EXAMINING THE INCREMENTAL EFFECTS OF PARTICIPANT SPORTING EVENTS IN PROMOTING ACTIVE LIVING: CREATING ACTIONABLE KNOWLEDGE TO TACKLE A PUBLIC HEALTH CRISIS

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ABSTRACT

Using a theoretical synergy between the Psychological Continuum Model (PCM) and Behavioral Ecological Model (BEM), the current dissertation research provides empirical evidence to support that organized participant sporting events can play a significant role in building a healthier community. First, using a proprietary U.S. community-based panel data from 2008 to 2014, study 1 examines the incremental effects of participant sporting events (PSE) in promoting active living at the population level. Panel regression with an instrumental variable approach and Multigroup Latent Growth Curve Analysis were administered. The key findings included (1) these population-based interventions have the capacity to impact population health at the state level; (2) such an influence significantly varies across the United States contingent upon a state's economic development and the geographical region to which a state belongs. In study 2, the Multilevel Mediation Analysis was conducted with a spatially clustered cross-sectional data in 2014. The findings revealed that the access to exercise opportunities at the state level represents the underlying mechanism through which various forms of participant sporting events have the ability to elicit positive effects on health with respects to mental health, physical health, and physical activity participation at the county level. The findings suggested that PSEs represent effective public health platform to create healthier communities through integrating physically active leisure into population's everyday routines. Overall, empirical results also help us better understand the importance of effectively leveraging community sporting events to deliver required health benefits to the general public and create practical guidelines to inform policy formation on resource allocation.

Dedicated to my parents and family –Zhaopeng Pan, Bolin Du, Jing Chen and Sophia Du

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CHAPTER 1

INTRODUCTION

The adoption and maintenance of healthy lifestyle such as adhering to physical activity are essential to optimal health (Funk, Jordan, Ridinger, & Kaplanidou, 2011). Active behaviors, including participation in regular physical activities, in particular, contribute to longevity and healthier life (Sato, Jordan, & Funk, 2014). However, epidemiology researchers suggest that physical inactivity has become a major public health crisis. Combined with tobacco use and poor diet, it represents one of the leading factors contributing to more than 50% of global morbidity and mortality (Nair, Collins, Patterson, & Rodriguez, 2015). By World Health Organization (WHO), sixty percent of the adult U.S. noninstitutionalized population failed to engage in a recommended level of routine physical activity, and 51% of them had at least one chronic illness associated with a sedentary lifestyle (Ward, Schiller, Freeman, & Peregoy, 2013). This pandemic among American adults continue to rise from 58.7 million in 2010 to 60 million in 2012, and the economic consequence of such physical inactivity is substantial (Bauman, Murphy, & Lane, 2009). Hence, promotion of active living in the population should be a major goal of interdisciplinary research between public health and sport management to achieve positive behavioral change (Inoue, Berg, Chelladurai, 2015). Remedies must be sought to raise awareness by promoting the adoption of accessible physically active leisure pursuits at the population level. It ultimately aims to enable people to establish healthier lifestyles (Beaton, Funk, & Alexandris, 2009; Sato, Du, & Inoue, 2016).

Statement of the Problem

The aforementioned rising trend in physical inactivity suggests collaborative efforts of governments, health professionals, industry providers, and academics should be conducted to promote active living and reduce associated health-related problems and risks. Prior researchers suggest that participation in physically active leisure and the development of active lifestyles are sought by a broad spectrum of society, but the knowledge base with a multi-discipline focus remains underdeveloped (Henderson & Bialeschki, 2005). Within the last decade, the potential contribution of sport to public health agenda has obtained increasing consideration. The inseparable link between sport, physical activity, and health provides opportunities for sport management researchers to explore an in-depth understanding of factors that influence sport and recreation participation, as an exemplary form of physical activity. Building and identifying a theoretical framework that guides the development of strategies and interventions is the first step to fulfilling this goal (Beaton et al., 2009).

To respond to this call, Beaton and Funk (2008) evaluated a selection of relevant theoretical frameworks suggesting that the Psychological Continuum Model (PCM) (Funk & James, 2001; 2006) represents a promising platform to understand a range of internal and external determinants that influence individuals' adoption of physically active leisure. The stage-based conceptual paradigm guides the exploration of a sequence of personal, psychological, and environmental correlates that govern the connection between individuals and physical activity participation (Beaton et al., 2009). Specifically, psychological determinants represent intrinsic and extrinsic factors (e.g., hedonic and utilitarian needs, and benefits desired). Personal determinants represent person-specific characteristics and dispositions (e.g., social economic status, gender, experience with physical activity). Environmental correlates can be derived from a myriad of external influences (e.g., sociocultural connections, geographical and climate factors, and built environments). Among these environmental correlates, various forms of participant sporting events (PSEs) (e.g., structured running events and road races) have received extensive attention in the existing sport management literature (Crofts, Dickson, Schofield, & Funk, 2012; Crofts, Schofield, & Dickson, 2012; Du, Jordan, & Funk, 2015; Filo, Funk, O'Brien, 2009; Kaplanidou, Jordan, Funk, & Rindinger, 2012).

Theoretically, PSEs represent effective community-based interventions designed to promote physical activity participation, which in turn can enhance associated physical and mental well-being, boost the local economy, and build a more vibrant and integrated community (Maher et al., 2013; Sato et al., 2014). The role of these community-based interventions has been considered a critical piece of an overall strategy to promote physical activity for policy makers and community leaders (Downward & Rasciute, 2011). Given the potential benefits of physically active leisure, scholars and practitioners are concerned about the effectiveness of PSEs to contribute to participants' behaviors and attitudes toward physically active leisure that lead to health outcomes (Funk et al., 2011; Henderson, 2009).

Reviews of the previous literature have offered inconclusive results. Prior empirical research suggests that PSEs represent a promising platform that can form positive attitudes toward physical activity for individuals through preparation before the event, participation during the event, and continuation of active routines post event (Du et al., 2015; Sato et al., 2014). Similarly, Bowles et al. (2006) and Crofts et al. (2012) found that the event experience allows participants to perceive a higher intent to engage in physical activity post event compared to the equivalent they measured before the race day. The fundamental premise that these sport events have the potential to help people initiate exercising and are effective in promoting positive behavioral change is predominantly based on the findings observed from active groups. The question remains whether these events can influence less active individuals or inexperienced event participants who have not been addressed empirically. In accordance with the Matthew

Effect (Merton, 1968) from economic sociology, self-producing advantages derived from event participations perpetuate inequality between active and inactive groups. The resultant cumulative advantage principle indicates that active people are more likely to engage in organized running events while less active do not, and the gap between active and inactive people would become larger. In other words, conceptually PSE's may simply allow active people to be more active but may not promote participation among less active adults. The disparity between two groups produces biased evaluations for the benefits of PSEs. As a result, it challenges the effectiveness of PSEs predominantly based on evidenced from individual-level survey data. Hence, a holistic and systematic approach to justify the impact of PSE's in promoting population-based physical activity should be considered to create actionable knowledge to address public health concerns.

Definition of Terms

Table 1.1 displays conceptualizations of key terms that are used in this dissertation. *Physically active leisure* represents a subset of general recreational activities. *Participation in physical activities* that inherently requires moderately intense physical exertion. It is perceived by the individual as relatively freely chosen as well as beneficial, enjoyable, or both (Beaton & Funk, 2008; Beaton et al., 2009). *Physical activity participation* refers to various forms of leisure-time bodily movement, performed by a muscle, or group of muscles that ultimately leads to an increase in one's energy expenditure (Rowe, Shilbury, Ferkins, & Hinckson, 2013). S*port-related environmental determinants* are external forces that can influence physical activity participation. *Environmental determinants* include physically active leisure settings, policy environment, sociocultural environment, natural environment, and information environment. *Sport-related environmental determinants* encompass accessible managed institutions and built environments. These determinants have a business element related to physically active leisure participation (e.g., PSEs, Recreational Facilities, and infrastructures) (DiClemente, Crosby, & Kegler, 2009; West et al., 2012; Sallis et al., 2006). *Psychological determinants* refer to desirable intrinsic and extrinsic benefits that individuals expect to receive through the participation in physically active leisure activities (Funk & James, 2001; 2006). *Personal determinants* involve sociodemographic characteristics that can influence physical activity participation. These individual determinants include demographics, genetic factors, and prior experience with physically active leisure participation (Funk & James, 2001; 2006). Last, *Health outcomes* relate to "the health status (e.g., physical and mental wellness) of a defined group of people and the actions and conditions to promote, protect, and preserve their health" (McKenzie, Pinger, & Kotecki, 2011).

Table 1.1

Definitions of Key Terms

Terms	Definitions	References
Physically active leisure	The concept encompasses a subset of general recreational activities. Participation in physical activities that inherently requires moderately intense physical exertion and is perceived by the individual as relatively freely chosen as well as beneficial, enjoyable, or both.	Beaton & Funk (2008) Beaton, Funk, & Alexandris (2009)
Physical Activity/Exercise Participation	The concept refers to any form of leisure-time bodily movement, performed by a muscle, or group of muscles that ultimately leads to an increase in one's energy expenditure.	Rowe, Shilbury, Ferkins, & Hinckson (2013)
Sport-related Environmental Determinants	Environmental determinants that can influence physical activity participation as well as personal resources related to physically active leisure. Environmental determinants, in general, include physically active leisure settings, policy environment, sociocultural environment, natural environment, and information environment. Sport-related specifically refer to accessible managed institutions and built environments that have a business element related to physically active leisure participation (e.g., PSEs, Recreational Facilities, and Infrastructures).	DiClemente, Crosby, & Kegler (2009); Funk & James (2001; 2006); Sallis et al. (2006)
Psychological Determinants	Desirable intrinsic and extrinsic benefits that individuals expect to receive through the participation in physically active leisure activity.	
Personal Determinants	Sociodemographic characteristics that can influence physical activity participation. Personal determinants include demographics, genetic factors, and historical behavioral characteristics related to physically active leisure participation.	
Health Outcomes	"The health status (e.g., physical and mental wellness) of a defined group of people and the actions and conditions to promote, protect, and preserve their health."	McKenzie et al. (2011); Inoue, Berg, & Chelladurai (2015)

Significance of the Research

The Psychological Continuum Model (PCM) (Funk & James, 2001; 2006) represents a sound theoretical framework to investigate personal, psychological, and environmental factors that influence individuals' connections with physical activity. Prior research has utilized the PCM to examine various contexts of physically active leisure. This line of the studies investigated distance road races, charity sporting events, community-based running programs, and recreational sport participation (Alexandris, Kouthouris, Funk, & Tziouma, 2013; Beaton et al., 2011; Filo et al., 2009; Funk et al., 2011; Filo, Chen, King, & Funk, 2013; Lee & Funk, 2011). This stream of research primarily focused on identifying key personal and psychological determinants of attitude formation and behavioral change, which are internal forces to move individuals along four hierarchical stages of awareness, attraction, attachment, and allegiance toward a recreation or leisure activity. The findings support that individuals' attitudinal connection is positively correlated with the staged-based progressive development of physically active leisure participation, that is, a greater level of psychological involvement can elicit persistent active behavioral engagement. Conceptually, the PCM also proposes the critical role of external forces, such as built environments and socializing agents on increasing the psychological connection but empirical evidence to support this proposition has yet to be provided. To advance our understanding of this theoretical proposition, a broader health perspective would be beneficial to examine the role of external forces on individuals’ psychological connection and the associated behavioral outcomes. In accordance with the Behavioral Ecological Model (BEM) (DiClemente, Crosby, & Kegler, 2009), individuals' behavior is a function of external forces applied to it. Causes of the behavioral change are to be found in the living organism’s surrounding environment. A thorough examination of contextual factors, with a particular focus on sport-related environmental determinants, on individuals' active routine and health-related outcomes is vital (Beaton et al., 2009).

This dissertation research strives to theoretically augment the PCM framework by integrating a broader perspective of BEM to address external determinants proposed to influence the psychological connection. It also aims to examine whether sport-related external determinants, specifically the role of participatory sporting events (PSEs) at a population level can lead to positive health outcomes including increasing physical activity participation and associated physical and mental wellness. The findings can shed light on the importance of utilizing organized participatory sporting events to encourage a healthier lifestyle through integrating physically active leisure into individuals’ everyday routine. Theoretically, PSEs in various forms of organized running events and road races, have the capacity to produce accumulative effects on host communities that may influence population-based participation rate in physical activity. It has to be noted that the accumulation would include various environmental considerations and forces. For instance, living in a state that provides resources to promote health and wellness can lead to a greater likelihood to engage in physically active leisure for state residents and participating in running event represents just one of the experiences. The notion of awareness of these developments and opportunities to be active stems from various environmental forces that accumulate over time (Funk & James, 2001; Beaton & Funk, 2008).

Prior sport management studies on the capacity and effectiveness of PSEs primarily use participants as the unit of analysis (Du et al., 2015; Funk et al., 2011; Sato et al., 2014). It has mainly drawn on individualistic approach, that is, individual-level of analysis of reasons for being active. However, results concluded from these self-selected samples can be biased or misleading given the event population consistently consists of active individuals. On the other hand, the public health focus has been on the population unit of analysis, that is, changes to behavioral patterns at a macro-level. Big scale studies continue to demonstrate the association of outdoor recreation opportunities with physical activity and wellbeing (Huang & Humphreys, 2012; Ruseski, Humphreys, Hallman, Wicker, & Breuer, 2014; Stanis, Oftedal, & Schneider, 2014). The benefits of regular physical activity at all levels of population are well documented in the clinical and public health literature (Bedimo-Rung et al., 2005; Gobey et al., 2005; Kaczynski and Henderson, 2007). However, the potential link between PSE participation and behavioral change to physically active leisure at a state-level has not been examined empirically to date. As a result, the current research examines whether PSEs can increase state-level health outcomes.

This dissertation aims to explore (a) the linkages between sport-related built environments and state-level health results, (b) how these relationships differ based on other contextual factors (e.g., economic development and geographical location), and (c) an underlying mechanism through which PSEs can elicit positive health benefits for host communities. Potential findings can provide scholars with a holistic perspective to understand the benefits of PSEs while controlling for the impact of exogenous environmental correlates.

Results of this dissertation can also echo Funk, Mahony, and Havitz's (2003) call that besides lacking explanatory power, prior research related to human participation in physically active leisure tends to be the most susceptible to challenges and threats related to external validities. These problems and threats include establishing a tradition of replication, snapshot study instead of programmatic research, and misleading conclusion derived from correlation-based studies. The proposed research could answer this call by exploiting the advantages of an empirical model, strengthening external validity of empirical findings, and increasing explained variance embedded within a geographically nested data.

Last but not the least, understanding the benefits of sport-related built environments, with a particular focus on PSEs at a state-level, is pivotal to promote this population-based intervention to benefit society as a whole. Results of this research can provide opportunities for industry practitioners and policy makers to understand better how PSEs can be utilized as an effective population-based intervention to help battle the public health crisis of physical inactivity. Findings of this thesis can also provide practical guidelines to inform policy and debate on resource allocation. Collectively, this research can facilitate future interdisciplinary research agenda between sport management and public health to solve the complex problems in our world.

Purposes of the Research

The purpose of this research is to examine the accumulated effect of organized participant running events on population-level health outcomes. Theoretically, the current dissertation will augment the Psychological Continuum Model (PCM) (Funk & James, 2001; 2006) by integrating a behavioral ecological perspective to examine sport-related built environments. Integrating the PCM and BEM will help theoretically study this incremental effect. Empirically, this dissertation utilized aggregated U.S. state-level panel data and a cross-sectional county-level data to explore the incremental effects of PSEs. The following three research questions were addressed through this dissertation. The first is whether PSEs related factors at the state level (e.g., the total number, and the average size and tenure of PSEs) can influence the state-level health outcomes with respects to physical health, mental health, and physical activity participation rate while considering other macro-level conventional correlates. The second is whether these effects vary based on state-level contextual factors (e.g., policy environment, geographical regions, and meteorological factors). The third research question aims to reveal an underlying mechanism through which PSEs deliver these health-related benefits to host communities.

Overview of Chapters

The remainder of this dissertation is organized as the following. In Chapter 2, the main theoretical framework for the present research is reviewed, with a particular focus on delineating the potential environmental factors that have the capacity to elicit individuals' positive psychological connection with physical activity and associated behavioral change. The chapter then reviews a behavioral ecological perspective to operationalize the sport-related built environment and leads to hypotheses testing of the impact of PSEs on state-level physical activity and related physical and mental wellness. The chapter then discusses the derivation of research hypotheses. Chapter 3 elaborates the overall method for two macro-level studies undertaken to answer the research hypotheses developed in Chapter 2. Specific methods, results, and discussions are detailed in Chapters 4 and 5. In Chapter 6, the discussion of the findings leads to the contributions of the current research, managerial implications, limitations, future directions, and a conclusion.

CHAPTER 2

REVIEW OF LITERATURE

Chapter 2 examines a body of knowledge relevant to the current research. This endeavor builds upon three streams of research. First, the chapter surveys the historical development and current state of scientific inquiry regarding the intersection between sport management and public health, with a particular focus on the principle that adopting physically active behaviors is central to combat the public health crisis of physical inactivity. Next, the chapter identifies the Psychological Continuum Model (PCM) (Funk & James, 2001) as a main theoretical framework to understand the individualistic perspective for the attitudinal formation and the subsequent behavioral adoption of physically active leisure (Beaton et al., 2009). Within the PCM framework, various sources of personal, psychological, and environmental determinants of population health and active behaviors are discussed. Third, the Behavioral Ecological Model (BEM) (Hovell, Wahlgren, & Gehrman, 2002) is reviewed to provide an external understanding of a macro-level perspective on population health. The BEM explicitly articulates the impact of environmental factors on health outcomes (e.g., physical health, mental wellness, and physical activity participation) at the population level. This emphasis provides a useful means to assess the effectiveness of participant sporting events (PSEs), as a sport-related environmental influence, in promoting population-level health outcomes including creating active communities, enhancing social well-being, and improving physical health for community residents.

As discussed in Chapter 1, the conventional individualistic paradigm has largely based findings on active participants. This approach suffers from the resulting selection bias to evaluate if the PSEs can serve as a population-based intervention. In this sense, the BEM augments the PCM framework by looking at a broader ecological perspective to examine the capacity of sport-related environmental factors on community-level health outcomes. Finally, the conceptual integration of the PCM framework and BEM is used to create a conceptual map, in which an empirical model and related hypotheses were specified and derived.

Public Health and Active Living Research

Understanding the determinants of the health for a population defines the aim of public health research, which requires interdisciplinary approaches to tackle the emerging public health crisis of physical inactivity and lack of health literacy (Inoue et al., 2015). In sport management, provision of sport for health has been acknowledged as a major connection to bridge the gap between sport management and health-related domains (Chelladurai, 1992). There is an inseparable link between physical activity participation and health when developing public health programs to promote sustainable healthy lifestyles (Berg, Warner, & Das, 2015). However, to date, only 6% of the articles published in *Sport Management Review,* a leading publication outlet in the field of sport management, have examined the benefits of active participation for the general population (Henderson, 2009).

To bridge this gap, sport management scholars have increasingly bestowed attentions to the role of sport in curing the pandemic of physical inactivity and promoting population health (Berg et al., 2015; Inoue et al., 2015; Funk et al., 2011; Sato, Du, & Inoue, 2016; Sato et al., 2014; Rowe et al., 2013). This line of research prescribes that seeking effective population-based interventions can generate a positive impact on population health. This approach is essential to combat the increasing rate of physical inactivity and lack of health literacy (Paasche-Orlow & Wolf, 2007). Conceptually, this attempt can also help unify and further address the need to encompass interdisciplinary efforts between sport management, public health, and related academic fields (Doherty, 2012). In the following section, the domain of population health is defined to specify areas relevant to the current dissertation. The goal is to facilitate the introduction of the Psychological Continuum Model (PCM). It serves as a main theoretical foundation on which the impact of participant sporting events on community health is examined.

Domain of Health of Population

According to Kindig and Stoddart's (2003, p. 380) definition, population health was defined as "the health outcomes of a group of individuals, including the distribution of such outcomes within the group." In this sense, public health integrates two essential components of population and wellbeing outcomes with distinct meanings. Population relates to an assembly of heterogeneous groups of people. The definition of this concept can refer to both geographical regions (e.g., country, state, or county) and additional group-related parameters such as event participants, club members, and residents.

Health represents a broad concept that conventionally encompasses three key components including physical health, mental wellness, and social well-being (Inoue et al., 2015). Specifically, physical health refers to a state of physical fitness based on the levels of disability, the status of Chronicle illnesses and related symptoms, conditions of impairments, and bodily energy levels. Mental wellness refers to the extent to which people experience positive (e.g., joy) or negative (e.g., stressed) mental states. Social wellbeing evaluates one's effective functioning in society. It should be noted that the mental wellbeing concerns are more related to an individual-level psychological state or condition whereas the social wellbeing is captured by people's assessment of their life functioning within the social boundaries (Keyes & Lopez, 2002). It should be noted that both physical health and social wellbeing have been operationalized by collective measures (e.g., community-level physical wellbeing and sense of community) to evaluate community-level health outcomes, which conceptually is more relevant to the focus of the current dissertation.

In addition to the three key components, health-related behaviors conceptually should be entailed to define the population health. Research examining health-related issues can be dated back to early 20th century in the medical fields, where scholars predominantly emphasized upon fatal infectious diseases such as pneumonia, tuberculosis, and diarrhea (Novick & Morrow, 2008). This focus has shifted to chronicle diseases and health-related behavioral patterns in a majority of developed countries in the 21st century. Since then, medical and health-related scientific communities have supported a notion that behaviors, such as tobacco use, poor diet, and physical inactivity, are responsible for global mortality and morbidity (Mokdad, Marks, Stroup, & Gerberding, 2004). This epidemic is even more widely spread throughout the western developed economies. Given the significant impact of engagement in health-related behaviors, the domain of population health should include this element. In the current study, the health-related behaviors are conceptualized as a myriad of behavioral outcomes that may affect health status. Good examples include eating habits, physical activity, and addictive behaviors such as substance abuse.

Theoretical Foundation

As elaborated in the previous section, the ultimate success of an effective public health agenda depends upon individuals' willingness to undertake and maintain the required physically active behaviors. However, data indicates that poor adherence to professional advice on recommended amount of daily active routine often occurs wherever a form of discretionary action is involved. Adherence to recommended changes in habitual active behaviors is disappointing (e.g., 75% of world's population failed to engage in the recommended amount of physical activity). Therefore, a theory-based approach is vital to creating aforementioned tangible benefits to public health.

In sport and related disciplines, behavioral scientists have contributed extensive conceptual and empirical efforts to explain and predict individuals' health-related decisions. These scholarly efforts have resulted in the advancement and widespread application of various relevant theoretical frameworks and models such as Health Belief Model (HBM), Transtheoretical Model (TTM), Theory of Planned Behavior (TPB). Beaton and Funk (2008) developed criteria to evaluate these relevant conceptual frameworks. The purpose was to identify the most suitable sport and health science model to aid understanding and promote participation in the leisure-tine physical activity. In essence, conventional theories/frameworks tend to predominantly focus on cognitive variables, such as attitudes, beliefs, and emotional state, and the factors thought to influence individuals' conative outcomes. The underlying assumption is that individuals wish to maximize positive health benefits. Among the models examined, the Psychological Continuum Model (PCM) was identified being the most appropriate model to understand participation in physically active leisure based on the selected criteria (Beaton et al., 2009).

The Psychological Continuum Model (PCM) represents a sound theoretical framework that holistically describes the developmental progression of physically active leisure. The PCM proposes that a broad range of personal (e.g., socio-economic status), psychological (e.g., dispositional needs and symbolic meaning) and environmental determinants (e.g., socializing agents, cultural influences, and built environments) have the potential to affect an individual's psychological connection towards a specific leisure pursuit. Within the PCM, the psychological connection represents the level of attitude formation and change that has occurred within a specific leisure context.

Prior conceptual and empirical work using the PCM has predominantly focused on the effects of internal determinants (i.e., personal and psychological factors) with limited theoretical and no empirical attention given to external determinants. Precisely, there has been little discourse on the role of sport-related environmental influences on population health within the PCM framework. Hence, there exists an opportunity to expand the conceptual understanding of environmental factors to explain individuals' connection with physical activities and related health outcomes. Notably, the present body of knowledge is insufficiently developed to understand the complexity and variety of sport-related managed and business-focused enterprises that could influence public health. Specifically, the key question is that what external sport-related built environments drive active living behaviors? With this in mind, the following section is devoted to reviewing the evolution of PCM framework and how it suits the current context to examine physical activity participation from an individualistic perspective.

Theoretical Framework: The Psychological Continuum Model

According to the theory of participation (TOP), the central tenet underlying the PCM (Funk & James, 2001) describes how an individual progresses along a stage-based continuum to capture the dynamics of the individual's commitment to and involvement in participation in leisure-time physical activities (Beaton et al., 2009). The PCM suggests that person’s attitude formation toward a physical activity is a function of a hierarchy of psychological contingencies, that is, causes to behaviors are found in the psychological aspects internal to the individuals. It includes perceptions, feelings, and motivations, which jointly can drive behaviors (Ajzen & Driver, 1992). This premise creates the opportunity to allow integration of relevant theories on positive health-related behavioral adoption and maintenance to guide the active living research (Beaton et al., 2009; Beaton et al., 2011).

Physical Activity Participation with the PCM Theoretical Framework

The Psychological Continuum Model (PCM) (Funk & James, 2001) was developed to study individuals’ social-psychological connection with physical activity and the associated behavioral change. Specifically, the different ways in which a person may engage in physical activity could be conceptualized regarding distinct stages along a vertical psychological continuum. The developmental processes underneath this continuum are theorized as a linear progression along four stages named Awareness, Attraction, Attachment, and Allegiance (See Figure 2.1). The core principle of the PCM lies in a notion that individuals’ psychological connection with physically active leisure is capable of explaining the attitudinal formation and the associated behavioral change. The continuum of psychological connection represents a different level of psychological connection, a temporal process that an individual may experience after the initiation of an action (Beaton et al., 2009). Active behavior increases from non-existent to simple and sporadic in the early stages to complex, and consistent in the allegiance stage (Funk & James, 2001).

In sport management, prior researchers using the PCM framework have predominantly focused on the effects of internal determinants with limited conceptual and no empirical attention given to environmental determinants, which are external to one's involvement with physically active behaviors and related health outcomes. Moreover, the previous research using the PCM framework has also failed to examine empirically how prior behavior and experiences influence the developmental progression. Behavior is mainly treated as an outcome rather than an antecedent influencing person's future attitude formation and behavioral change, especially when looking at broader health outcomes.

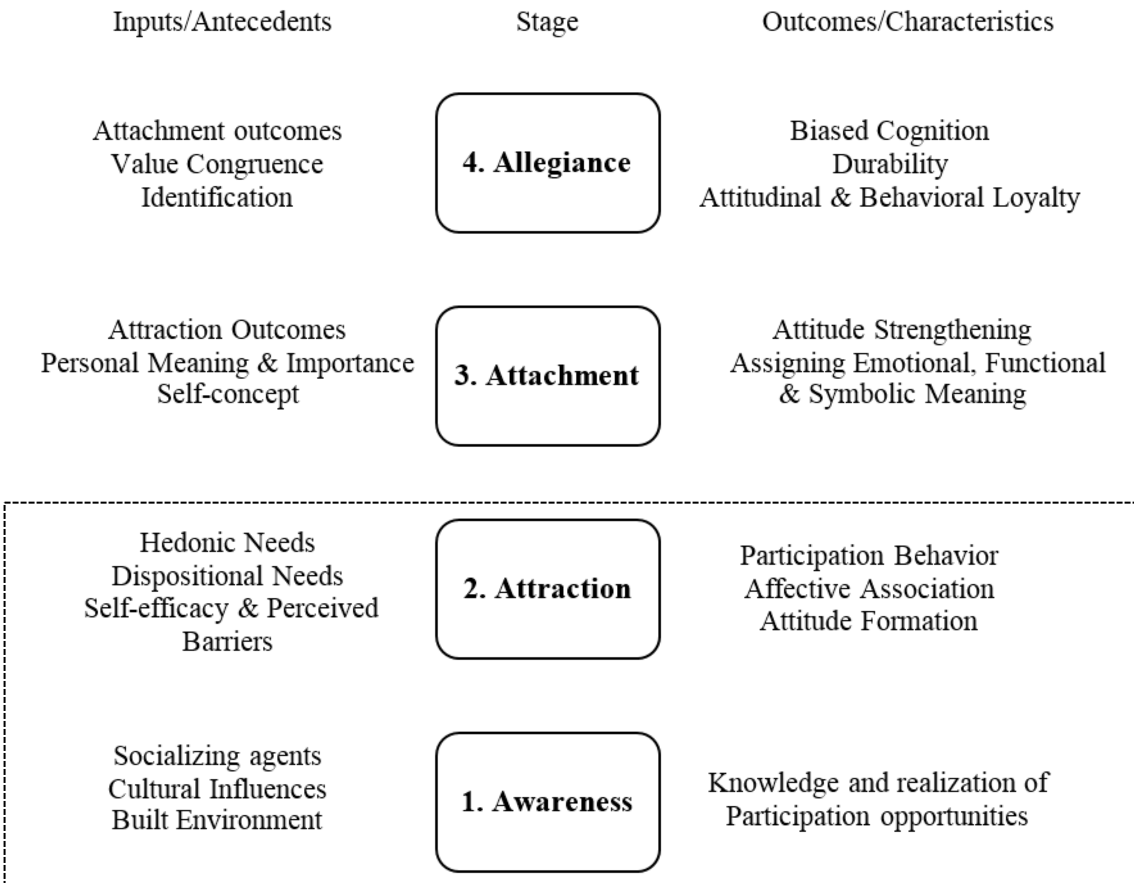

Figure 2.1 Psychological Continuum Model with Physically Active Leisure Participation (Beaton, Funk, & Alexandris, 2009)

As shown in Figure 2.1, the first two stages of Awareness and Attraction as highlighted in Figure 2.1 are central to combat the physical inactivity crisis. Of which, awareness is key to understanding potential options and alternatives while attraction is key to getting people active and liking the activity (Funk & James, 2001). Within these two stages, an individual starts to formulate a specific favorite among the available options of physically active leisure. The positive attitudinal connection has not yet formed (Beaton et al., 2011). These stages are relatively unstable regarding behavior.

However, psychological and behavioral outcomes can be activated by creating the realization of available physical activity participation opportunities through the influences of socializing agents (e.g., family, mass media) and built environments (e.g., PSEs, public available physical activity infrastructures) (Beaton et al., 2009). The goal is to promote an element of stability to the connection between individuals and physical activity. It can ultimately elevate individuals to the attraction or even higher stages, where hedonic and dispositional needs, health prevention benefits, and social situational factors become the driving forces to create the inception and behavioral adherence to physical activity participation (Beaton et al., 2009).

The Internal and External Determinants of Physical Activity Participation

The PCM framework has been adopted extensively to examine sport contexts (Alexandris et al., 2013; Beaton et al., 2011; Filo et al., 2013). This evidence delivers preliminary support of theoretical propositions and statistical validities of the framework. Specifically, the PCM framework highlights the complex interplay between personal, psychological, and environmental factors to study how these internal and external forces influence individual’s recognition of whether engagement with physical activity would help achieve desirable health-related outcomes. Beaton, Funk, & Alexandris (2009) developed a theory of participation (TOP) within the PCM framework. This scholarly work further suggests a mechanism including inputs, process, and outputs to explain individuals' movement along the four stages as the person's relationship with physically active leisure progresses. The focus of this framework is not only on the resultant outcomes of desired behavioral changes but also in the identification of a myriad of factors thought to influence the formation of a strong connection to physical activity. These factors broadly depend on internal (e.g., personal and psychological factors), and external (e.g., environmental) forces. The following section is devoted to articulate two streams of forces (e.g., individual-based dimensions and environmental dimensions that can influence individuals' connections with physical activity.

Personal forces represent individual-specific characteristics and dispositions that have the ability to influence individuals' processing of information inputs and alter their behaviors (Beaton et al., 2009). These personal forces offer opportunities for individuals to reflect personal traits, express personal meaning, and define personal dispositions (Beaton et al., 2009). These forces are well encapsulated by a myriad of social-demographic and genetic factors including but not limited to gender, ethnicity, social-economic status, prior experience, and physical characteristics (e.g., body weights and type), among other person specific features. This set of personal forces not only informs individuals' attitudinal processing to assess the experience with the physical activity but also to interact with other psychological and environmental factors. It should be noted that this set of demographics and genetic factors are stable in nature and unlikely to change over time (Beaton & Funk, 2008).

Psychological factors relate to additional internal sources. Precisely, these forces signify desirable intrinsic and extrinsic benefits that individuals expect to receive through the participation in physically active leisure (Beaton et al., 2009). These advantages are twofold, which are, hedonic benefits and functional benefits. The former is experiential in nature. It involves emotional feedback caused by euphoric feelings through physical activity participation (e.g., runner’s high), which satisfies individuals’ internal needs. On the contrary, the functional benefits are utilitarian in nature. It represents tangible outcomes that individuals desire through the behavioral engagement with sport and derivative events (e.g., a positive change in body shape or body mass index) (Beaton et al., 2009). It is noted that psychological correlates of physical activity have been documented in the previous leisure research (Alexandris, Du, & Funk, 2016; Alexandris, Du, Funk, & Theodorakis, 2016; Brandon-Lai, Funk, & Jordan, 2015). For instance, Alexandris and his colleagues employ the PCM to explain why and how a particular individual is motivated to adopt and maintain a physically active lifestyle or what individual-based constraints and barriers can prevent the individual from participation in physical activity.

External force encompasses three sub-categories, which are major sources of environmental inputs that help people realize the benefits of active lifestyles. The first category is sociocultural and interpersonal influences that help individuals determine whether engagement with physically active leisure provides accessible and desirable health-related outcomes (Funk & James, 2001). Conceptually, PSEs can create an ecosystem, in which event participants can receive endorsements and information from the interlocking network. It involves social ties (e.g., family, friends, colleagues), structured organizations and institutions (e.g., event and health agencies), and social groups/class (e.g., a local running clubs the prepare individuals for event participation). Specifically, this category is mainly comprised of socializing agents. Through which, a variety of PSEs-centric institutions such as event organizations, mass media, U.S. Department of Health and Human Services can communicate norms and promote behaviors through the public campaign and social interaction during the phase of event preparation (Funk et al., 2011). They also occur through public health education and health promotion. According to *2008 Physical Activity Guidelines for Americans*, participating in physically active leisure represents one of the most effective steps that people of all ages can take to improve their well-being. The World Health Organization also emphasizes the critical role of public health institutions in promoting population to routinely engage in recommended amount of physical activity (Funk et al., 2011). The minimum goal for an average adult is to accomplish a moderate level of fitness activity for cumulative 150 minutes a week to elicit science-based health benefits including smoking cessation, weight loss, improve BMI, increase endorphins, and decrease the risk of metabolic syndrome (Churilla et al., 2012). The goal of these public health initiatives is to promote active atmosphere at the societal level, which in turn facilitates meta-contingencies created by interlocking groups and parties within a community. These meta-contingencies conceptually can help promote leisure-time physical activity participation and prevent sedentary behaviors at an individual level (Sallis et al., 2006).

The second environmental influence encompasses physical environmental factors (e.g., access to sport and recreational facilities such as parks, playgrounds, sporting grounds) and natural environmental factors including geography and climate or additional equivalent contextual determinants (Funk & James, 2001; 2006). The third source of environmental dimensions refers to a range of policies and funding structures (Funk & James, 2001; 2006). Although the PCM framework identified these general sources of environmental influences, it primarily focuses on the articulation of compositional structure of these sources from an individualistic perspective. In next section, I will discuss environmental factors, with a particular focus on sport-related PSEs, which influence population-based physical activity drawing upon the behavioral ecological approach (Sallis et al., 2006). Overall, the PCM highlights the importance of understanding how these different categories of environmental influences shape an individual's attitudinal formation with physical activity and initiate the individual's behavioral adoption and maintenance. For instance, marketing communications used by PSEs organizations can facilitate the stimulation of cognitive thoughts, beliefs and emotional feelings within awareness stage, where trial behaviors and affect are contemplated. The behaviors, in turn, affect goal-directed intent and actual behavioral engagement in physically active leisure related to the attraction stage.

In sum, PCM represents a sound theoretical framework that primarily focuses on individualistic perspective for physical activity. Prior conceptual and empirical work using the PCM has predominantly concentrated on the effects of psychological determinants with limited theoretical and no empirical attention given to personal and external determinants of population-based physical participation, which is central to succeed the public health battle with physical inactivity. In other words, the PCM overly focuses on the psychological aspects that lead to behavioral changes regarding intrinsic and extrinsic motivation, feelings, and perceptions (Brandon-Lai et al., 2015). It gives little emphasis on the large sociological and environment which include, for example, socio-cultural and demographic factors. Hence, it is pivotal to expand the conceptual understanding of environmental factors using a macro-level perspective. A useful approach to understanding the environmental determinants is well captured in a broad-based ecological model called the Behavioral Ecological Model (BEM).

Behavioral-Ecological Model

BEM presents "an integrated approach focusing on the cultural, ecological, and dynamic aspects of hierarchical interactions within and across all societies as critical to understanding and effecting population-wide changes in health behavior" (Krug, Mercy, Dahlberg, & Zwi, 2002). It is an applied theoretical model that is derived from philosophical tenets of functional contextualism (Biglan & Hayes, 1996). Its roots are based on a premise: individuals' behavior is a function of a hierarchy of environmental meta-contingencies, that is, causes are to be found in the environment external to the behavioral change. The BEM relies on unifying ecological and cultural sciences for an explanation of modifying health behaviors in the population (Hovell et al., 2002). The conduct of the group or community is the central focus of BEM, which examines functional external contingencies to explain these behavioral changes at a different level of analysis. It provides opportunities to facilitate the identification and operationalization of vaguely defined built environments and individual characteristics within the PCM framework.

In general, the BEM focuses on the interrelations between organisms and their surrounding environments (Hovell et al., 2002; Kaczynski & Henderson, 2007). Rooted in biology, this model has been widely applied in public health research and practices to battle the epidemic of physical inactivity. Since the 1980s, researchers and practitioners in public health and leisure began to use this model to guide the development of effective interventions and programs. The goals of these programs and interventions are to promote positive health-related behaviors such as physical activity participation, healthy diet consumption, and smoking cessation (Oftedal & Schneider, 2013; Stokols et al., 2013; Thompson et al., 2013). Therefore, examining the environmental characteristics that promote or damper physically active leisure is a major concern of public health researchers (Henderson & Bialeschki, 2005). It would also help explore the personal forces within the PCM framework.

The behavioral-ecological model originated from the public health and biological research based on ecological theory and socio-ecosystem models (Baer, Wolf, & Risley, 1968). Conceptually, it augments the PCM framework by focusing on the identification of a myriad of social, cultural and physical environmental factors that can create awareness and attraction to physical activity which can subsequently influence people's health status and related behavioral outcomes (Stokols et al., 2013; Sallis et al., 2006). Sociocultural environments include culture, social climate, norms, economics, and politics. For example, land use policies can influence the accessibility and availability of public open space; transport policies can affect air quality, which indirectly influences population health and related behavioral outcomes such as participating in outdoor sports and physical activities. Physical environments encompass built facilities, institutions, infrastructures, technology, as well as natural environmental factors such as geographic locations, climate, and natural resources. Conceptually, participation in physically active leisure can be influenced by the opportunity and access to these environmental resources.

Prior public health researchers have used BEM to examine the impact of various environmental determinants in promoting physical activity. Empirical investigations include (1) recreational environment (e.g., participant sport events, professional sport clubs, after-school youth sport programs and recreational facilities). (2)The neighborhood and home environment (e.g., walking/bike paths, green spaces, public parks, and home-based fitness equipment). (3)The workplace environment (e.g., facilities and internal programs that aim to promote physical wellbeing to employees). (4) school environment (e.g., physical education programs). (5) information environment (e.g., health-related information, news, advertising, and programming generated and distributed by mass and social media). (6) Policy environment (e.g., mechanisms, policies, and incentives that promote public engagement in health-related behaviors) (Henderson & Bialeschki, 2005; Sallis et al., 2006). Additional empirical studies using BEM have supported the proximity of neighborhood parks (Cohen et al., 2007; Oftedal & Schneider 2013; Veitch et al., 2012), the size of parks (Cohen et al., 2010; Kaczynski et al., 2009; Sugiyama et al., 2010), a city's parkland density (West, Shores, & Mudd., 2012) were positively associated with the level of physical activity at the community level.

The increasing popularity of BEM stems from a notion that most public health challenges such as the crisis of physical inactivity and lack of health literacy are too complex to address from a single source of influence. It requires a broad perspective that integrates a comprehensive list of sociocultural, natural, and physical built environments to influence population health. Conceptually, the BEM provides a holistic view for the development of multilevel interventions that can systematically address the mechanisms of change at various levels (Henderson & Bialeschki, 2005). It allows researchers to allocate these determinants at multiple levels of analysis particularly focusing on community and society as a whole.

Previous studies in sport management and leisure science have predominantly emphasized individual-level determinants, but limited attention has been directed to a multi-level behavioral ecological perspective to better understand a myriad of environmental factors that affect individuals' attitudinal change (e.g., Alexandris et al., 2016; Beaton et al., 2009; Brandon-Lai et al., 2015; Funk, Beaton, & Pritchard, 2011). Specifically, the PCM is concerned with attitude formation and change regarding psychological connection. Conversely, the BEM specifies a range of external influences on behaviors of all levels in population and propose that health-related physical activity is affected by interactions of these influences across different levels. Hence, an integration of both approaches should be warranted.

Integrating BEM into the PCM

As discussed earlier, prior researchers using the PCM framework have largely focused on psychological determinants in promoting participation in physically active leisure. Participating in a PSE is a behavior produced by the environment and the individual factors that lead to attitude formation toward the activity. Specifically, environmental and personal determinants influence physically active leisure but also subsequent health outcomes, which has not been suggested previously as a potential use of the PCM framework. In contrast, BEM is distinctive in the way multifaceted environmental determinants of population health and related behavioral outcomes are highlighted. This comprehensive environmental approach could lead to the explicit consideration of influences at multiple levels. Hence, it facilitates the development of broader and effective population-based interventions (Kaczynski & Henderson, 2007). Sallis et al. (2006) provide a thorough review of key research advancement in health, medical field, behavioral science, urban planning, public policy, and leisure sciences, among others. The authors note that the ecological approach and the derivative BEM have received a broad recognition to highlight the importance of multi-layer environmental influences on physically active behaviors. This statement shares tremendous congruities with the notion of environmental and individual inputs within the PCM framework, that is, the complex interplay of personal and external factors across different domains and settings that have the capacity to influence an individual's connection with physical activities and participation (Funk & James, 2001).

Henderson (2009) also advocates the value of ecological approaches may offer opportunities to facilitate active participation research in sport management. She also underscores that future scientific inquiries should shift from traditional spectator entertainment sport to focus on population-wide physical inactivity. In the prior public health research, the ecological approach and BEM have been used extensively, in a variety of contexts, to advance our understanding of physically active behaviors (Cohen et al., 2010; Kaczynski et al., 2009; Sugiyama et al., 2010). Nevertheless, the focus of previous models has been primarily on the role of environmental factors in health-related behaviors with limited attention on other population health measures (e.g., collective physical health and social wellbeing). Empirically, this approach can enhance explanatory power and predictive validity beyond the psychological factors (perception, feelings, and motivation) within the PCM framework to influence the connection to physical activity at a population level (Kaczynski & Henderson, 2007). However, sport related environmental factors and macro-level analysis are of secondary consideration.

The macro-level analysis investigates the broader societal and environmental factors that facilitate a climate in which public policies; economic stimulus and state-level interventions are designed and implemented to inhibit inactive or sedentary behaviors (Sallis et al., 2006). This level specifically explores the settings, such as communities, metropolitan areas, and states or provinces, in which social relationships form an ecosystem to promote active living (McKenzie et al., 2011). Social marketing campaigns are popular to foster group and community climates and pro-active lifestyle social norm, which in turn increases community level of engagement with physically active leisure (Ruseski et al., 2014). Increasingly, local governments are considering the way in which community design will produce a positive impact on residents' physical activity. This research documents effective strategies for creating communities that support active living and promote health. The macro-level unit of analysis also identifies aggregated physiological and psychological related factors that have the capacity to increase the likelihood of forming active lifestyles for community residents.

The synergy between the PCM and BEM enables the identification and operationalization of potential sport-related individual and environmental factors. Theoretically, organized sport events and infrastructures (e.g., recreational sport facilities) represent social institutions to facilitate behavioral contingencies largely through boosting economic stimulus, creating an atmosphere to promote physically active leisure and build inclusive and cohesive communities at large. Participating in these events creates accumulative advantages for people to adhere to physically active recreation and to elicit positive health outcomes.

To sum, the purpose of this dissertation is to examine the accumulated effects of sport-related environmental determinants of population health outcomes with specific attention to organized participant sporting events. Hence, the current research shifts the focus of the PCM to consider behavior and the environment as antecedents by integrating the PCM framework with a behavioral ecological perspective. It allows the examination of environmental influences on both individual and collective health and related behaviors. The conceptual synergy augments prior research in studying physically active leisure to understand the role of participant sporting events as a built environmental intervention in enhancing population health and related behavioral outcomes. It also helps illustrate that with existing studies using the PCM, the selection bias of active population is an individual characteristic that needs to be examined.

Research Hypotheses Development

In the previous sections, the PCM framework was introduced as a theoretical foundation to guide the current research. The following section discusses how various forms of participant sporting events can serve as environmental resources to influence population health. Prior empirical studies in public health have widely supported five environmental correlates that have the capacity to influence individuals' level of physical activity, which include facility accessibility (e.g., walking trails, public parks); opportunity for participation in physical activity (e.g., public provision of programs to promote physical activity participation); perceived aesthetics (e.g., comfort and satisfaction with the community environment); variation of weather; and condition of safety (Humpel et al., 2002; Owen et al., 2004). Among the aforementioned environmental resources, recreational and the neighborhood environment represents key determinants in promoting physical activity participation (Sallis et al., 2009). For example, the availability of walking trails can increase the physical activity participation rate among the vulnerable population (Brownson et al., 2000). That is, inactive groups including females and people with lower socioeconomic status are likely to increase the level of physical activity through the provision of access to infrastructures designed to promote active routine.

While the trails and paths represent promising infrastructures to influence participation in physical activity in public health, the equivalent effects were found being inconclusive in the field of leisure and recreation. Kaczynski and Henderson (2007) conducted a scoping study by reviewing research published between 1998 and 2005 in leisure sciences. Frequency and thematic analyses also revealed that trails and paths represent the most influential environmental factors to change individuals' behavioral pattern in physical activity, which was widely supported by more than 30% of empirical studies, followed by public parks, open space, and non-for-profit recreation centers. In contrast, Starnes et al. (2011) identified negative effects were found between proximity to neighborhood parks and walking trails and physical activity. Collectively, significant correlations between accessibility of recreational parks and trails have been widely supported, however, the directionalities of such effects were mixed across prior empirical studies (Kaczynski & Henderson, 2007; Starnes et al., 2011). Evidence-based research is still missing to look at the relationships between sport-related built environments and a broad set of population health outcomes, which is the ultimate goal for interdisciplinary studies between sport management and public health.

Parallel to the approaches adopted by colleagues in public health and leisure, sport management researchers have supported that PSEs theoretically represent a promising community-based intervention to increase level of physical activity and promote active living (Crofts et al., 2012; Du et al., 2015; Funk et al., 2011; Sato et al., 2014). The nature of the effectiveness of these events in enhancing community level health status and related behavior outcomes remains unsubstantiated with objective data (Bauman et al., 2009; Crofts et al., 2012). Specifically, the interpretation of this positive correlations, however, is not self-evident. The issue of endogeneity between PSEs and health inevitably arises from the reasons below: (a) the selection bias due to the difference in individual characteristics. For example, individuals might volitionally choose to participate in PSEs; (b) those who choose to take part in these PSEs may be genetically healthier; (c) those who are more experienced with events are more likely to acquire the sense of accomplishment through the event participation. Therefore are more willing to engage in physical activity participation and the associated PSEs. It is hard to establish a causal linkage between event attendance and population health using micro-level data. One approach to overcome this challenge is to combine individual-based census data with secondary information on sport-related environmental factors. Variation in these factors where events theoretically play a role of social marketing tools to create active meta-contingencies, in turn, affect population health.

Drawing on a behavioral ecological perspective, the current research proposes a positive linkage between a broader set of environmental resources with which a state is equipped and the level of physical activity bounded across states. The purpose was to quantify the capacity of PSEs on health outcomes at the population level. Specifically, the number of PSEs a state possesses and operates combined with other environmental resources at an aggregated level would positively influence population health at the state level. Through which, the state would be more supportive of having events and investing money and allowing business to run these events.

Taken together, PSEs provide accesses and opportunities to the engaging population to get involved in physically active leisures (Bowles et al., 2006; Funk et al., 2011; Crofts et al., 2012). These community-based interventions have the capacity to increase awareness of benefits of physical activity, elicit the realization of opportunities to participate in physically active leisure, promote the accessibilities of resources in the given community, which collectively can lead to the positive attitudinal connection with leisure-time physical activities (Funk & James, 2001; 2006). Such positive change in psychological connection to physically active leisure will have accumulative effects on the health of community population.

These sporting events are part of a larger physical activity ecosystem in which social interactions are facilitated through a variety of interlocking parties. The conceptual integration between the PCM and BEM suggests these sporting events can create a virtuous cycle by boosting the economy, enhancing the perceptual image of the safety and attractiveness of a host community, and increasing the awareness of health and active living through the implementation and promotion of related organizations, grassroots clubs, and educational programs. The ultimate goal is to use the events to facilitate positive social interactions and initiatives, change cultures and norms, diffuse the benefits of physical activity participation throughout the community, and ultimately deliver health promotion outcomes at the population level (Funk et al., 2011; Murphy & Bauman, 2007). Hence, the first research hypothesis was derived as follows:

H_1: The participant sporting events operated in a state are significantly associated with population health at the state level.

In addition to examining the benefits of PSEs on population health, the second research question is to determine if such impact differs significantly contingent upon a state's economic development and the geographical region to which the state belongs. Prior studies examining the potential benefits of participant sporting events have largely relied on the attitudinal assessment of physical activity based on cross-sectional survey data. Specifically, the previous studies using the cross-sectional survey data often fail to consider this mechanism. This approach only focused on the change of mean scores of the psychological variables in interest and lacks sufficient information to capture the trajectory of effects of participant sporting events on population health across the states over time. Researchers often assume that the underlying relationship between sport-related environmental influences and health is time-invariant (Huang & Humphreys, 2012; Humpel et al., 2002; Ruseski et al., 2014). However, the strength of the relationship between PSEs and population health is unlikely to be invariant across the states and be static over time.

Moreover, counties geographically bounded by the same state are structurally nested in the way that the aggregated level of physical activity is likely to possess similar pattern with geographically overlapping or adjacent counties. In other words, particular health outcomes (e.g., general health, physical health, mental health, and physical activity) are likely to be influenced by common state-level physical or natural environmental factors (e.g., geographical location) and various economic contingencies (e.g., economic development). For example, residents who live in a traditionally active geographic area are more likely to have a healthy life than their counterparts reside in a state where the socio-cultural environment does not support active living routine and healthy eating habits. Hence, the following hypothesis was developed.

H_2: The positive effects of participant sporting events on population health at the state level differ significantly across the states over time, where the impact is more pronounced contingent upon a state's economic development and the geographical region to which the state belongs.

Finally, there still has been a debate about the extent to which participant sporting events by itself can produce sufficient levels of positive attitudinal change within a community (Bauman et al., 2009; Funk et al., 2011; Murphy & Bauman, 2007). The key is to identify the underlying mechanism through which PSEs can deliver benefits to promote health at the population level. While various forms of participants sporting events are designed to promote active living, it should be noted that a vast majority of these community-based interventions are owned and operated by private sectors, where the profit maximization should be the baseline.

Theoretically, sport-related environmental resources provided at the state level have indirect effects to influence population health partially through changes in access to available opportunities to promote physical activity participation. That is, a state that provides more accessibilities and opportunities to promote health and wellness is likely to possess a stronger effect between sport-related environmental factors (e.g., the number, tenure, and size of participant sporting events) and related health outcomes. Specifically, residents who pay taxes which are used to produce such opportunities might be more likely to support a vote for public investment on leisure and recreation. Taken together, the third hypothesis was proposed:

H_3: The accessible opportunities to participate in the leisure-time physical activity at the state level mediates the relationship between the provision of participant sporting events and population health (composite of physical health, mental wellness, and physical activity participation rate) at the county level.

In sum, the current section examines the direct and indirect impact of participant sporting events as sport-related built environment on population health. Chapter 3 reviews the overall methods, included measures, the procedure of data collection and empirical testing, as well as the specific analytical techniques that current dissertation employed.

CHAPTER 3

METHODS

The purpose of this dissertation research is to examine accumulated effects of participant sporting events on population health. Three key research questions were discussed in Chapter 2. They include (1)if and the extent to which PSEs have the capacity to impact population health at the state level? (2)if yes, whether or not such an influence varies across the states contingent upon a state's economic development and the geographical region to which the state belongs? (3)what are the underlying mechanism that can serve as a mediation pathway through which PSEs can elicit positive effects on population health? This chapter introduces the overall methods designed to address the aforementioned research hypotheses. The data collection and measures are first discussed followed by the development of empirical models and testing procedures.

Study 1

Data Collection and Measures

The relationship between PSEs-related determinants and community health was examined using secondary panel data merged from multiple sources in Study 1. This procedure aimed to minimize common method bias, which arises when both predictor and outcome variables are gathered from a common source (Podsakoff, MacKenzie, & Podsakoff, 2012). States within the United States of America were chosen as the unit of analysis because health departments at the state-level play a decisive role in making health-related policies and providing public health services, which are central to understanding the macro-level linkage between participant sporting events and community wellbeing (Berg et al., 2015). The next section discusses focal independent variables, dependent variables, instrumental variables, and control variables. Table 3.1 includes the information about the name and measures of all included variables used in Study 1.

Table 3.1

Variable Descriptions of Study 1

Variables	Measurement
StateID	50 States + D.C.
Year	2008-2014
RegionD_S	South
RegionD_W	West
RegionD_NE	Northeast
Location	Location Altitude in ft.
SIZE	Average Size of Participants
Tenure	Average Tenure of Events
TotalN	Total Number of Events
PRECI	Precipitation in Inches
TEMP	Average Temperature in F
PD	Population Density
FV	In the last seven days, on how many days did you have five or more servings of fruits and vegetables?
Age1	18-29
Age2	30-49
Age3	50-64
Age4	65+
Religion	How often do you attend church, synagogue, or mosque? At least once a week
GHR	Would you say your own health, in general, is …? Excellent
PA	In the last seven days, on how many days did you exercise for 30 or more minutes?
MH	Now, please think about yesterday, from the morning until the end of the day. Think about where you were, what you were doing, who you were with, and how you felt. Did you smile or laugh a lot yesterday?
PH	During the past 30 days, for about how many days did poor physical health keep you from doing your usual activities?
BMI	Underweight<18.5; Normal 18.5-24.9; Overweight 25-29.9; Obesity>30
HP	Do you have any health problems that prevent you from doing any of the things people at your age normal can do? Yes

Table 3.1, continued

Variable Descriptions of Study 1

Variables	Measurement
Edu	What is your highest completed level of education? College
Gender	Gender_Female
Income	Monthly Household Income $ 3000 to $7500
Married	What is your current marital status?
Ethnicity	Race_Caucasian
Smoke	Do you smoke? Yes

Dependent Variables

As shown in Table 3.1, data on core aggregated health outcomes including the state-level physical activity participation rate (PA), physical health (PH), mental wellness (MH), and evaluative well-being (GHR) were obtained from the Gallup U.S. database for the years 2008 through 2014. Gallup U.S database is compiled using the probability sampling strategies (e.g., simple random sampling and probabilities proportional to state population size) via random-digit-dial methodology. Gallup research group continually surveys U.S. residents in all 50 states and the District of Columbia, using randomly selected, community representative samples (Gallup, 2014). It should be noted that the sampling frame comprises of the entire civilian, non-institutionalized, aged 15 and older population of the entire the United States. At a minimum, one thousand surveys of individuals per state are recruited. Participants who agreed to join the panel are required to complete two to three surveys per month for a typical length of 15-30 minutes in total. No financial and material incentive are provided to panel participants (Gallup, 2014).

The existence of potential spurious effects of PSEs on population health is justified by including correlates suggested by the previous research (Stanis et al., 2014). Theoretically, differences in the impact of PSEs and other sport-related infrastructure and establishments on the state-level health could be confounded from variations of state-level characteristics. These factors include population density and diversity, the level of urbanization, socio-economic composition, and geographical locations (Huang & Humphreys, 2012; Sallis et al., 2006). For this reason, an extensive list of control variables was included in the current empirical testing. In addition to the three population health measures (e.g., physical health, mental well-being, and physical activity participation), Gallup collects information on other commonly used environmental determinants of the state-level wellbeing, including youth development, community basics, and population diversity (Gallup, 2014). Gallup constructs major indexes that are conceptually connected to population health. For example, the community basics index used seven formative items (e.g., social communication, sanitation quality, the human development index, poverty rates, child mortality, and adolescent fertility rates) to evaluate the quality of living in a community, including the assessments of the environment, housing, and infrastructure. This set of measures conceptually are complementary and not interchangeable to predict the population health at the state level (Kaczynski et al., 2009; Ruseki et al., 2014). This approach is consistent with the instruments used by the previous research on examining the environment correlates of population health (Bauman et al., 2012; Floyd et al., 2008; Huang & Humphreys, 2012; Ruseski et al., 2014; Stanis et al., 2014; Wicker et al., 2009; Wicker et al., 2013).

According to the Gallup worldwide research codebook (Gallup, 2014), the included items use a simple or multiple dichotomous response-set to minimize potential contamination of data. For instance, state-level education was coded from three categories: elementary (e.g., up to 8 years of basic education), secondary (9 to 15 years of education), and tertiary (at least received a four-year college degree). Once the data were screened, all recorded information went through a rigorous validity and reliability assurance process before being published by Gallup. One worthy note is that the measures used to construct various indexes were validated through correlating with recognized external measures. Only indexes with significant correlations with the external measures at the alpha of .01 level were retained. The 95% margin of errors of retained measures and index components were also reported in the Gallup database.

Independent Variables

As displayed in Table 3.1, focal independent variables used in this dissertation include the average size (Size), tenure (Tenure), and total number (TotalN) of PSEs across the 50 states plus the District of Columbia for the years 2008 through 2014. A scrapping technique was administered to collect the information on the focal independent variables related to participant sporting events. Data was obtained from multiple sources including Athlinks.com, Running USA statistics database, and U.S. Track and Field (USATF) event sanction database. Among which, Athlinks.com represents a non-profitable social networking website aimed at competitive endurance athletes. Although Athlinks' primarily serves to connect competitors and local enthusiasts, the online platform to date provides the most comprehensive information on various forms of PSEs (e.g., swimming, road racing, cycling, and adventure racing) held in the United States (Athlinks, 2015).

Running USA is a Los Angeles-based non-profit organization for the U.S. running industry. The organization was launched in 1999 aiming to advance the growth and prosperity of the U.S. running industry. The statistics database collects, analyzes, and stores data gathered from a National Runner Survey. The survey is a comprehensive study conducted every two years by Running USA. The purpose is to obtain information about the running population nationwide, with particular focuses on event participation behaviors, specialty product preferences, and attitudes toward running and healthy lifestyles. On average, it recruits more than 15,000 randomly selected running event participants, organized running club members, running gear consumers, subscribers to running publications, and those who frequently engage with online running communities (Running USA, 2015). Lastly, USATF sanction database was used to collect information on various forms of PSEs, including indoor track and field, distance running, and race walking events. These event organizations are committed to providing a safe environment and comply with national and international rules and regulations of the sport before obtaining a license issued and approved by USATF (USATF, 2015).

Data on total number of PSEs (TotalN), event tenure (Tenure) (i.e., the length in years an event has been operated in a State), and geographic location (Location) were scrapped from Athlinks.com. Also, the information regarding the average size of an event (Size) was obtained from Running USA statistics database. Finally, the total number of PSEs within 50 states over the designated period was captured from the USATF event sanction database. To match with Gallup database, a time framework ranging from 2008 to 2014 was defined to run the data scrapping procedure in Perl. The program iterated over all event profile pages from the respective websites and extracted the pertinent information on all listed PSEs. Lastly, the information on population density (PD) and weather conditions (PREC & TEMP) at the state level was obtained from the United States Census Bureau and National Oceanic and Atmospheric Administration's National Centers for Environmental Information (NOAANCEI) respectively. This information combined with LOCATION were included as instrumental variables in the subsequent panel analysis.

Data Analysis

Panel Data Analysis

To investigate the effect of PSEs-related determinants on population health at the state level (e.g., H_1), panel regression with an instrumental variable (IV) approach was conducted using a Simultaneous Equations Models (SEMs) framework in Stata version 14. In the obtained panel, the value of the three dependent variables and three instrumental control variables varies across the states over the years 2008 through 2014. Potential confounding effects of unobserved time-invariant regressors (e.g., socio-cultural factors) can be mitigated by using fixed-effects two-stage least squares with the instrumental variable approach. For example, residents' attitudes toward active leisure can be an endogenous factor that has cumulative spurious effects on both the event participation behaviors and health outcomes at the state level. The influence of such unobserved time-invariant regressors can be removed by first differencing through the employment of time-averaged time variant regressors (e.g., population density), which should be uncorrelated with state-specific error terms to become a valid instrument (Angrist & Pischke, 2008).

Prior to empirical testing, a standard procedure of data screening was conducted through the examination of missing data, homogeneity of variance, multivariate outliers, and potential multicollinearity (Tabachnick & Fidell, 2007). Once the data screening procedure was completed, the subsequent empirical analysis contains four steps. In step one, a reduced-form of regression model was identified using Mallow's C(p) technique. Empirical models, in which the computed value of C(p) equals to or is indefinitely close to the total number of predictor variables, were retained. This specification was crossed checked by comparing the variance explained as well as the Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC) statistics of competing models. Once the identification of reduced-form regression models was established, panel regressions without the inclusion of instrumental variables were administered to examine the relationship between PSEs breakdown with Size, Tenure, TotalN and population health outcomes (e.g., PA, MH, & PH) in step two. In addition to regressing three specific community health outcomes, a composite health measure was also computed for a robustness check. This formative composite was calculated by using community-level physical activity participation rate, reported physical health and mental wellness, and evaluative well-being index with the Weighted Least Square Regression technique (DiStefano, Zhu, & Mindrila, 2009).

In the third step, the IV approach was employed to regress endogenous PSEs variables on a vector of explanatory variables, which includes four instrumental variables (e.g., PD, LOCATION, TEMP, & PREC). Econometrically, this set of IVs is correlated with PSEs related factors but unnecessarily related to community health outcomes. This selected set of instrumental variables were adapted from prior research examining sport participation on wellbeing. The selection was based on the assumption that they are exogenous to unobservable state-specific factors affecting the status of PSEs across the states over time (Forrest & McHale, 2011; Huang & Humphreys, 2012; Ruseski, Humphreys, Hallman, Wicker, & Breuer, 2014; Humphreys & Ruseski, 2015). To obtain consistent estimation, a valid instrumental variable is required to meet the following two assumptions: (a) relevance condition, that is, it can affect endogeneous independent variables such as PSE related factors such Size, Tenure, and TotalN; (b) exogeneity condition, that is, it cannot affect population health at the state level (Angrist & Pischke, 2008). Hence, the first-stage F-statistic and Durbin-Wu-Hausman test of endogeneity were used to assess the strength and validity of three instrumental variables. Finally, the predicted value of PSEs factors was used in the fourth step to estimate the effect on the aggregate community health outcome. Collectively, the above four steps can be translated into an empirical model as the follows:

Stage 1: $\widehat{X}_{it} = \pi_0 + \pi_1 Z_{it} + v_{it}$ (1)

Stage 2: $Y_{it} = \beta\hat{X}_{it} + \lambda_1\Gamma_{1it} + \lambda_2\Gamma_{2it} + \ldots + \lambda_m\Gamma_{mit} + \alpha_t + f_i + u_{it}$ (2)

Where Y_{it} is the dependent variable of a state-level health status for a particular state *i* at year of t ranging from 2008 to 2014, $\hat{X}_{it}$ is the predictive number, tenure, and size of organized participant sport events using estimation with instrumental variables, *m* refers to the number of state-level control variables including demographic and environmental factors; where *Z* represents a vector of four instrumental variables (PD, LOCATION, TEMP, & PREC); *α and f* refer *to* time and state fixed effects; *i* refers to each of the 50 states plus the District of Columbia in the U.S.; *t* indicates a particular point of year; v_{it} is residual term with mean of zero and constant variance capturing unobservable and omitted factors that affect PSEs related factors; u_{it} represents the error terms with mean of zero and constant variance measuring additional omitted determinants of community health, where u_{it} and v_{it} are uncorrelated.

Following Wooldridge's (2010) recommendation for empirical research, a sequence of robustness checks was conducted. The goal was to provide quality assurance of the accuracy and precision of the estimated the effects of PSEs on population health: (a) although it is deemed appropriate to relax the assumption of independence across the states in the collected panel given that the number of states is fixed (i.e., N=50), estimations with autocorrelated heteroscedasticity-robust standard errors were used in Stata 14 in the current investigation (Wooldridge, 2010). (b) The Hansen's (1982) J-statistic was adopted to determine if the issue of overidentifying restriction is present in the current investigation given that the number of instruments is greater than the equivalent of endogenous independent variables. (c) Ramsey's (1969) RESET test was conducted to test the functional form of the proposed empirical model. The current research did not include nonlinear functions of squares and cross products of all exogenous regressors as this procedure can absorb considerable amount of degree of freedom. (d) the Generalized Method of Moments (GMM) estimator and Pooled OLS was cross-checked as references to test the consistency and efficiency of the causal estimates (Windmeijer, 2005). (e) a reverse causality check was examined to control for potential feedback loop.

Moreover, the current dissertation undertook a series of actions recommended by Lin, Lucas, & Shmueli (2013) to mitigate the p-value pitfalls (i.e., the too big to fail problem) and the associated misleading conclusions drawn from large samples. The problem commonly arises when researchers utilize conventional small sample statistical methods to handle large data sets (namely over 10,000 data points). The detailed modeling and inference approach overly rely on a designated p-value, and the sign of regression coefficients of focal predictor variables to determine the significance of results despite the findings are equipped with little or no practical values. The explanations aimed to present informative evidence to show the impact of these population-based PSEs on population health at the state level as they can (a) indicate the baseline effect of a state's health outcome when the independent variable equals to zero. (b) infer the traditional sense of the effect size in percentage terms. (c) demonstrate the relative magnitude of the effect size by displaying the range of expected outcomes.

Multigroup Latent Growth Curve Analysis

In the previous section, the testing of hypothesized effects of PSEs on population health was discussed using panel data analysis with the time and state fixed-effects models. This technique assumes that the underlying relationship between PSEs and population health at the state level is static and fails to reveal if the strength of such relationship may change over time and, more importantly, whether it can be reflected differently in a given state (Zheng, Pavlou, & Gu, 2014). In other words, this approach does not capture the dynamic state-specific forces that might affect the longitudinal trajectory of community health and how the effects of participant sport events on community health vary over time contingent upon time-centric yet intra-state differences.

The crucial distinction between fixed and random effects does not lie in the nature of the effect, but whether an inference is made with regards to the population characteristics in general (e.g., across all 50 states) versus sample-specific effects (e.g., the provision of PSEs at a given state) (Hsiao, 2014).

Hence, in order to address the H_2, the current dissertation employed Multigroup Latent Growth Curve Analysis (LGCA) with the robust maximum likelihood estimation in Mplus 7.4 (Muthén & Muthén, 1998-2017) to estimate the random effects of participant sport events on community health. The results of a model validation process using Zheng et al's (2014) *d-separation*[2] criterion suggested that the initial model developed latent growth modeling offers a proper lens through which the current investigation can test H_2. This random coefficient model provides an alternative strategy to account for the varying effects (slopes and intercepts) for each state over time. The purpose was to examine if the positive impact of PSE's on community health significantly differ across the states over time. Specifically, there are two layers of information to unfold: (1) If the effects of PSEs on population health are significantly different across the states contingent upon the provision of environmental resources (e.g., economic development & geographical region to which a state belongs) to promote healthy living. (2) Wether or not increasing trajectories of change will occur in the hypothesized effects during the time period of this investigation (2008-2014).

Following Chan and Schmitt's (2000) recommendation, a procedure of multi-phases of analysis was employed to test H_2 operationalizing in the covariance-based structural equation modeling (CBSEM). It should be acknowledged that the LGCA with the CBSEM approach is superior to traditional longitudinal models given that: (1) It allows measurement with errors. (2) It is highly flexible to handle censored and unequally spaced data points. (3) It relaxes the assumption of multivariate normality. (4) It provides a series of criterion to justify the goodness of fit. (5) It requires sufficiently large sample size to assure statistical power (Curran, Obeidat, & Losardo, 2010). This process has been adopted in prior longitudinal research looking at the capacity of PSEs in sport (Sato et al., 2014).

First, four unconditional latent growth models (see an example in Figure 3.1) were evaluated breakdown with TotalN, Size, Tenure, GHR. It aimed to (1) assess if PSEs related factors and an aggregated population health outcome follow an increasing trajectory over the time period (2008-2014). (2) Whether or not the initial value of each included variable (e.g., the number of PSEs in 2008) influences the rate of change in the respective variable (e.g., the rate of change in the number of PSEs over time).

Second, a generalized multigroup LGCA for the effects of PSEs on population health is presented in Figure 3.2. The loadings of the latent intercept factor were constrained at a value of one over the period from 2008 to 2014. This parameter represents an initial status of the effects for PSEs related factors on community health. The loadings of the repeated-measure beta coefficients of the effects of the latent slope factor were uniformly configured as [0,1,2,3,4,5,6,7,8]. This specification proposes a linear growth of change given the equal spacing time periods, that is, the PSEs related factors follow either a monotonically increasing or decreasing pattern 2008 through 2014 (Duncan & Duncan, 2009).

Third, same-item residuals were constrained to be equal with freely estimated error variance and a fixed intercept at a value of zero. This specification was made based on the assumption of homoscedastic errors across the repeated measurement occasions under the classical test theory (Curran et al., 2010). The covariance between the latent intercept and slope factor was included. This model configuration provides valuable information regarding the manner in which the trajectories of specific effects over time are influenced by the point of inception at each state in 2008 (Duncan & Duncan, 2009). For example, a downward slope regarding the rate of change in the number of PSEs over time is more likely to be observed if a state in which more PSEs were hosted in the year of 2008, the starting point for each state.

To establish the robustness of the functional form of the final linear model of change, a series of nested univariate non-linear polynomial and unspecified growth models were also fitted to the data (Duncan, Duncan, & Strycker, 2013). For example, the loadings of parameter describing rate of change in the Number of PSEs were specified as [0, 1, 4, 9, 16, 25, 36, 49 and 64] in the quadratic models while the loadings of equivalent parameters were fixed as [0, 1, 8, 27, 64, 125, 216, 343, and 512] in the cubic models, and as [0, 1, λ_1, λ_2, λ_3, λ_4, λ_5, λ_6] in the optimally estimated unspecified models. In this model configuration, the remaining of factor loadings on the change variable beyond the first two were freely estimated (Sterba, 2014).

Next, an augmented global multivariate latent growth model (See Figure 3.2) was constructed. The purposes were twofold. First, the goal of the multivariate LGCM was to test if specific effects of PSEs on population health follow an increasing trajectory 2008 through 2014. That is, whether the rate of change in PSEs related factors can positively lead to the trajectory of population health. Second, it assesses if the specific effects of PSEs on community health significantly differ across the states contingent upon two state-specific factors. That is, whether a stronger effect will be observed in a state (a) where more environmental resources are in place to promote health due to the relative advantage in economic development, and (b) where a better socio-cultural environment exists to support healthy living. All previously supported time-variant and time-invariant controls and covariates were included in the global model testing. For the present study, these were variables presented in Table 3.1.

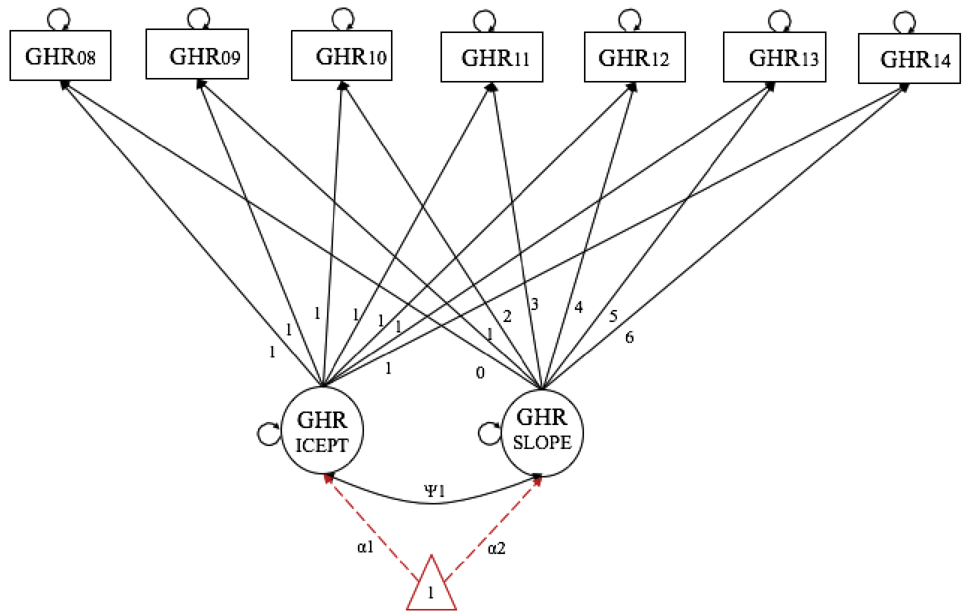

Figure 3.1. Unconditional Latent Growth Model of General Health Rating

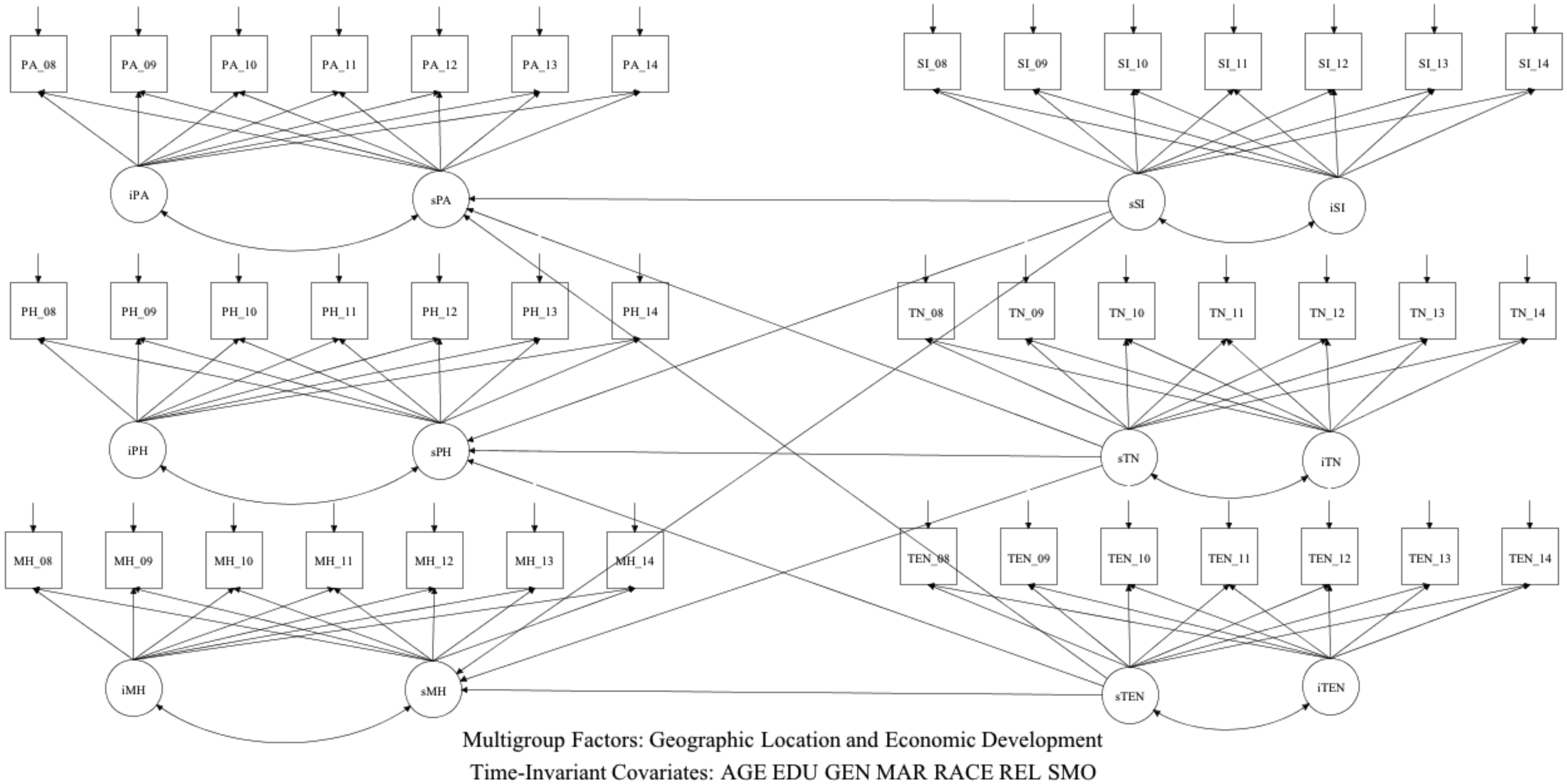

Figure 3.2. Multi-group Multivariate Latent Growth Curve Modeling

Finally, to run the multigroup moderation analysis in the multivariate latent growth model, two state-related dummy variables were used. These dummy variables were the provision of environmental resources and past behavior of physical activity participation and were created by using a median split technique (MacCallum, Zhang, Preacher, & Rucker, 2002). This procedure helps tests for equality of parameters across the groups. Finally, in the current study, the following five indices were utilized to evaluate how well the proposed empirical model fits the data: (a) the Chi-square goodness of fit test, (b) the comparative fit index (CFI), (c) the standardized root mean square residual (SRMR), and the root mean square error of approximation (RMSEA). The Satorra-Bentler scaled statistic (Δ $S\text{-}B\chi^2$) difference test was utilized to compare the fit of any a pair of nested models and conduct the multigroup analysis in the proposed latent growth model.

Study 2

Data Collection and Measures

Study 2 used a spatially clustered cross-sectional data to test H_3. The purpose was to explain the underlying mechanism through which PSEs influence population health. Specifically, it aimed to determine if the accessible opportunities to participate in the leisure-time physical activity at the state level mediates the positive relationship between the provision of PSEs and population health at the county level. Conceptually, the positive impact of PSEs at the state level can spill over to subordinate local counties (Huang & Humphreys, 2012).

Multiple data sources were used to obtain independent and dependent variables. This approach has been commonly recommended as a procedural remedy to mitigate threats caused by common method bias in social science research (Podsakoff et al., 2003; Podsakoff et al., 2012). First, the information regarding PSEs, the Independent Variables, was scrapped from

Athlinks.com and USATF sanction database. Second, information on the focal Dependent Variables was extracted from the 2014 County Health Ranking (CHR) database. The complete codebook of this dataset is available at the CHR website (CHR, 2014). The dataset contains the measured value, numerator, and confidence intervals for all county health measures for each county in the United States.

The 2014 dataset compiled population health outcomes (e.g., general health rating, physical health, mental health, and physical activity participation) using county-level measures from multiple national data sources. They include the American Community Survey (ACS), Behavioral Risk Factor Surveillance System (BRFSS), Current Population Survey (CPS), the National Center for Chronic Disease Prevention and Health Promotion (NCCDP), and National Center for Health Statistics (NCHS). These data were originally collected via a state-based system of surveys. It randomly sampled over four million adult respondents aged 18 years or older through either landline telephones or personal cell phones. This data compilation helps the current research identify theoretically-supported risk factors that influence physical activity participation and community health outcomes. The health behavior of physical activity participation rate represents a percentage of adults aged 18 and over in a county who participated in leisure-time physical activity or exercise within the past 30 days other than their regular job. Optional responses include yes, no, or refused to answer. Evaluative Wellbeing (GHR) was measured by a self-reported general health status with a 5-Likert scale ranging from 1= poor health condition to 5= excellent health status. This item has been widely accepted to assess general health and wellness (Cerin & Leslie, 2008; Leslie & Cerin, 2008; Senn, Walsh, & Carey, 2014).

Detailed information on measures of included variables and correlates are presented in Table 3.2. To proceed with a parsimonious model for the subsequent empirical testing, a model selection procedure was conducted using Mallows' C(p) in Stata version 14. A model consisting of items presented in Table 3.2 was identified to provide an optimal solution based on: (a) it explained the largest variance in what DV; (b) the computed C(p) value was equal or close to the total number of predictor variables (what are the predictor variables) based on Mallows' C(p) criterion (Livingood et al., 2013; Pliakas, Wilkinson, & Tonne, 2014); (c) it provided the smallest value of the Akaike information criterion and Bayesian information criterion. It should be noted that five statistically insignificant variables (gender, marital status, ethnicity, food environment, air pollution, and drinking water violation) were also included because prior research has shown that they are important demographic and environmental factors that can influence community health outcomes (Sallis et al., 2006; Senn et al., 2014). Taken together, thirty-three variables were included in the subsequent analyses. Given the participants were randomly selected and representative of county population, information on the county-level variables was aggregated using a 5-digit Federal Information Processing Standard code. The combined data set included 2,235 usable counties across the 50 states and the District of Columbia, which accounts for 71% of the 3,143 counties and county equivalents in the United States.

Table 3.2

Variable Descriptions of Study 2

Variables	Measurement
Year	Year
State	StateID
Region	Region (South, West, Northeast, Midwest)
County	FIPS County Code
SIZE	Average Size of Participants
TEN	Average Tenure of Events
TN	Total Number of Events
HCOMP	A composite score using PA,GHR, PH,and MH
GHR	General health rating 1= poor 5=excellent
PH	Number of days physical health not good during the past 30 days
MH	Number of days mental health (Stress, Depression, Emotional Problems) not good during the past 30 days
PA	Exercise or physical activity other than regular job in the past month (percent of adults aged 20 and over reporting leisure-time physical activity)
ATEO	Access to exercise opportunities (Value percent of the population with adequate access to locations for physical activity
INC	Monthly household income \$3000 to \$7500
DOC	Could not see doctor because of cost
POV	Children in poverty Value
UNI	Uninsured rate
AGE	Age groups 18-60
EMP	Full time employee
GEN	Female
EDU	Some college
RACE	Mean scores represent % of white in each county
MAR	Married
CHI	Number of children in household
BMI	Body mass index
SMO	Adult smoking Value
FEI	Food environment index Value
HOME	Own or rent home
lnPOP	2014 population estimate Value
OW	Mean scores represent % of obese in each county
CRIM	Violent crime value
AP	Air pollution - particulate matter Value
DWVV	Drinking water violations Value

Data Analysis

Multilevel Mediation Analysis

To assess multilevel mediation as proposed in the H_3, a 2-2-1 multilevel modeling (MLM) (see Figure 3.3) was operationalized in the multilevel structural equation modeling (MSEM) using Mplus 7.4 (Muthén & Muthén, 1998-2017). The MSEM does not require multiple stages of analysis and provides simultaneous estimation and unbiased statistical conclusions with accurate standard errors (Preacher, 2015). Hence, this integrative approach is deemed appropriate to testing the proposed mediation hypotheses with geographically clustered data by accommodating mediation pathways with level-2 (i.e., state-level) outcomes (Preacher, Zyphur, & Zhang, 2010). For the present study, this means to determine if there are state-level factors can explain why PSEs can impact the population health at the county level.

Traditional methods that use ordinary regression analysis are inappropriate in such settings given that the assumption of independence of observations is likely to be violated. Therefore, accounting for two levels is required because the counties in the sample are nested geographically in states. The following section describes the specific procedure to conduct the multilevel mediation analysis. First, a merged dataset was aggregated using the weighted grand mean and group mean centering techniques to create meaningful clusters to the state level in Stata version 14. This process informed the subsequent analysis of the nested structure in Mplus. Without centering, data is likely to exhibit high levels of multicollinearity (Preacher, 2015). The level-1 predictors contain variables at the county-level whereas the level-2 regressors include variables at the state level. For example, in the current study, level-1 predictors included socio-demographic factors at the county level. Level-2 regressors included PSEs related information with respects to Size, Tenure, and Total Number at the state level.

Prior to the administration of the empirical testing, the design effect was evaluated by calculating the intra-class correlations (ICC) for the included endogenous variables at the level 2. The purpose using ICC was to test if there are significant and meaningful variations in PSEs regarding Size, Tenure, and Total Number across the 50 states and the District of Columbia. If the value of design effect is less than two, it is appropriate to proceed with multi-level analysis by including clustered structure as part of the empirical model. This result was augmented based on the findings of the one-way Analysis of Variance (ANOVA).

As shown in Figure 3.3, I specified the state-level PSEs factors (e.g., Size, Tenure, and Total Number) and the Access to Exercise Opportunities at the level 2 and county-level Population Health (e.g., a composite of Physical Health, Mental Health, and Physical Activity Participation) at the level 1. Hypothesized multilevel associations were then constructed using a 2-2-1 design in Mplus. In addition, maximum likelihood estimation with robust standard errors was employed. Lastly, following Preacher et al's (2010) procedure, I used the Monte Carlo method to test the significance of multilevel indirect effects by computing 95% confidence intervals (CIs). Detailed results of empirical testing are presented in Chapter 4.

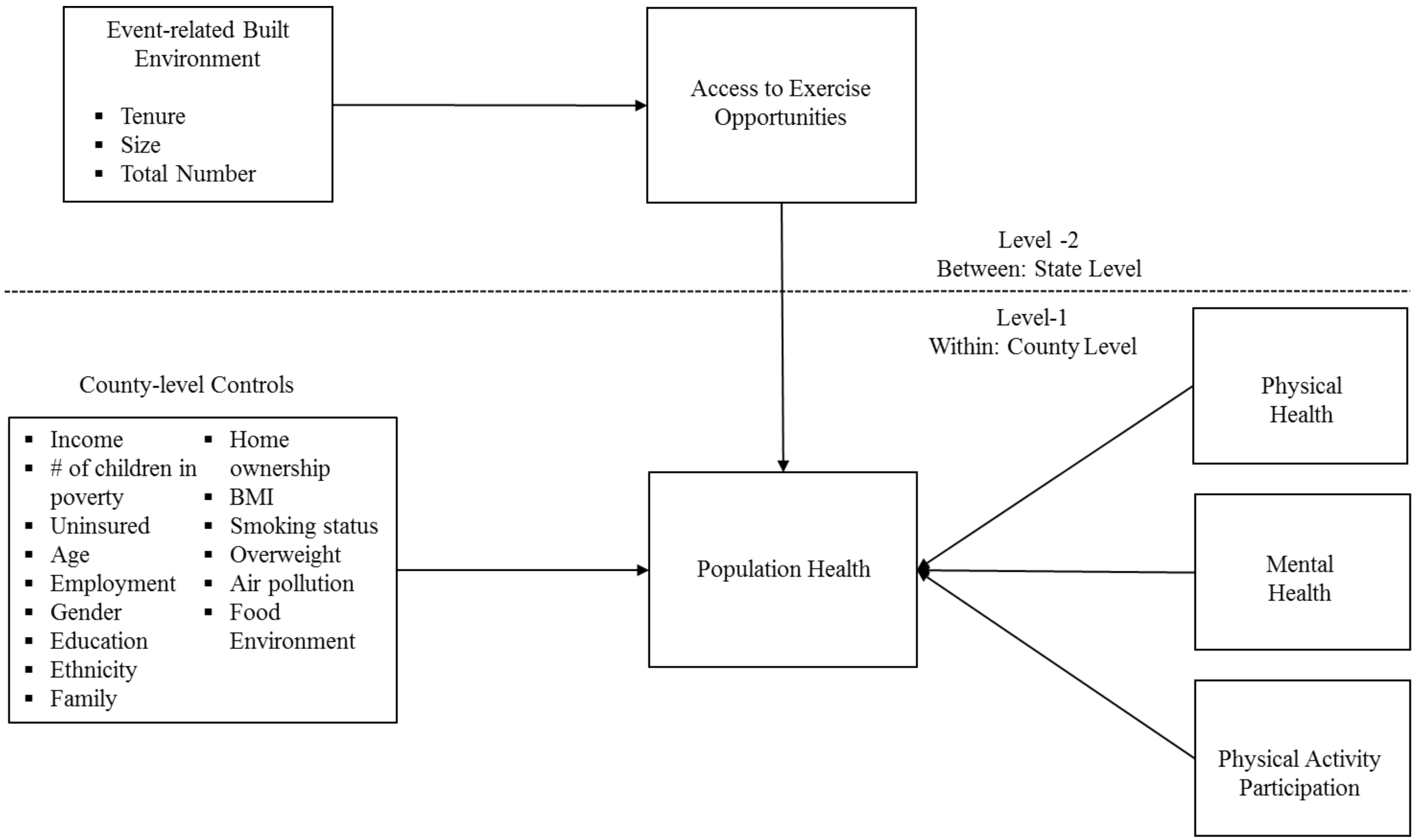

Figure 3.3 The Hypothesized 2-2-1 Multilevel Mediation Model

CHAPTER 4

RESULTS

This section describes the results of the statistical analyses that were employed in the current dissertation. First, with fixed-effects panel regression and an instrumental variable approach, the results supported that variance in PSEs related factors (i.e., Total Number, Size, and Tenure) can influence the state-level population health with respects to Physical Health, Mental Wellness, and Physical Activity Participation while accounting for correlates thought to affect population health. Second, the findings of the multi-group latent growth curve analysis showed that the strength between the provision of PSEs and health yielded different patterns contingent upon a state's economic condition and the geographical region to which a state belongs. Third, using a cross-sectional county-level data, the results of multilevel mediation analysis indicated that resources and opportunities available to promote active lifestyles for the state population represent a supporting pathway through which PSE's collectively enhance the health of the respective constituent counties.

Study 1

Panel Data Analysis

The following section highlights the econometric specifications employed to examine the relationship between PSE and health at the state level, with particular emphases on the association between Total Number, Size, and Tenure of PSE and population health breakdown with Physical Health, Mental Health, and Physical Activity Participation. Overall, the identification strategy used panel regression with fixed effects to account for state and year-specific variation, relaxed potential omitted variable bias with a set of previously identified control variables, and alleviated potential endogeneity issue between PSE and health using the instrumental variable approach. Lastly, I robust checked the results using a number of alternative empirical specifications to demonstrate that the findings are preferable to these alternative model configurations.

First, a summary of descriptive statistics of included measures was presented in Table 4.1. Results revealed that mean scores for the dependent variable of health outcomes ranged from M=2.884 for Physical Activity Participation, M=.817 for Mental Health, and to M=3.347 for Physical Health. Table 4.1 also presents the means, standard deviations, minimum and maximum values, as well as a number of observations for independent (Total Number, Size, and Tenure of Events) and control variables (e.g., Socio-economic and personal factors). Inferential analyses were administered to create dummy variables of nonmetric control variables (Hair, Black, Babin, & Anderson, 2010). Geographical regions were coded into levels of four groups (1=South, 48.9%), (2=West, 11.81%), (3=Northeast, 9.4%); (4=Midwest, 29.89%). This item was then transformed into three dummy variables to represent a respective region.

Table 4.1

Summary Statistics of Panel Regression

VARIABLES	(1) N	(2) mean	(3) sd	(4) min	(5) max
StateID	357	26	14.74	1	51
Year	357	2,011	2.003	2,008	2,014
RegionD_S	357	0.333	0.472	0	1
RegionD_W	357	0.255	0.436	0	1
RegionD_NE	357	0.176	0.382	0	1
Location	357	326.2	421.6	0	1,786
Size	357	298.9	204.7	0	1,792
TotalN	357	141.1	157.2	4	946
Prec	357	39.48	17.74	7.030	131.9
Temp	357	52.49	8.923	24.30	74.70
PD	357	465.6	1,959	1.200	15,077
FV	357	4.068	0.148	3.567	4.666
Age1	357	0.198	0.0277	0.126	0.310
Age2	357	0.331	0.0269	0.262	0.397
Age3	357	0.264	0.0218	0.165	0.336
Age4	357	0.194	0.0241	0.104	0.255
Religion	357	0.325	0.0733	0.156	0.506
GHR	354	0.209	0.0270	0.139	0.300
PA	357	2.884	0.197	2.467	3.587
MH	357	0.817	0.0174	0.743	0.876
PH	357	3.347	0.601	1.856	5.775
BMI	357	27.43	0.500	25.43	28.81
HP	357	0.221	0.0303	0.131	0.337
Edu	357	0.459	0.0439	0.330	0.568
Gender	357	0.511	0.0114	0.465	0.555
Income	357	0.327	0.0414	0.218	0.428
Married	357	0.522	0.0535	0.214	0.646
Ethn	357	0.773	0.137	0.325	0.976
Smoke	357	0.214	0.0367	0.104	0.317
Tenure	357	1.854	0.950	0	5.500

Note. Prec=Precipitation; Temp=Temperature; PD=Population Density; FV=Fruits and Vegetables; GHR=General Health Rating; PA=Physical Activity; MH=Mental Health; PH=Physical Health; HP=Health Problems; Edu=Education; Ethn=Ethnicity

Fixed Effects Panel Regression

One issue that when researchers analyze the effects of PSE on population health refers to the fact that we are unable to control for all variables that may have the capacity to influence health at the population level (Inoue et al., 2015). In this regard, two commonly used econometric strategies were employed. First, I used state fixed effects to control for all state-level variables that intuitively do not vary over time. Year fixed effects were also included to control for all time-related variations and the potential impact that may contribute to the change in population health. In sum, the proposed fixed effects model controls for both the unobservable state-specific time-invariant characteristics and time-variant factors that may influence the outcome variable, population health. The second strategy followed the previous empirical research by including a number of control variables, such as state-level socioeconomic factors, in the empirical model. This procedure further accounts for previously identified factors and correlates that may impact the population health (Sato et al., 2016). Unlike the fixed effects models, the representation of the models with control variables aims to account for factors that either stay constant or vary over time whose effects has been examined in the previous literature. Finally, the evidence of the practicality of statistical significance of the effect and directionality of hypothesized independent variables were reported by presenting the effect size. The sensitivity of focal dependent variable (e.g., population health) to marginal changes in independent variables (e.g., Total Number, Size, and Tenure of Events). The purpose was to, as objectively as possible, facilitate a better understanding of the meaning and magnitude of each significant regressors breakdown with both signs and values within the current research context.

Following previous empirical study (Huang & Humphreys, 2012), the effect size of hypothesized independent variables was reported. All the results including regression coefficients, the associated p-values, robust stand errors and t-statistics were presented in Table 4.2. I started by estimating the impact of PSEs on population health at the state level using the econometric analysis with the full sample (*n*= 357). The interpretations breakdown with three included independent variables were illustrated as the following. Model 1 was robust pooled regression model. Model 2 and 3 represent fixed-effects models to test the effects of PSE on community health comprised of physical, mental, and behavioral aspects. Model 4-6 represent three Seemingly Unrelated Regression models to check the robustness of the findings generated from Model 2 and 3. For instance, to interpret the practical or economic significance of PSE in promoting perceived health for state residents, the results in Model 3 indicated that adding every 1,000 events in a state is likely to elicit detrimental effects on the state residents' positive evaluation towards their wellbeing by less than 1%. Introducing a large-scale participant sport event in a state, the proportion of the state population feels they are physically in good condition increases by 1.2%. Creating a positive and lasting event legacy through successfully managing and operating PSEs in a state is likely to help the state residents live actively by .07%.

Table 4.2

Results of Robust Pooled OLS, Panel Regression with Fixed Effects, and Seemingly Unrelated Regression

VARIABLES	(1) GHR Robust Pooled OLS	(2) GHR Panel1	(3) GHR Panel2	(4) PA SUR	(5) MH SUR	(6) PH SUR
Tenure	0.000	0.007*	0.007*	0.0003	0.001	0.025**
	(0.073)	(1.812)	(1.812)	(0.070)	(0.918)	(2.105)
Size	0.000	0.0012*	0.0012*	0.000	0.000	0.000
	(0.722)	(1.776)	(1.776)	(0.110)	(1.162)	(0.625)
TotalN	-0.000	-0.0008*	-0.0008*	-0.0023	-0.0032*	-0.0029
	(-0.095)	(-2.343)	(-2.343)	(-0.808)	(-1.788)	(0.486)
Age1	0.907***	-0.015	-0.015	8.568***	-0.043	-5.242
	(4.279)	(-0.101)	(-0.101)	(3.769)	(-0.185)	(-1.361)
Age2	1.040***	-0.185	-0.185	5.142**	-0.296	-3.460
	(5.187)	(-1.248)	(-1.248)	(2.199)	(-1.253)	(-0.873)
Age3	0.990***	-0.118	-0.118	7.192***	-0.178	-3.160
	(4.787)	(-0.646)	(-0.646)	(3.151)	(-0.770)	(-0.817)
Age4	0.943***	-0.220	-0.220	6.764***	-0.139	-3.624
	(4.393)	(-1.435)	(-1.435)	(2.877)	(-0.585)	(-0.910)
Religion	-0.018	-0.012	-0.012	-0.500***	-0.019	1.254***
	(-0.909)	(-1.026)	(-1.026)	(-2.888)	(-1.057)	(4.273)
FV	0.005	0.025**	0.025**	0.480***	0.006	-0.030
	(0.680)	(3.201)	(3.201)	(7.402)	(0.955)	(-0.268)
HP	-0.437***	-0.267***	-0.267***	-0.720	-0.151***	14.092***
	(-7.958)	(-4.928)	(-4.928)	(-1.479)	(-3.072)	(17.068)
Edu	0.133***	0.069***	0.069***	0.874***	0.123***	-0.855*
	(4.490)	(4.458)	(4.458)	(3.197)	(4.449)	(-1.846)
Gender	0.207**	0.157	0.157	-1.285	0.045	1.329
	(2.226)	(1.928)	(1.928)	(-1.565)	(0.536)	(0.955)
BMI	-0.017***	-0.014***	-0.014***	-0.074***	0.001	0.037

Table 4.2, continued

Results of Robust Pooled OLS, Panel Regression with Fixed Effects, and Seemingly Unrelated Regression

VARIABLES	(1) GHR Robust Pooled OLS	(2) GHR Panel1	(3) GHR Panel2	(4) PA SUR	(5) MH SUR	(6) PH SUR
	(-6.541)	(-3.843)	(-3.843)	(-3.287)	(0.429)	(0.973)
Income	0.073*	0.163*	0.163*	0.640*	0.045	-0.758
	(1.866)	(2.129)	(2.129)	(1.656)	(1.145)	(-1.157)
Married	-0.122***	-0.076**	-0.076**	0.127	0.081***	-0.928*
	(-3.918)	(-2.709)	(-2.709)	(0.447)	(2.825)	(-1.923)
Ethn	0.072***	0.056***	0.056***	0.078	-0.057***	0.228
	(6.555)	(7.254)	(7.254)	(0.781)	(-5.702)	(1.352)
Smoke	-0.018	-0.124**	-0.124**	0.944***	0.005	2.005***
	(-0.464)	(-2.633)	(-2.633)	(2.859)	(0.147)	(3.584)
RegionD_S	0.018***	0.011**	0.011**	0.054**	-0.005*	0.029
	(6.170)	(2.978)	(2.978)	(2.113)	(-1.769)	(0.674)
RegionD_W	0.009***	0.001	0.001	0.139***	-0.003	0.178***
	(2.728)	(0.359)	(0.359)	(4.488)	(-1.000)	(3.387)
RegionD_NE	0.015***	0.012***	0.012***	0.038	-0.001	0.039
	(4.308)	(3.844)	(3.844)	(1.306)	(-0.265)	(0.789)
2009.Year				-0.046*	-0.002	0.013
				(-1.817)	(-0.809)	(0.311)
2010.Year				-0.013	-0.001	0.052
				(-0.443)	(-0.485)	(1.022)
2011.Year				-0.067*	-0.007**	0.095
				(-1.826)	(-1.971)	(1.521)
2012.Year				-0.056	-0.005	0.084
				(-1.422)	(-1.176)	(1.247)
2013.Year				-0.083*	-0.013***	0.089
				(-1.745)	(-2.637)	(1.109)
2014.Year				-0.035	-0.019***	0.118

Table 4.2, continued

Results of Robust Pooled OLS, Panel Regression with Fixed Effects, and Seemingly Unrelated Regression

VARIABLES	(1) GHR Robust Pooled OLS	(2) GHR Panel1	(3) GHR Panel2	(4) PA SUR	(5) MH SUR	(6) PH SUR
				(-0.748)	(-3.895)	(1.480)
Constant	-0.406*	0.548**	0.548**	-3.633	0.902***	2.393
	(-1.784)	(2.986)	(2.986)	(-1.512)	(3.711)	(0.588)
Observations	354	354	354	357	357	357
R-squared	0.766	0.744	0.744	0.699	0.605	0.907
Number of Years		7	7			
State FE		YES	YES			
Year FE			YES			

Note. FE=Fixed Effects; FV=Fruit and Vegetable Intake; GHR=General Health Rating; HP=Health Problem; MH=Mental Health; PA=Physical Activity Participation; PH=Physical Health; SUR=Seemingly Unrelated Regression; t-statistics in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Two-Stage Least Squares Regression

Following the discussions in Chapter 3, three individual instrumental variables (temperature, precipitation, and population density) were included in the 2SLS regression analysis. Conceptually, these natural factors have the potential to influence the provision of PSEs at the state level. For instance, a higher temperature in states will make it harder to operate long distance road races given the fact that severe weather such as heat will be likely to lead to cancellations of these events. However, there is no *ex-ante* reason to assume that these factors are necessarily directly correlated with the level of well-being in a state. The results of 2SLS with instrumental variables presented in Table 4.3 support this assumption given that small effect size of respective beta coefficients (e.g., ranging from -.741 to .380) between non-event related factors and health. The findings also indicated that no serious multicollinearity issues were present in the current empirical investigation.

Further, the finding shown in Table 4.3 suggested that regression results are robust to a two-staged least squares model with the inclusion of the instrumental variables, which was confirmed by following a series of robustness testing including model identification, weakness of the instrumental variable, the exogeneity, and endogeneity of the instrument. The results support the validity of selected instrumental variables as they largely satisfy the conditions that IV should be correlated with the actual provision of PSEs but not correlated with error terms in the regression models. Overall, the results of a series of diagnostic tests provide evidence for the validity and appropriateness of the proposed IV. After controlling for the issue of potential endogeneity between PSE and health using the IV approach, the results were consistent and comparable to the findings in the previous fixed-effects empirical specifications. Hence, H_1 was partially supported.

Table 4.3

Results of Two Stage Least Square Regression with Instrumental Variables

VARIABLES	(7) GHR 2SLS1	(8) GHR 2SLS2	(9) GHR xtivreg2
Size	0.001**	0.001**	0.001**
	(2.080)	(2.080)	(2.083)
TotalN	-0.006**	-0.006**	-0.006**
	(-2.533)	(-2.533)	(-2.549)
Tenure	0.0070*	0.0070*	0.0070
	(1.934)	(1.934)	(1.550)
Size×ED	0.005*	0.005*	0.004*
	(2.192)	(2.192)	(2.174)
TotalN×ED	-0.003*	-0.003*	-0.002*
	(2.204)	(2.204)	(2.215)
Tenure×ED	0.008**	0.008**	0.007**
	(1.798)	(1.798)	(1.988)
Age1	-0.429	-0.429	-0.429
	(-0.114)	(-0.114)	(-0.117)
Age2	-0.508	-0.508	-0.508
	(-0.132)	(-0.132)	(-0.136)
Age3	-0.595	-0.595	-0.595
	(-0.154)	(-0.154)	(-0.158)
Age4	-0.741	-0.741	-0.741
	(-0.188)	(-0.188)	(-0.194)
Religion	-0.117***	-0.117***	-0.117***
	(-4.488)	(-4.488)	(-4.503)
FV	0.057*	0.057*	0.057*
	(1.696)	(1.696)	(1.717)
HP	-0.057	-0.057	-0.057
	(-0.066)	(-0.066)	(-0.068)
Edu	0.027**	0.027**	0.027**
	(2.132)	(2.132)	(2.136)
Gender	-0.085	-0.085	-0.085
	(-0.077)	(-0.077)	(-0.079)
BMI	-0.022***	-0.022***	-0.022***
	(-4.741)	(-4.741)	(-4.764)
Income	-0.076	-0.076	-0.076
	(-0.131)	(-0.131)	(-0.135)
Married	0.380	0.380	0.380
	(0.465)	(0.465)	(0.479)
Ethn	-0.057	-0.057	-0.057
	(-0.202)	(-0.202)	(-0.208)

Table 4.3, continued

Results of Two Stage Least Square Regression with Instrumental Variables

VARIABLES	(7) GHR 2SLS1	(8) GHR 2SLS2	(9) GHR xtivreg2
Smoke	0.042*	0.042*	0.042*
	(2.197)	(2.197)	(2.100)
RegionD_S	-0.010	-0.010	-0.010
	(-0.231)	(-0.231)	(-0.238)
RegionD_W	-0.019	-0.019	-0.019
	(-0.466)	(-0.466)	(-0.480)
RegionD_NE	-0.009	-0.009	-0.009
	(-0.206)	(-0.206)	(-0.212)
Constant	0.954***	0.954***	
	(5.265)	(5.265)	
Observations	354	354	354
R-squared			.717
Number of Years	7	7	7
State FE	YES	YES	YES
Year FE		YES	YES

Note. ED=Economic Development; FE=Fixed Effects; FV=Fruit and Vegetable; GHR=General Health Rating; HP=Health Problem; t-statistics in parentheses; xtivreg2 represents fixed-effect 2SLS regression with both heteroscedasticity and serial correlation robust standard errors.
*** p<0.01, ** p<0.05, * p<0.1

Multi-Group Latent Growth Curve Analysis

In the Multi-Group Latent Growth Curve Analysis (LGCA), the sample size allows the current study to exploit the relationship between participant sport events and the state-level health outcomes. Specifically, the panel data provides sufficient information to conduct advanced analysis on subsamples of interest at each state while the statistical power in each subsample at the state level remains sufficient. The large sample size also enables the current research to incorporate as many control variables selected by previous research as possible into the modeling without compromising statistical power.

Unconditional Latent Growth Model

First, the growth trajectories of PSE-related factors (e.g., Total Number, Size, and Tenure of Events) combined with health-related factors (e.g., Physical Health, Mental Wellness, and Physical Activity Participation) were examined using unconditional latent growth models. In the unconditional latent growth models, the estimation of means of intercepts (i.e., the average starting point across the states) and slopes (i.e. the average rate of change nationwide) along with recommended a set of fit indices for all included both the exogenous and endogenous variables were calculated. Following the (Hooper et al., 2008)'s recommended cut-off benchmarks, the findings suggest that all unconditional latent growth models equipped with marginal satisfactory fit to accommodate the merged data: Total Number (χ^2/df = 109.22/23 = 4.75, CFI = .78, RMSEA = .081, SRMR = .084), Size (χ^2/df = 30.87/23 = 1.34, CFI = .71, RMSEA = .082, SRMR = .072), Tenure (χ^2/df = 109.22/23 = 4.75, CFI = .68, RMSEA = .097, SRMR = .089), Physical Health (χ^2/df = 132.752/23 = 5.77, CFI = .61, RMSEA = .090, SRMR = .091), Mental Wellness (χ^2/df = 128.35/3 = 5.58, CFI = .73, RMSEA = .085, SRMR = .082), Physical Activity Participation (χ^2/df = 137.32/23 = 5.97, CFI = .76, RMSEA = .092, SRMR = .091).

The mean of the linear slopes was positive and significant for Total Number (*M*=.22, *p*= .042), Size (*M*=.086, *p*= .042), Tenure (*M*=.19, *p*= .026) and Physical Activity Participation (*M*=.023, *p*= .034), whereas the mean of the equivalents was negative and significant for Physical Health (*M*= -.05, *p*= .031), Mental Wellness (*M*= -.01, *p*= .02). In the meantime, the mean of all the non-linear specifications of slopes (e.g., quadratic and cubic terms) was not statistically significantly at α= .05. Therefore, the non-linear slopes were removed from unconditional models. In addition, significant differences were revealed in both the initial levels of and the rate of change of all PSE and Health-related factors across the states at p<.05. Finally, the significant negative covariance between the intercepts and slopes of all the variables were found at $p<.05$. Overall, these results suggested that it is adequate to proceed with the following multi-group LGCA.

Multi-group Multivariate LGCA

Overall, the results of model evaluation suggested an acceptable fit (χ^2/df = 1.61/3 = .54, CFI = 1.00, RMSEA = .00, SRMR = .08). Specifically, the results of the multivariate associations between PSE-related factors and health-related outcomes were consistent with the findings concluded from the panel analysis. Specifically, a significant negative relationship between Total Number and Physical Health was found (β= -4.11, p= .012). Change in Average Size of Events (β= 0.15, p= .04) and change in Event Tenure (β= 0.01, p=.06) were significantly associated with a change in Physical Health. Likewise, regarding the relationships between PSE-related factors and Mental Wellness, change in Total Number of events (β= -0.039, p=.04), Average Size of Events (β= .02, p= .08), and Event Tenure (β=.09, p= .05) were significantly associated with a change in perceived Mental Wellness. Further, change in Total Number of Events (β= -1.341, p=), Size of Events (β=.07, p=.06), and Event Tenure (β=.06, p=.07) had a positive influence on the change in Physical Activity Participation. Finally, the included a set of control variables were found significantly associated with the initial level of health-related outcomes but insignificantly influenced the change in these health-related outcomes (p> .05).

Finally, I analyzed if the impact of PSE on health varies based on different clusters of states to test multi-group LGCA model. Two factors were identified, geographic location, and economic development, to understand in which states PSEs have played a stronger role in promoting health. The geographic and economic conditions are supported by the previous literature when examining population health (Sato et al., 2016). Last, to test the accumulative effects hypothesis, a median-split approach was used to create a moderator, where states were classified into low and high groups based on the respective historical record of physical activity participation. Subsequently, fifteen interaction terms using the mean-centering technique between clusters and PSE-related factors (e.g., Total Number, Size, and Tenure) were created. The results showed that both economic conditions (e.g., low vs. high-income conditions) benefit from the operating PSEs on health at the state level. However, differences resulting from geographical locations and accumulative effects do exist. For example, an increase in the Total Number of events in Northeast has a bigger impact on Physical Activity Participation (β= -1.341, p=.032) relative to the influence of PSE on health in Midwest (β= -1.124, p= .045). Hence, H_2 were supported.

Study 2

Multilevel Mediation Analysis

The third goal of the current dissertation was interested in testing the top-down influences of state-level factors on the county-level relationship between the participant sport events and health outcomes using a 2-2-1 multilevel mediation model configuration. Following conventions used by previous research, the current dissertation relies on formal designations of a five-digit Federal Information Processing code to draw the boundaries of geographical locations including all 48 lower states plus the District of Columbia and Hawaii. Such designations of focal units of theory and analysis help examine the relationships within and across levels of analysis. Specifically, the state-level resources (e.g., access to the exercise opportunities) influence the state-level provision of participant sport events, which in turn affects a collective health outcome at the county level. A summary of descriptive statistics of included measures was presented in Table 4.4.

Table 4.4

Summary Statistics of Multilevel Mediation Analysis

VAR	(1) N	(2) mean	(3) sd	(4) min	(5) max
Year	2,235	2,014	0	2,014	2,014
Region	2,235	2.203	1.318	1	4
SIZE	2,235	259.0	142.3	99	804
TEN	2,235	2.185	0.977	0.562	4.722
TN	2,235	143.2	158.3	16	781
HCOMP	2,235	3.947	1.190	-0.512	13.71
GHR	2,235	3.308	0.283	1.600	4.500
PH	2,235	4.836	1.796	0	22
MH	2,235	3.696	1.492	0	17
PA	2,235	0.715	0.0980	0	1
ATEO	2,235	0.567	0.224	0	1
INC	2,235	5.332	0.668	1	7.553
DOC	2,235	0.137	0.0693	0	0.600
POV	2,235	0.243	0.0874	0.0400	0.596
UNI	2,235	0.173	0.0520	0.0310	0.389
AGE	2,235	56.53	3.717	29.50	74
EMP	2,235	0.503	0.106	0	1
GEN	2,235	0.608	0.0811	0	1
EDU	2,235	0.546	0.131	0	1
RACE	2,235	0.835	0.156	0	1
MAR	2,235	0.566	0.0992	0	1
CHI	2,235	1.900	0.403	0	6
BMI	2,235	28.12	1.305	21.55	43.06
SMO	2,235	0.200	0.0746	0	0.511
FEI	2,235	7.524	1.050	1.430	10
HOME	2,235	0.779	0.0884	0	1
lnPOP	2,235	10.93	1.135	9.380	16.11
OW	2,235	0.670	0.0867	0	1
CRIM	2,235	277.7	212.7	0	1,990
AP	2,235	11.73	1.624	0	14.90
DWVV	2,235	0.0757	0.139	0	1

Note. TEN=Tenure; TN=Total Number; HCOMP=Health Composite Score; GHR=General Health Rating; PH=Physical Health; MH=Mental Health; PA=Physical Activity; ATEO=Access to Exercise Opportunity; INC=Income; DOC=Doctor; POV=Poverty; UNI=Uninsured rate; EMP=Employment; GEN=Gender; EDU=Education; MAR=Married; CHI=Children; SMO=Smoke; FEI=Food Environment Index; InPOP=Population Size; OW=Overweight; CRIM=Crime rate; AP=Air Pollution; DWVV=Drinking Water Violation Value

To test the hypothesized multilevel model, information regarding PSE as well as the Access to Exercise Opportunities at the state-level was aggregated using the grand-mean centering technique. In the meantime, the state level event information was collected from a separate third-party source. The procedure aimed to the largest extent to mitigate the common method bias and potential confounding effects that is commonly faced to social science research. Following, a one-way analysis of variance (ANOVA) was conducted. The results showed that the means of Number of Events, Size of Events, Event Tenure, and Access to Exercise Opportunities differed significantly across the states, with F (49, 2,230) =1.42, $p< .05$, F (49, 2,230) =1.42, $p< .01$, F (49, 2,229) =1.39, $p< .05$, and F (49, 2,234) =1.39, $p< .05$, respectively. In addition, intra-class correlations, ICC (1), ICC (2), were respectively .12 and .61 for Number of Events, .08 and .52 for Size of Events, .06 and .43 for Event Tenure, and .11 and .72 for Access to Exercise Opportunities.

Hypothesis three was tested using multilevel structural equation modeling (MSEM) within Mplus 7 (Muthén & Muthén, 2010). Compared to the conventional HLM approach, this framework estimates the proposed multilevel model simultaneously. Maximum likelihood with the robust standard error was selected to estimate coefficients. To test the significance of multilevel indirect effects, Monte Carlo method was used to compute the confidence intervals (CIs) (Preacher, Zyphur, & Zhang, 2010).

To estimate the hypothesized multilevel mediation model, cross-level direct effects were specified from Access to Exercise Opportunities to a composite health variable generated by three health-related outcomes (e.g., Physical Health, Mental Wellness, and Physical Activity Participation) using a formative Barlett score technique.

At the state level, PSEs-related factors (e.g., Number of Events, Size of Events, and Event Tenure) were specified to have a direct impact on Access to Exercise Opportunities, which would, in turn, related positively to Health at the county level. The Akaike Information Criterion (AIC) value of the proposed multilevel model was 968.32. It was smaller than that of the competing nested model with direct paths from PSE at the state level to Health at the county level (AIC= 1135.68), which suggested that the hypothesized model was superior.

Next, pseudo R^2 was computed to indicate the total amount of variation in the state and county level outcome variables. In total, the total variance explained by our model was 12% for Access to Exercise Opportunities, 8% for Physical Health, 15% for Mental Wellness, and 18% for Physical Activity Participation. To test the cross-level mediation effects, a parametric bootstrapping procedure with 20,000 Monte Carlo iterations was used. Bootstrapping results indicated that significant positive indirect effects of PSEs-related factors on Population Health via the Access to Exercise Opportunities, with the indirect effect= .17, (95% CI: .02, .32) for Number of Events → Access to Exercise Opportunities → Population Health. The indirect effect= .26, (95% CI: .13, .39) for Size of Events → Access to Exercise Opportunities → Population Health. Last, the indirect effect= .08, (95% CI: .01, .15) for Tenure of Events → Access to Exercise Opportunities → Population Health.Hence, H_3 was supported. A detailed discussion of results is provided in Chapter 5.

CHAPTER 5

DISCUSSION

Building upon the theoretical integration between the Psychological Continuum Model (PCM) and Behavioral Ecological Model (BEM), this dissertation investigated the potential capacity of participant sporting events (PSE) in enhancing population health. Using a series of empirical analyses, three aspects of the impact of participant sporting event (PSE) on health were illustrated: if the relationship is viable, how the relationship exists and varies, and why the linkage is established.

Collectively, the results of Study 1 and 2 indicated that (a) PSEs represent effective community-based interventions to influence population health at the state level. Average Size and Tenure of PSEs were found positively associated with population health while Total Number of PSEs was negatively related to population health. Hence, H_1 was partially supported. (b) Significant differences of the proposed significant linkage were found across the states. The effect of PSEs on population health at the state level significantly varies across the United States contingent upon a state's economic development and the geographical region to which a state belongs. Hence, H_2 was supported; (c) the access to exercise opportunities at the state level represents a key mediation pathway through which PSEs can elicit positive effects on health at the county level. Hence, H3 was confirmed.

Conceptually, the findings inform and augment the PCM framework (Funk & James, 2001) and the previous research using the PCM by including additional socio-economic and environmental factors drawn from a broader ecological perspective of BEM. Benefiting from a macro standpoint, this investigation provides empirical evidence to support prior research on the effectiveness of mass participant sporting events. Results demonstrated that these population-based sporting events have the potential to not only engage event participants to participate in physically active leisure continually but also help the less active segment of society to formulate positive attitudes toward active lifestyles and adopt health-related behaviors (Funk et al., 2011; Sato et al., 2016).

Although the previous research has validated the psychological benefits of PSEs at the individual level, the sport management literature has not yet shown the broader role of PSEs in enhancing health at the population level (Funk et al., 2011; Ridinger et al., 2012; Sato et al., 2014; Du et al., 2015). To bridge this gap, this dissertation has conducted initial empirical investigations to analyze the relationship between PSE and population health while controlling for differences among states through the macro-level analysis. The following discussion reports the findings related to the set of tested hypotheses.

Examining a number of empirical specifications in Study 1, the relationship between PSE and Health does exist at the state level. This finding is robust with a series of empirical and statistical testing. Specifically, the results of panel analysis with the instrumental variable approach substantiated the effectiveness of the PSEs on population health by revealing the significant positive impacts of Size and Tenure on health at the state level for the years 2008 through 2014. Also, a negative relationship between the Total Number of PSEs held across the United States and the state level health was revealed when accounting for the endogeneity issue using the 2SLS panel analysis with the instrumental variable approach. The counter-intuitive results of the negative association between TotalN and Population Health indicated that the less number of events is related to better health. This finding is consistent with contrasting directionality of growth patterns regarding the number of events and general health over the designated time framework. Using robust empirical specifications, this dissertation shows evidence of the role of PSE in promoting health at the state level. Specifically, results indicated that the Total Number, Size, and Tenure of PSE represent key driving forces to influence health with respects to physical health, mental wellness, and physical activity participation at the state-level while controlling for the effects of social-economic factors and external natural and policy-related environmental correlates.

For instance, using fixed-effects panel models with the instrumental variable approach, this dissertation provided empirical evidence to relax the endogeneity issue between PSE and health. The results from the fixed effects panel regression indicated that the average Size and Tenure of PSEs were positively associated with Health at the state level. An alternative explanation for the significant positive relationships could be that a state chooses to host running events is to attract residents and non-local participants. These non-local participants are more likely to live a healthier lifestyle and more experienced with these events. They are, therefore, more likely to maintain a better physical condition (e.g., physical health) through training before events, obtaining the sense of accomplishment (e.g., mental wellness) during event participation. Ultimately, they are more willing to engage and sustain in healthy behaviors post events. In turn, the state needs to introduce more events on a bigger scale to accommodate people’s needs. Using four identified valid instrumental variables (precipitation, temperature, and population density, and location), the statement about the relationship between PSEs and population health can be established since the aforementioned reverse causality between the two were reasonably alleviated.

Moreover, the results of multi-group latent growth curve analysis indicated that such impacts of PSE on health vary based on a state's economic development and geographical locations. Specifically, the results suggested that economically developed states, in which large-scale events are provided and operated over the years, are more likely to produce a higher level of health benefits. Also, the impact of PSE on health varies significantly based on geographical regions. For instance, change in PSE-related factors in Northeast generates a bigger impact on health relative to such influence in Midwest. The results confirmed that people, who live in the states with a better historical record of physical activity participation, on average are healthier compared to the people reside in historically less active states where the socio-cultural environment is not prominent to support active living routine and healthy eating habits.

Finally, the Multilevel Mediation Analysis was performed in Study 2 to explore the underlying mechanism through which these events have the capacity to influence health at the county level. H_3 involves a multilevel phenomenon, where the focus was on determining the impact of PSEs on health breakdown with geographically clustered states and counties. Given that a majority of sport management research predominantly relies on a single level of analysis, mainly at the individual level, the multilevel lenses adopted by the current dissertation helps yield a complete understanding of the impact of such events.

Specifically, the results of Study 2 identified significant state-level factors (e.g., access to exercise opportunities) was the driving force that helps us understand why PSE can serve as an important catalyst to create healthier communities. The findings demonstrated that collectively these organized sport events could change aggregated health status, a composite of physical activity participation, physical health, and mental wellness at the county level. In other words, the net benefits of PSEs can be explained and determined by the availability of related supporting programs and resources allocated to foster positive attitude change toward engaging active lifestyle in a given state. The findings of multilevel mediation analysis indicated that the provision of accessible resources and opportunities to promote health and wellness at the state level represents a key pathway through which health-related benefits can be elicited at the level of constituent counties. In this sense, public health policy makers can utilize participant sporting events and related eco-system as an integrated environmental and social platform to improve and advance the health of citizens and all communities.

Overall, the results lend support for the conceptual synergy between the PCM and BEM that various forms of participant sporting events can serve as central environmental platforms to promote community health (Funk et al., 2009; Funk et al., 2011). The findings provided empirical evidence to identify key environmental factors thought to elicit population-level health behaviors (e.g., physical activity participation) and enhanced both the physical and mental wellbeing. However, we should use caution to overestimate the events' capacity to promote health outcomes. It is unrealistic to conclude that events as a standalone intervention without appropriate educational programs, policies, and the surrounding ecosystems can approach and better serve less active segments of society and hence deliver the claimed net benefits for all individuals.

CHAPTER 6

CONTRIBUTIONS, IMPLICATIONS, AND FUTURE RESEARCH

The current dissertation provides empirical evidence to support that organized participant sporting events can play a major role in building a healthier community. The key findings are (1) these population-based interventions have the capacity to impact population health at the state level. (2) Such an influence varies across the United States contingent upon a state's economic development and the geographical region to which the state belongs; (3) the access to exercise opportunities at the state level can serve as a key mediation pathway through which PSEs can elicit positive effects on health at the county level. Overall, the findings help us better understand how to effectively leverage community sporting events to deliver required health benefits to the general public (Chalip, 2006).

Theoretically, I should acknowledge that the conventional individualistic perspective based on the PCM is valuable. For instance, the theory of participation (TOP) (Beaton et al., 2009) derived from the PCM framework (Funk and James, 2001) delineates key personal and psychological determinants of participation in physically active leisure. A recent publication by Sato et al. (2016) examined the impact of community-based participant sporting events in promoting life satisfaction through producing positive attitudinal formation toward health-related behaviors for the engaging participants. However, prior empirical evidence with individual-level survey data falls victim to the selection bias problem where the findings of these research are difficult to generalize to the actual population. That is, events' potential to promote health may merely apply to current active participants (Bowles et al., 2006; Funk et al., 2011).

Limited empirical attention has examined whether these community-based sport interventions initiate and sustain required health-related behaviors at the population level. The question that whether events can elicit required health benefits to both event participants and community residents, especially the less active section of the community (e.g., vulnerable population), and increase or sustain population-level physical activity participation remains unanswered. In this sense, the current dissertation bridges this gap by integrating two conceptual frameworks to examine the influence of PSE on population health. The findings highlighted that integrating a broader perspective of BEM into the PCM framework is beneficial. The results shed light on the importance of understanding potential external, environmental, and ecological determinants of actively engaging physically active leisure.

The PCM is an individual-centric framework that examines attitude formation and changes toward physical activity (Beaton et al., 2009). This psychological model occurs at the individual level. The PCM does not provide much detail on how non-sport community-based assets contribute to awareness and attraction to a recreational hobby or an organized sport product or service. Whereas the focus has overly been on psychological factors at the individual level such as motivations, perceptions, and feelings that lead to positive attitude formation and change toward physical activity (Funk & James, 2001). Overall, the PCM has failed to examine socio-demographic and cultural forces empirically (Brandon-Lai et al., 2015). The BEM and related ecological approach, on the other hand, consider both the community-based determinants and individual-level determinants of health and interventions. It focuses on issues that are community-based and not just individually targeted. The BEM is more concerned with the larger sociological environment which includes socio-cultural and demographic factors. These environmental factors also include behaviors such as participating in PSEs.

Hence, integrating the BEM with the PCM highlights the importance for sport management researchers to consider a variety of sport and non-sport environmental forces that influence initial attitude formation toward physical activity and subsequent positive change in population health. Specifically, the current dissertation addresses the deficiency of the PCM framework and extends the model by empirically supporting that PSE's when combined with communities environmental assets can enhance population health. Overall, by integrating BEM into the PCM framework helps sport management scholars consider the community-based determinants that lead to individual-level attitude formation and change, which is of particular importance at the awareness and attraction stage where attitudes are initially forming and unstable.

In this regard, the findings of Study 1 supported that PSEs can serve as such external forces to create awareness and opportunity for individuals to engage in physical activity and promote health for communities. The results inform the PCM framework by highlighting the important role of the socio-cultural environment for initiating positive attitudes toward active lifestyles to combat the physical inactivity crisis (Beaton et al., 2009). The results of Study 2 further highlighted the positive impact of various forms of PSEs on population health could be realized through resources allocated to provide community residents with viable opportunities to engage active living. These findings can help guide future investigation on physically active leisure and allow assessment and evaluation of interventions, policies, and programs. They can also facilitate interdisciplinary collaborations to seek for solutions to cope with the physical inactivity crisis and the related negative public health consequences (Berg et al., 2015; Inoue et al., 2015; Sato et al., 2016).

Managerially, the findings provide policy implications for public health officials on how to leverage organized sporting events to promote better social welfare for communities. The results suggest public resources could be invested into these population-based interventions that are produced by private companies and organizations to deliver claimed health benefits to a broader society. Specifically, the results of this dissertation help key event stakeholders better understand the positive impact of these events on health at the population level. To elicit health-related benefits to the host communities, event managers should focus on building a strong event brand and increasing the capacity for the recurring events, rather than merely emphasizing on expanding the existing event portfolios by introducing novel products at a small scale.

Public health officials might create effective strategies through promoting PSEs and related supporting programs to promote public welfare and wellbeing (Inoue et al., 2015). The findings could also benefit future interdisciplinary study that examines benefits of sport-related events and programs from a community-planning perspective (Berg et al., 2015). Specifically, organized PSEs along with related ecosystem (e.g., running clubs, training programs, and nutritional workshops) should be incorporated as critical pieces of overall health promotion efforts for regional health departments and initiatives.

Finally, the concept of utilizing health promotion and social change has broad social marketing implications. Event organizers should go beyond the conventional commercial paradigm to enhance the accessibility and legacy of PSEs to a large society, with a particular focus on the less active segments within communities. These people tend to be less affluent, more diverse, and are more in need of support to engage in a healthier and active lifestyle. In this regard, marketing messages delivered by sport organizations should not merely reflect on the benefits of sport business entities; rather, they should be centered on the events' ability to prevent sedentary lifestyles.

Limitations and Future Directions

There are limitations associated with the current dissertation that people should use caution when considering, interpreting, generalizing the results, and conducting future studies related to this area. First, the measure of population health was a weighted formative composite based on a combination of instruments adopted by previous research. The approach has not yet been validated in previous public health or sport management research. This mathematical transformation might be overly universal to capture a specific aspect of community health outcomes. A future study could focus on decomposing the composite breakdown with individual health factors. Future empirical studies could also examine the effects of PSEs on additional population health measures such as obesity rate, adult smoking rate, and the premature death rate. The collective efforts could enhance our confidence in the impact of PSEs.

Second, the information regarding the PSEs was exclusively scrapped from online websites assuming the sources provide a comprehensive list of the major PSEs, with special attention to events that require a more intensive physical exertion than other conventional participatory sporting events such as basketball, soccer, golf that are popular in the North America. Hence, this approach might underestimate the true impact of the events on community health. It should also be cautious to apply and generalize the findings of the current dissertation to other event contexts.

In addition, the omitted variable bias (OVB) was not fully excluded. Future studies should look into additional meta-contingencies thought to influence population health. For example, researchers could inspect the impact of additional socio-cultural and legal reinforcement on health. The goal is to examine if the effects of PSEs could be strengthened or alleviated by the socio-cultural fabrics that are embedded through the enrichment of interlocking network, legal infrastructure, and community capacity (Krug et al., 2002).

Finally, future research should augment the econometric approach within a community as a case study. Researchers should interview and survey residents about PSEs and other community-based assets to gain an in-depth understanding on whether or not the PSEs can cultivate a positive attitude towards physically active leisure. Future efforts should also look into the spillover effects of hosting such events in a community. For instance, the health-related benefits and economic consequences of regular physical activity at an individual level are well supported (Oftedal & Schneider, 2006; Murphy & Bauman, 2007), the gap between the scope of the problem and the linkage between the events and healthcare costs remains significant. Hence, future studies could be warranted to investigate if and the extent to which such events combined with other intervention programs have the ability to lower government health care expenditures.

Conclusion

The current dissertation extends the previous line of research on PSEs to provide informative insights on the extent to which PSEs have the capacity to produce accumulated effects to benefit population health. Integrating the BEM into the PCM framework bridges a conceptual gap by highlighting events' potential to elicit incremental health benefits to the general population while controlling for environmental correlates. This work helps us better understand how the formation of individuals' attitude toward healthy lifestyles can be influenced by community-based assets especially for people in the awareness and attraction stages in which external forces are more instrumental in activating healthy behaviors. Such conceptual synergy also lays a solid foundation on which actionable knowledge could be built to guide public health policy makers to create a healthier society.

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APPENDIX A

CODING SYNTAX FOR PANEL DATA ANALYSES

```
xtset StateID Year
descsave using Panel, saving(James)
outsheet using 1.xls

quietly sum
outreg2 using x.doc, replace sum(log)

global covar "Age1 Age2 Age3 Age4 Religion FV HP Edu Gender BMI Income Married
Ethn Smoke RegionD_S RegionD_W RegionD_NE"
global instvar "Prec Temp PD Location"

quietly rreg GHR Tenure Size TotalN $covar, gen(wt)
outreg2 using x.doc, replace ctitle (Robust Pooled OLS) tstat bdec(3) tdec(3)

quietly xtreg GHR Tenure Size TotalN $covar, fe r
outreg2 using x.doc, append ctitle (Panel1) tstat bdec (3) tdec(3) addtext (State FE, YES)

quietly xtreg GHR Tenure Size TotalN $covar, i(Year) fe r
outreg2 using x.doc, append ctitle (Panel2) tstat bdec (3) tdec (3) addtext (State FE, YES,
Year FE, YES)

quietly sureg (ExeDay MH PH = Tenure Size TotalN $covar i.Year), corr
outreg2 using x.doc, append ctitle (SUR) tstat bdec (3) tdec(3)

quietly xtivreg GHR (Size TotalN Tenure = $instvar) $covar, fe
outreg2 using x.doc, append ctitle (2SLS1) tstat bdec (3) tdec(3) addtext (State FE, YES)

quietly xtivreg GHR (Size TotalN Tenure = $instvar) $covar, i(Year) fe
outreg2 using x.doc, append ctitle (2SLS2) tstat bdec (3) tdec(3) addtext (State FE, YES,
Year FE, YES)

quietly xtivreg2 GHR (Size TotalN Tenure = $instvar) $covar, endog (Size TotalN
Tenure) i(Year) fe
outreg2 using x.doc, append ctitle (xtivreg2) tstat bdec(3) tdec(3) addtext (State FE, YES,
Year FE, YES)
```

APPENDIX B

CODING SYNTAX FOR MULTIGROUP LATENT GROWTH CURVE MODELING

```
Title:
Entering data from D_LGCM.csv file

Data:
File = "D_LGCM.csv";

Variable:
Names = REG INC GH08-GH14 PA08-PA14 MH08-MH14 PH08-PH14 SI08-SI14
TN08-TN14 TEN08-TEN14 AGE GEN EDU MAR REL RACE SMO;

USEVARIABLES= All;

Missing = All (999);
Analysis: ESTIMATOR = MLR;
TYPE = RANDOM;
PLOT: TYPE=PLOT3;
ALGORITHM=INTEGRATION;
PARAMETERIZATION = DELTA;

Model:
i s q | GH08@0 GH09@1 GH10@2 GH11@3 GH12@4 GH13@5 GH14@6;
iPA sPA | PA08@0 PA09@1 PA10@2 PA11@3 PA12@4 PA13@5 PA14@6;
iMH sMH | MH08@0 MH09@1 MH10@2 MH11@3 MH12@4 MH13@5 MH14@6;
iPH sPH | PH08@0 PH09@1 PH10@2 PH11@3 PH12@4 PH13@5 PH14@6;
iSI sSI | SI08@0 SI09@1 SI10@2 SI11@3 SI12@4 SI13@5 SI14@6;
iTN sTN | TN08@0 TN09@1 TN10@2 TN11@3 TN12@4 TN13@5 TN14@6;
iTEN sTEN | TEN08@0 TEN09@1 TEN10@2 TEN11@3 TEN12@4 TEN13@5
TEN14@6;
iPA-sTEN ON AGE GEN EDU MAR REL RACE SMO;
sPA ON sSI sTN sTEN;
sMH ON sSI sTN sTEN;
sPH ON sSI sTN sTEN;

OUTPUT:
SAMPSTAT TECH1 STANDARDIZED RESIDUAL MODINDICES TECH4 TECH8;
```

APPENDIX C

CODING SYNTAX FOR MULTILEVEL MEDIATION ANALYSIS

```
Title:
Entering data from D_MMA.csv file

Data:
File = "D_MMA.csv";

Variable:
Names = County SIZE TEN TN HCOMP GHR PH MH PA ATEO INC DOC POV UNI
AGE EMP GEN EDU RACE MAR CHI BMI SMO FEI HOME lnPOP OW CRIM AP
DWVV HCOMP_S GHR_S PH_S MH_S PA_S INC_S DOC_S POV_S UNI_S AGE_S
EMP_S GEN_S EDU_S RACE_S MAR_S CHI_S BMI_S SMO_S FEI_S HOME_S
lnPOP_S OW_S CRIM_S AP_S DWVV_S STATE Region;

USEVARIABLES= ALL;
CLUSTER=STATE;
BETWEEN= SIZE TEN TN ATEO;
WITHIN= PH MH PA INC DOC POV UNI AGE EMP GEN EDU RACE MAR CHI
BMI SMO FEI HOME lnPOP OW CRIM AP DWVV;

Missing = All (999);

Analysis:
Type=TWOLEVEL; ESTIMATOR = MLR; PLOT: TYPE=PLOT3; Bootstrap = 5000;
PARAMETERIZATION=THETA;

Model:
%WITHIN%! Level 1 model
HCOMP ON INC DOC POV UNI AGE EMP GEN EDU RACE MAR CHI BMI SMO
FEI HOME lnPOP OW CRIM AP DWVV;

%BETWEEN%! Level 2 model
EV BY SIZE TEN TN;
HCOMP ON ATEO_S EV;
ATEO_S ON EV;

MODEL INDIRECT: HCOMP IND EV;

OUTPUT: TECH1 TECH8 STANDARDIZED MODINDICES
CINTERVAL(BCBOOTSTRAP);
```