consistent with previous months. Interestingly, the average session duration dropped to 51 seconds and the average number of pages view per session decreased to 1.68. Similarly the bounce rate increased to 86.5%. Usage rates dropped in February with only 466 users engaging in 870 sessions. Fifty percent of users were new users. Interestingly, during February average session length was 6 minutes and 25 seconds, with an average of 9.8 pages visited per session. Consistent with this finding was a reduced bounce rate of 37%.

Tables 2 and 3 further elucidate the demographics of user trends by age (Table 2) and month (Table 3). There was a fairly even spread of usage across users aged 18-65+. Users aged 25-34 years old took up the largest percentage of use with 23.1% of total sessions. This age group also engaged with the site more as indicated by longer average session duration (2:11 min), more pages viewed per session (3.3) and lower bounce rate (75.4%) than all other age groups. Adults aged 65+ years old made up the smallest percentage of total users (11.6%) and engaged with the site the least as indicated by shorter average session duration (0:30), fewest pages viewed per session (1.6) and the highest bounce rate (91.3%) of all age groups.

Table 1. Overview of FitFaceoff Usage

Month	# Users	Male/ Female (%)	% New	#Sessions	Average Duration(min)	Pages per Session	Bounce Rate
November	132	74.3/ 25.7	39.2	309	3:26	4.2	22%
December Pre Advertising	127	42.1/ 57.9	41.6	250	2:23	4.4	40.1%
December- Post Advertising	312	33.2/66.8	34.7	475	0:41	2.1	81.7%
January	2,252	38.1/ 61.9	65.8	3,253	0:51	1.7	86.5%
February	466	40.5/59.5	50.8	870	6:25	9.8	37%

Table 2. Compiled FitFaceoff User Demographics by Age (Nov 1.- Feb 28)

Age	% Total Sessions	Average Duration (min)	Pages per Session	Bounce Rate
18-24	13.7	0:53	2.0	81.4%
25-34	23.1	2:11	3.3	75.4%
35-44	18.0	1:48	2.7	80.5%
45-54	17.0	1:18	2.8	78.3%
55-64	16.6	1:40	2.7	78.4%
65+	11.6	0:30	1.6	91.3%

Table 3. FitFaceoff User Demographics By Month

	Average Duration (min)				Pages per Session				Bounce Rate			
Age	**Nov.**	**Dec.**	**Jan.**	**Feb.**	**Nov.**	**Dec.**	**Jan.**	**Feb.**	**Nov.**	**Dec.**	**Jan.**	**Feb.**
18-24	1:38	0:37	0:50	2:37	2.8	2.1	1.6	7.2	44.7%	81.1%	86%	44.5%
25-34	2:45	2:27	1:28	5:07	6.5	3.4	2.2	7.6	60%	73.1%	85%	45.7%
35-44	-	1:34	0:51	5:37	-	2.8	1.3	7.2	-	77%	91%	45%
45-54	-	0:18	0:46	3:43	-	1.9	2.0	5.4	-	85%	85%	50.6%
55-64	-	0:11	0:58	5:38	-	1.7	1.6	7.9	-	81%	83%	57.7%
65+	-	1:00	0:19	1:39	-	2.6	1.9	4.4	-	90.9%	94.5%	68.3%

Discussion

Taken together, the data from this study highlights the need for more/better resources for rural residents in Kentucky regarding quality nutrition and physical activity. This supports previous data collected by this group (Gustafson et al.,2017), as well as others (Behringer, B., and Friedell, GH., 2006; Schoenberg, Hatcher, & Dignan, 2008). While it is well established that diet quality and physical activity are vital components to a healthful life, lack of access and understanding have left certain areas to suffer the health consequences of poor diet and physical inactivity. Management of the resulting chronic diseases such as obesity, diabetes and cardiovascular disease creates escalating healthcare costs for both families and society (cdc.gov; Behringer, B., and Friedell, GH., 2006). To this end, technology based interventions offer a connection between evidence-based approaches and geographically isolated regions where access to healthcare and education may be scarce.

Formative Assessment: Identification of region-specific barriers of good nutrition and physical activity as well as desired features of website and phone app

The formative assessment in the current study identified convenience, lack of availability/knowledge and cultural traditions as barriers to good nutrition and physical activity in rural Kentucky communities. These results reflect those of previous work in rural, and more specifically Appalachian, communities (Gustafson et al., 2017; O'Brien, 2013; Rye et. al., 2009; Shortridge, 2005). Due to geographic isolation, it is often assumed that rural areas suffer more than urban in regards to access to healthy foods. However, much research regarding urban food deserts has illuminated the needs for better access and affordability of healthy foods in urban areas as well (for review, see Walker, Keene and Burke, 2010). Similarly, convenience (lack of time) has been identified commonly as a barrier to healthy eating and physical activity in both urban and rural communities (Stankevitz et. al., 2017; Escoto et al., 2012). Cultural traditions however appear to be unique to rural communities, more specifically those located in Appalachia (Schoenberg et al., 2008; Rye et al., 2009; O'Brien, 2013). In these communities, food is seen as a means of socialization, expressing care for one another and an act of kindness or appreciation. Many of the foods preferred for these purposes involve the use if inexpensive, high-calorie foods that are also highly palatable (Shortridge, 2005). Although identifying recipe alternatives that maintain the palatability of such dishes was not a primary goal of this project, it is certainly an option that should be considered in future research.

Development of Web-App

The advantage to a formative approach is efficiency in allocation of resources. By taking the time to fully understand the challenges and desires of the communities that we sought to serve, we were better able to ensure that we target those items specifically and

effort is not wasted on exogenous or theoretical factors. As previously summarized, participants in the current study expressed a desire for tracking capabilities seen in other weight-loss apps. Additionally, they wished for educational and community engagement components. That said, the present study was limited in that the product developed was a web-app, which differs from a native app in that it does not store information internally. Instead, a web-app draws it from the internet each time the web-app is opened or used. While native apps are arguable more user-friendly, they are also more expesive to develop. Furthermore, separate products must be developed for different devices (i.e. iOS vs. Android products). Therefore, a web-app was developed for the current study due to monetary restrictions that prevented the development of a native app. Like a native app, a web-app can be accessed from any mobile device via the internet browser, and appears virtually the same as a native app. However in the development of FitFaceoff the choice to utilize a web-app introduced several limitations. First, it prevented the incorporation of push notifications, which many participants indicated would be a useful tool. Originally, push notifications were anticipated to be used as a customizable component that could serve as meal/activity/logging reminders or as engagement prompts such as nutrition tips, fun facts and encouragement messages. Absence of these components may have affected participant liking, and subsequent interaction with the web-app. Additionally, because a web-app cannot store data internally on the device, they tend to load significantly slower than a native app. To participants who stated convenience and lack of time as barriers to good nutrition, the cumbersome nature of a web-app may have been unappealing.

In addition to diet tracking basics, participants expressed a desire for community engagement tools such as a community calendar, check-in options and the ability to link

to social media. All of these components were incorporated into FitFaceoff in addition to a competition feature, which allowed participants to compete as part of a team or solo vs. a computer generated “Wally Cat.” Points were earned for logging food and exercise, completing weekly quizzes and visiting check-in points such as the local farmers market or WIC clinic. The hope was that tailoring the web-app to the local community as much as possible would encourage residents to utilize local health-related resources more often. However as previously stated app usage has dramatically dropped. This would imply that residents are either already aware of/using local health-related resources, or that such resources are not effective, and therefore not used. Interestingly, while social media has dynamically changed the way we communicate over the last few decades, rural communities tend to engage in similar social interactions as they did 30 years ago, while the urban dynamic has shifted to include more technology-based interactions and less personal contact. However, in a recent study Goh et al. found that internet communities between rural and urban residents provide highly beneficial interactions for rural residents (Goh et al., 2016). Furthermore, the measures of the present study did not examine the overall efficacy of the web-app in altering weight changes or health outcomes. Therefore we are unable to say whether or not app usage is linked to health benefits

The final component participants expressed a desire for was educational materials. This was incorporated into FitFaceoff in the form of healthy recipes (Stephenson et al., 2013), exercise demonstration videos and sample workout plans. Additionally evidence-based resources regarding health and nutrition were provided along with weekly “nutrition knowledge” quizzes. Here again, the study was limited by

the development of a web-app rather than a native app. Many participants had expressed an interest to provide a “did you know?” section that would provide education regarding health and nutrition facts. However, due to the inability to produce push notifications, this process was not possible with FitFaceoff.

Taken together, FitFaceoff represents our best attempt to meet our participants’ desires and needs, while remaining within our allotted budget and evidence-based restrictions. Because of this, several desired features were not possible. Additionally features such as tracking operated slower than they might on similar products such as MyFitnessPal or Loseit. While they can be beneficial to users, these programs are designed from user experience stand point and developed to generate profit, making them often inaccurate. FitFaceoff is an attempt to remedy that disconnect, however users expecting the user-friendly nature of other market products were likely disinclined to use FitFaceoff as an alternative.

Assessment of feasibility of app-based intervention

Generally speaking, users interacted with FitFaceoff the most during December and January, when marketing campaigns were at their height. Marketing was initiated by Cornett Inc. in mid-December 2016 and consisted of billboards, radio adds and digital media. Following the January surge, there was a significant drop off in use in February. This coincides with evidence from U.S. News and World Report that states gym attendance spikes in January and then steadily falls off until March (www.usnews.com). It is worth noting, however, that while more users engaged in more sessions in late December and January, there was less interaction with the web-app as seen in the reduction in number of pages viewed and session time. Furthermore in February there

was a drop in the number of users and sessions, but the users interacted more with the web-app. This could indicate user disliking or frustration, but identify a subpopulation of users who responded well to the app. Future research should seek to determine the demographics of this cohort and refine the web-app to adapt to their specific needs.

In addition to limitations incurred by the development of a web-app rather than a native app, FitFaceoff was further limited in the timing of it's release. FCS agents had been promised the web-app in early fall, 2016 in hopes of planning a release event in each county in December. However, development took longer than anticipated and although the web-app was released on schedule, it contained several glitches that either prevented users from utilizing all intended features of the web-app, or caused user frustration and dismissal. Furthermore, FCS agent turnover rates were high at the time of the web-app release. Many of the agents who received the app instructions did not have existing relationships with in the counties and therefore were unable to generate user buy-in from community members. What can be taken from this is the importance of communication and planning. Had the researchers spent more time discussing the aims of the FitFaceoff release with FCS agents, as well as bringing them up to speed with the overall project goals and objectives, implementation methods may have been more profitable. Additionally, it may have been more effective to introduce FitFaceoff in small group tutorials, giving participants the opportunity to ask questions and provide feedback regarding onboarding issues, prior to trial initiation. This could have perhaps prevented user frustration and increased user buy-in, altering the results of the feasibility and liking evaluation.

Initially, the evaluation of FitFaceoff was intended to be via focus group interviews in the three counties several weeks after the product launched. However, due to low attendance rates, these data were not viable. Therefore, assessment of the feasibility and liking of FitFaceoff was determined using Google Analytics software, which tracks usage of and interaction with the app by registered users. While this quantitative data is detailed and telling, it is not without limitations. Parameters such as number of sessions, bounce rate, session time and pages per session give insight as to how and how often users are interacting with the app. However the software lacks the qualitative components that give such numbers meaning. For example, users may have a high bounce rate due to poor internet connectivity or frustration experienced while using the app. Similarly, the software does not collate information on a individual, user-associated, basis. Rather it reports totals over designated periods of time. Therefore we cannot assess which users are using the app most frequently or determine trends among users who long in frequently and their interaction type. Therefore in summary, we can accurately describe *how* users interacted with the app, we cannot assess *why* they interacted in such a way. As such, understanding user interaction of the web-app should be the aim of future research.

Summary, Conclusions and Future Directions

All in all, this project provided great insight as to the barriers faced by rural Kentucky residents when it comes to the battle against obesity. Lack of access to healthy foods, lack of knowledge as to how to prepare such foods, and cultural traditions involving unhealthy foods are key drivers. These drivers can be categorized into the various facets in the COM-B model. In some cases residents lack the *capability,* or

knowledge, to prepare healthy foods, lack the *motivation* to change from deeply rooted cultural traditions, or simply live in an environment that does not provide *opportunities* for healthy eating or physical activity. It would be unrealistic to expect dietary habits, and consequent health effects, to change without first addressing these barriers. To address the issues of capability and opportunity, FitFaceoff incorporated educational materials, recipes, physical activity guidelines and a location to connect users with available resources in their counties. To address motivation FitFaceoff tapped into the intrinsic community unity by providing opportunities for community engagement such as check-ins and social media links. Furthermore FitFaceoff incorporated a competition feature, which has been shown to increase health behaviors and weight loss (Leahey et al., 2012). Further research is needed to determine the efficacy of FitFaceoff in rural Kentucky communities. Furthermore, additional qualitative research into the liking and feasibility of FitFaceoff in rural communities will provide insight as to modifications and new features that can enhance user experience and ultimately enhance the efficacy of FitFaceoff.

Appendix: Focus Group Guide for Phone App Development Website and Phone App Development

Focus Group Sign-in Sheet

Name and email (Please Print)	Your Age Group		
	Under 18	19-64	65+

Focus Group Cover Page

Meeting Date	
Location	
Group Facilitator (s)	

Meeting Type (Place "X" in the appropriate box)	Community Meeting / Focus Group (e.g., PTA, Chamber, Service Clubs, Advisory Boards, etc)	Service Provider Group (Public and/or private service providers, e.g., educators/teachers, counselors, health providers, etc.)	Other (describe)	Other (describe)

Meeting Attendance
(Total attendance should be sum of service providers, other stakeholders, family members, and consumers).

Total Attendance	Service Providers	Other Stakeholders	Family Members	Consumers/Clients

Participant Demographics

	Total	White	Hispanic	Black/ African Am.	Native American	Asian	Pacific Islander	Other
Children/ Youth								
Adults (18-65)								
Seniors (65+)								

How was meeting advertised? (Mark all that apply)

Personal Contact		Letters to Groups	
Home Visitors		Newspaper articles/adv.	
Peer to Peer		Flyers	
Others (List)			

Were Incentives Used? No x Yes ___ If yes, please number and types of incentives

	Number provided	
Child Care		
Food		
Other		(Describe)
Other		(Describe)

Focus Group Results Documentation

What do you think are the biggest reasons some people in your community eat more calories than they need each day?

What do you think would help to reduce the amount of calories people eat each day?

How do people in your community stay physically active?

Can you tell me a story about someone who isn't physically active in your community?

Why do you think people aren't more physically active in your community?

What would help people in the community increase their physical activity each day and why would it help?

Phone App

- What online Service or App Service you have used:
- What do you like?
- What do you not like?

- How and when do you use websites containing information on health, nutrition, or physical activity?
- What influences you the most to visit a particular website?
- How and when do you use phone apps?
- Can you tell me a story about the positive experiences you have had with phone apps?
- Can you tell me a story about a disappointment you have had with a phone app

Website and phone app for your community

- What kinds of things would you like to see in a website and phone app for your community?
- What kinds of things should we avoid in developing the website and phone app?
- Is there a characteristic or feature of a health app that would motivate you to access it on a regular basis?
- Of all the things we've talked about, what is most important to you?
- Is there anything that we didn't talk about today that we should have discussed?

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Erin Casey, M.S.
CURRICULUM VIATE

Education

Jan 2018-August 2018 *Dietetic Internship*, Department of Dietetics and Human Nutrition, University of Kentucky, College of Human and Environmental Sciences

2015-2017 M.S. Nutrition and Food Systems, Department of Dietetics and Human Nutrition. University of Kentucky, College of Human and Environmental Sciences

Thesis: Utilization of a Web-based App to Target Obesogenic Factors in Rural Kentucky Counties with High Rates of Obesity

2013- 2016 M.S. Pharmaceutical Sciences, University of Kentucky, College of Pharmacy

2005-2009 B.S. University of Richmond, Richmond, VA
Psychology with Neuroscience Concentration

Research Interests

My current research involves using theory and evidence based behavioral modeling to initiate behavioral interventions in rural, obese populations. Specifically, we are working with UK extention offices in rural counties in Kentucky to help increase physical activity as well as fruit and vegetable consumption. Currently, we are working with the Center for Disease Control to develop a web-based weight and diet-tracking app to be launched in 3 rural counties in Kentucky.

Previously, I have been involved in research in the field of neuropharmacology, specifically in relation to drug development. The main focus of my research was to understand how reward pathways in the brain, specifically dopaminergic pathways, are affected by drugs of abuse, and how these modulations correspond to changes in behavior. Previous work in the lab has found that development of obesity lead to alterations in reward system function. It was also found that motivation for high-fat reward was predictive of obesity. Currently, I plan to expand on this project by determining the role of homeostatic, metabolic peptides in modulating the signaling of dopamine and serotonin neurons using both *in vitro* and *in vivo* models. This in turn could alter the perception of food reward-leading to changes in eating behavior. Other projects in our lab focus on screening novel compounds for the treatment of methamphetamine abuse *in vitro*. Once lead compounds are established, safety and efficacy are established *in vivo*.

Research Experience

2015-Present Graduate Student, University of Kentucky College of Human and Environmental Science

Thesis Mentor- Dr. Kelly Webber
Developing web-based, diet-tracking app as a method of behavioral intervention in 3 rural Kentucky counties with above-average rates of obesity
Funding: Center for Disease Control and Preventions (CDC): DP14-1416

2014-2015 Graduate Student, University of Kentucky College of Pharmacy, Lexington KY

Lab of Dr. Linda Dwoskin
Studying role of reward pathway signaling in the development of drug addiction and obesity
Funding: National Institute of Drug Abuse (NIDA) Training Grant T32DA016176

2013-2014 Completed Rotations:

06/13-08/13 Dwoskin Lab: *Learned* in vitro *and* in vivo *methodologies. Participated in meetings for project involved in screening novel compounds for methamphetamine abuse*
08/13-12/13 Black Lab: *Effects of simvastatin and erlotinib combination therapy on TKI resistant cell lines*
12/13-02/14 Nixon Lab: *Adolescent nicotine and ethanol exposure in a binge model of alcohol abuse*

2010-2012 Research Associate, Illumina Inc., Branford, CT

Responsible for implementing automation in high-throughput screening techniques in context of proteomics development

2007-2009 Undergraduate Fellowship, Univ. of Richmond, Dept. of

Studied effects of polyunsaturated fatty acids (PUFAs) on kinetics of voltage gated (Kv4) potassium channels

Publications

Webber K, **Casey E**, Gustafson A, Bastin S. (2016) Phone app development: Promoting healthy behaviors in a rural obese population. Abstract. *International Society of Behavioral Nutrition and Physical Activity (ISBNPA).* Cape Town, South Africa, June 2016

Webber, Kelly H., **Casey, Erin M.**, Mayes, Lindsay, Katsumata, Yuriko, Mellin, Laurel. (2016). Is stress management a better approach to improving health than a traditional weight loss program? Nutrition (In Press)

Van Skyke, Candice, E., Maggio, Sarah, E., Reynolds, Anna R., **Casey, Erin M**., Prendergast, Mark P., Bardo, Michael T., Dwoskin, Linda P., Nixon, Kimberly. (2016). Critical needs in drug discovery for cessation of alcohol and nicotine polysubstance abuse. *Neuro-Psychopharmacology and Biological Psychiatry,* 65, 269-287.

Boland, Linda M., Dzewiekcki, Michelle, M., Timoney, Gabriela, **Casey, Erin M.** (2009). Inhibitory effects of polyunsaturated fatty acids on Kv4/ChIP potassium channels*, Am. J Physiol Cell Physiol, 296*, 1003-1014.

Service

2015-Present Graduate Assistant-Campus Kitchen Project, University of Kentucky

Teaching Experience

2016-2018 Graduate Teaching Assistant, Department of Dietetics and Human Nutrition, University of Kentucky, College of Human and Environmental Sciences

2013-2014 Graduate Teaching Assistant, University of Kentucky College of Pharmacy, Lexington, KY