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Longitudinal Effects of Social Norms, Social Support for Physical Activity, Neighborhood Satisfaction, and Self-Efficacy on Light and Moderate-to-Vigorous Physical Activity in African American Adults

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by

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ABSTRACT

Few adults meet physical activity (PA) guidelines, and low rates of PA have been linked to negative physical and mental health outcomes including overweight status, chronic disease, cancer risk, depression, and decreased cognitive functioning. Both light PA (LPA) and moderate-to-vigorous PA (MVPA) have been linked to health outcomes, yet few studies have examined LPA associations in underserved and overweight populations. The neighborhood social environment, which includes social norms for PA, social support for PA, and neighborhood satisfaction, has been cited as an important factor of influence on PA behaviors. The current study aimed to integrate social cognitive theory and bioecological systems theory to examine the relationship between social norms for PA, social support for PA from friends and neighbors, and neighborhood satisfaction and predicted values of MVPA and LPA at baseline and predicted change in MVPA and LPA over 24 months. Self-efficacy for PA is a key cognitive variable related to health behavior based on social cognitive theory and was examined in the present study as a potential mediator for the effect of social environment on PA. This study utilized accelerometry and psychosocial data from African American adults who participated in the Positive Action for Today's Health trial (n=417; M_{age} = 51.65 years; 63.31% female; M_{BMI} = 31.18). It was hypothesized that participants who endorsed higher levels of positive social environment for PA would engage in higher minutes of MVPA and LPA at baseline and over time and that self-efficacy for PA would mediate these relationships. The hypotheses were only partially supported. Results for the model

predicting MVPA showed that the addition of social environmental variables significantly improved model fit beyond covariates only (time, community, age, sex, BMI, and season; F (4, 1199.79) = 4.04, $p < 0.05$), and social norms for PA ($\gamma = 0.37$, $SE = 0.12$) and social support for PA from neighbors ($\gamma = 0.37$, $SE = 0.13$) were both significantly positively associated with predicted baseline MVPA minutes. Addition of interactions between these variables and time did not significantly improve model fit (F (4, 641.22) = 0.20, $p > 0.05$), and none of the interaction terms were significant predictors of MVPA minutes. The addition of social environmental variables beyond covariates approached significance in improving model fit for LPA (F (4, 9100.52) = 2.07, $p = 0.08$). Only neighbor social support was significantly associated with predicted LPA minutes ($\gamma = 8.01$, $SE = 3.38$). Addition of interactions between social environmental variables and time did not significantly improve model fit (F (4, 3086.72) = 1.06, $p > 0.05$) and none of the interaction terms were significant predictors of LPA minutes. Because no interactions between predictors and time significantly predicted MVPA or LPA, only cross-sectional mediation was examined. Mediation for the relationships between social norms, social support for PA from friends and neighbors, and neighborhood satisfaction and MVPA and LPA through self-efficacy was not supported. Results from this study suggest that the neighborhood social environment, specifically social norms for PA and social support for PA from neighbors, may be a system of interest as a predictor of PA outcomes in older, overweight African American adults. However, more research is needed to examine these relationships over time and explore potential mechanisms of these relationships.

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CHAPTER 1

INTRODUCTION

Although the benefits of engaging in regular physical activity (PA) include lower all-cause mortality and higher health-related quality of life (Bize, Johnson, & Plotnikoff, 2007; Ekelund et al., 2015; Schmid, Ricci, & Leitzmann, 2015), most adults do not meet nationally recommended PA levels. Fewer than 10% of adults in the United States (U.S.) meet national recommendations of 150 minutes per week of moderate-to-vigorous PA (MVPA; as measured by accelerometry; Troiano et al., 2008; Tucker, Welk, & Beyler, 2011). National rates of PA engagement have been declining for decades with almost half of all American adults now reporting no leisure-time activity (Ladabaum, Mannalithara, Myer, & Singh, 2014). Physical inactivity accounts for 11% of all health care costs in the U.S. (Carlson, Fulton, Pratt, Yang, & Adams, 2015). Globally, it is estimated that physical inactivity is the fourth greatest underlying cause of mortality and is estimated to be responsible for between 3.2 and 5.3 million deaths annually (6-9% of premature deaths; Lee et al., 2012; Lim et al., 2012; World Health Organization, 2009). Physical inactivity been linked to the risk of chronic diseases and several cancers, depression, decreased cognitive functioning, and other negative health outcomes (Sallis & Carlson, 2015), underscoring the importance of examining potential determinants of this health behavior.

African American and/or overweight populations are least likely to engage in nationally recommended rates of PA compared to Whites (August & Sorkin, 2011;

Crespo, Smit, Andersen, Carter-Pokras, & Ainsworth, 2000; Tucker et al., 2011; Tudor-Locke, Brashear, Johnson, & Katzmarzyk, 2010). Specifically, African American adults engage in less PA compared to non-Hispanic White groups as measured by both self-report and accelerometry data (Tucker et al., 2011), with only 7.7% of this group engaging in recommended levels of MVPA. African American adults also report less leisure-time PA compared to White adults (Crespo et al., 2000), especially into older adulthood (August & Sorkin, 2011). In addition, African American adults have the highest prevalence of overweight and obesity (76.2%) compared to other ethnic groups (Ogden, Carroll, Kit, & Flegal, 2014; Wang & Beydoun, 2007) which has also been associated with decreased likelihood of meeting PA guidelines (Tucker et al., 2011) and lower daily PA counts (Tudor-Locke et al., 2010) as measured by accelerometry. These disparities highlight the need for better understanding of PA behaviors in African American adults who may be overweight and at-risk for negative health outcomes due to engaging in low levels of PA.

The social environment, which in the present study includes perceptions of PA behaviors of others (social norm), social support for PA from friends and neighbors, and neighborhood satisfaction, has been cited as an important system of influence on obesity-related health behaviors such as PA (Fleury & Lee, 2006; Suglia et al., 2016). In adults, PA most often occurs within the neighborhood or community (Li et al., 2005); therefore perceptions of the neighborhood social environment are an important contextual factor for understanding PA behavior. Reviews have generally found positive associations between perceptions of interpersonal resources for PA within the community, such as social norms and social support from significant others, as well as neighborhood

satisfaction, and PA behaviors (Fleury & Lee, 2006; Li et al., 2005; McNeill, Kreuter, & Subramanian, 2006). However, a gap in the literature has been identified as few studies have examined how these variables may influence change in PA over time (Li et al., 2005). The current study seeks to expand current literature by examining how social norms for PA, social support for PA from friends and neighbors, and neighborhood satisfaction are associated with levels of PA as well as changes in PA over time in African American adults.

Understanding the determinants and mechanisms for increasing levels of PA is important given the low engagement in PA among African American adults, yet little research has examined how perceptions of the social environment may influence PA and changes in PA over time. Self-efficacy is generally defined as one's perceived ability to succeed in accomplishing a task (Bandura, 1977). An individual's self-efficacy for a task is influenced by environmental factors (Bandura, 1977), and a supportive social environment for PA may improve perceived self-efficacy for engaging in PA. Further, self-efficacy specific to PA has been associated with higher levels of PA in cross-sectional studies (Prince et al., 2016; Young, Plotnikoff, Collins, Callister, & Morgan, 2014) and changes in PA over time within intervention studies (Williams & French, 2011). Therefore, the current study aimed to test whether self-efficacy for PA mediates the relationship between social environmental predictors and PA behaviors and change in PA over time.

PA recommendations have typically targeted MVPA (>3 metabolic equivalents; METS) which has been linked to cardiorespiratory fitness and numerous other health outcomes (U.S. Department of Health and Human Services, 2008). However, emerging

literature has begun to examine light PA (LPA), defined as activities ranging from 1.6-2.9 METs such as housekeeping or leisurely walking (less than three miles an hour), as an important PA outcome. LPA may confer health benefits in addition to MVPA, especially for populations who do not regularly engage in PA or experience significant barriers to engaging in MVPA (Pate, O'Neill, & Lobelo, 2008; Powell, Paluch, & Blair, 2011; Smith, Ekelund, & Hamer, 2015). Energy expended in LPA contributes to overall energy balance, and greater levels of LPA have been positively associated with improved mortality (Loprinzi, 2015), weight-related chronic disease outcomes (Buman et al., 2010; Healy et al., 2008; Hu, Li, Colditz, Willett, & Manson, 2003; Katzmarzyk, Church, Craig, & Bouchard, 2009; Powell et al., 2011) and even mental health outcomes such as reduced rates of depression (Ku, Steptoe, Liao, Sun, & Chen, 2017) and improved executive functioning (Johnson et al., 2016).

Further, recent literature has shown that social environmental factors may be differently associated with accelerometry-measured MVPA and LPA in African American populations (Huffman, Wilson, Pate, & Van Horn, 2018; Lawman & Wilson, 2014). For example, Huffman et al. (2018) demonstrated that authoritative parenting style and a tangible support in the home environment positively predicted daily LPA but not MVPA in overweight African American adolescents. In addition, Lawman and Wilson (2014) found that neighborhood supports for PA, such as the presence of sidewalks and perceived safety, positively predicted LPA but not MVPA in a similar sample. These studies provide preliminary evidence that for populations who engage in low levels of MVPA social environmental supports may be associated with higher levels of LPA. However, with the majority of current research in this area not including LPA as

an outcome these effects may be underestimated. Using an expanded view of PA outcomes that includes both MVPA and LPA may allow researchers to better describe correlates of PA in African American adults for future interventions.

The current study expanded on previous research by examining relationships between social norms for PA, social support for PA from friends and neighbors, and neighborhood satisfaction on MVPA and LPA both cross-sectionally and over time in African American adults. Accelerometry estimates of MVPA and LPA were used to more accurately assess PA intensity as these measures may be less susceptible to bias than self-report data (Bassett, Mahar, Rowe, & Morrow, 2008; Murphy, 2009; Sallis & Saelens, 2000). Further, the study examined self-efficacy as a potential mediator of the relationships between social norms for PA, social support for PA from friends and neighbors, and neighborhood satisfaction and MVPA and LPA in African American adults.

1.1 Theoretical Foundations of the Relationship between Neighborhood Social Environment and PA Outcomes

The current study integrated two widely used health behavior theories, social cognitive theory (Bandura, 1986) and the bioecological model (Bronfenbrenner, 1979), to examine predictors of PA such as social environmental factors (social norms for PA, social support for PA, and neighborhood satisfaction) and how individual (cognitive factors) may mediate these effects over time.

Social cognitive theory (Bandura, 1986) argues that health behaviors are influenced by reciprocal interactions of personal factors, environment, and behavioral outcomes. In this model, cognitive factors and affective states (such as self-efficacy or

outcome expectations) and environmental qualities (physical or social) may serve as either barriers to or facilitators of engaging in a behavior. Further, outcomes resulting from engaging in the behavior may reciprocally enact changes in the environment or in personal factors over time. Bandura identified the social environment as a key system that can provide resources for facilitating healthy behaviors such as PA (Bandura, 1977; Bandura, 1997; Bandura, 1998). Specifically, social cognitive theory and its predecessor social learning theory (Bandura, 1971) emphasize the role of observational learning as a facilitator of adopting novel behaviors. However, while social influence may be a powerful facilitator, adoption and/or maintenance of behaviors is also influenced by the extent to which the physical and social environment is supportive (Bandura, 1997; Bandura, 1998) which provides a rationale for examining both perceived social and environmental supports for PA within the social cognitive framework.

Similar to social cognitive theory, bioecological systems theory (Bronfenbrenner, 1979; Bronfenbrenner & Morris, 2006) poses that several contextual systems interact with individual factors (e.g., biology and cognitive characteristics) over time to influence an individual's health behaviors. In this model, behavior must be understood within the environment (context). Contextual factors include microsystems (relationships between the individual and their immediate environment such as the home or workplace), the mesosystem (interrelations between microsystems), the exosystem (influences on behavior that the individual is not directly interacting with), and the macrosystem (overarching cultural influences that indirectly influence microsystems and the individual; Bronfenbrenner, 1979). Bioecological models have proposed a comprehensive framework for understanding PA behavior that integrates individual psychological

processes that may influence motivation for PA, physical and social environmental factors in which PA occurs, and the larger cultural values around PA (Spence & Lee, 2003). The social environment has been identified as an microsystem that can facilitate or hinder healthy PA behaviors and weight related outcomes (Christakis & Fowler, 2007; Fleury & Lee, 2006; McNeill, Kreuter, et al., 2006) and that may interact with other systems such as the cultural influence of the macrosystem (cultural beliefs held by underserved African Americans about PA in the current study) and individual characteristics such as perceived self-efficacy for engaging in PA. Further, Bronfenbrenner (1979) argues that measuring the perception of the context is important for the ecological validity of a study describing behavior and thus provides support for measuring perceived social environment as a potential determinant in the current study.

Taken together, both social cognitive and bioecological theories provide support for examining effects of neighborhood social environmental constructs. A key component of the social environment is the descriptive social norm, or the perceived behavior of the majority group (Cialdini, Reno, & Kallgren, 1990). Social cognitive theory suggests that a social norm of engaging in PA facilitates social learning and provides a model of appropriate and effective behavior (Bandura, 1997; Cialdini, Kallgren, & Reno, 1991). For example, if one perceives others as engaging in regular PA, one is likely to view this behavior as normative and positive and thus will be more likely to engage in this behavior. Further, both social cognitive and bioecological theories suggest that proximal systems are most influential. Therefore, social norms for PA in the neighborhood context are likely to be influential for individuals who identify as part of the community, such as underserved minority groups that are typically more collective (Lapinski & Rimal, 2005).

Based on this hypothesized relationship, the current study examined direct effects of social norms for PA on PA outcomes over time in underserved African American adults.

Other theoretical constructs related to the neighborhood environment, such as social support for PA and neighborhood satisfaction, have also been associated with higher levels of PA engagement. Social support specific to PA has been defined as including actions by others (including friends and neighbors) that either encourage or directly facilitate an individual's PA goals such as discussing PA, doing PA together, or planning activities around PA (Sallis, Grossman, Pinski, Patterson, & Nader, 1987). Previous research has demonstrated that social support for PA was positively associated with PA behaviors such as MVPA and walking in adults (Joseph, Ainsworth, Keller, & Dodgson, 2015; Olander et al., 2013; Wendel-Vos, Droomers, Kremers, Brug, & van Lenthe, 2007). The buffering hypothesis which hypothesizes that social support is particularly beneficial during stress (Cohen & Wills, 1985) suggests that social support may be especially relevant for underserved groups that experience chronic stress and limited resources such as underserved African American adults. Neighborhood satisfaction, or how individuals perceive their neighborhood social environment on domains such as social connection, safety, and access to resources, may also serve to facilitate PA behavior. Being satisfied with one's neighborhood may make engaging in PA within this environment more enjoyable, increasing motivation for PA (McNeill, Wyrwich, Brownson, Clark, & Kreuter, 2006). Neighborhood satisfaction may be an important predictor of PA for the current population who often do not have access to other facilities or equipment for exercise (Estabrooks, Lee, & Gyurcsik, 2003). As a

result, the current study also examined direct effects of social support for PA and neighborhood satisfaction on PA outcomes over time.

1.2 Previous Literature on Social Environment and PA

Previous literature has highlighted the importance of social environmental factors on understanding the adoption and maintenance of PA behavior (Fleury & Lee, 2006; Li et al., 2005; McNeill, Kreuter, et al., 2006). However, limited research has examined the relationship of these constructs in underserved African American populations, over time, and with LPA included as an outcome. The following sections review current research available examining social norms for PA, social support for PA from friends and neighbors, and neighborhood satisfaction and PA outcomes in adult populations.

Social Norms for PA

Numerous studies have examined the relationship between social norms for PA and PA outcomes (Eyler et al., 2003; Hooker, Wilson, Griffin, & Ainsworth, 2005; Kowal & Fortier, 2007; Wilcox, Castro, King, Housemann, & Brownson, 2000). The current study conceptualized social norms for PA as the perceived descriptive norm for walking in the neighborhood context (i.e. seeing neighbors walk often in the neighborhood).

Several studies have examined the relationship between perceived social norms and PA and MVPA cross-sectionally and found significant associations. Ball, Jeffery, Abbott, McNaughton, and Crawford (2010) examined whether social norms for PA were associated with self-reported MVPA in Australian women. Results suggested that participants who reported seeing others exercise in the neighborhood were 1.30 to 1.68 more likely to engage in high levels of leisure-time MVPA. Wilcox and colleagues

(2000) found similar results in an ethnically diverse sample of rural adults. This study found that seeing neighbors exercise was associated with increased likelihood of engaging in MVPA in the past two weeks (OR=1.39) as measured by self-report for rural, but not urban women. Firestone et al. (2015) also found significant differences in weekly minutes of self-reported MVPA based on perceived social norms for PA in a diverse sample of adults. In this sample, men and women who reported that their neighbors engaged in PA reported participating in 48 and 57 more minutes of MVPA, respectively (in comparison to those reporting their neighbors did not). These studies suggest that there is a positive relationship between perceived social norms for PA and self-reported MVPA, but this has not yet been evaluated using accelerometry estimates of PA.

Few known studies have examined this relationship in African American samples (Eyler et al., 2003; Hooker et al., 2005; King et al., 2000). Eyler et al. (2003) stratified a larger study sample by data collection site to determine whether the relationship between social norms for PA and meeting PA guidelines (as measured by self-reported MVPA) was consistent across race. They found that rural African American women were between 1.57 and 2.02 times as likely to meet PA guidelines if they reported seeing neighbors exercise; however the results were not significant for urban women. King et al. (2000) also reported that seeing others exercise in the neighborhood was associated with being more likely to meet PA guidelines (as measured by self-reported MVPA) in African American women. In contrast, a study by Hooker et al. (2005), using a sample of African American men and women found no relationship between perceived social norms for PA and meeting PA guidelines (as measured by self-reported MVPA). The mixed results in studies using African American samples call for additional work examining the

relationship between social norms for PA and more objective assessments of MVPA in this population.

To the best of our knowledge no previous studies have examined the relationship between social norms for PA and accelerometry-measured LPA. However, several studies have used self-reported walking which may be correlated with social norms for PA and LPA. Ball et al. (2010) found that social norms for walking (seeing others walking the neighborhood) were associated with increased likelihood for engaging in self-reported walking (OR=1.41-1.78) in a sample of Australian women. In a similar sample, Timperio, Veitch, and Carver (2015) examined whether social norms for walking were associated with walking at least 150 minutes a week as measured by self-report. They found that reporting seeing others walking in the neighborhood was associated with walking 150 minutes per week (OR=1.45). Nehme, Oluyomi, Calise, and Kohl (2016) also examined the relationship in a sample of predominantly White adults and found that participants who reported seeing others engage in PA in the neighborhood were 3.56 times more likely to walk recreationally compared to those who did not. Only one known study has examined this relationship in African American participants. Hooker et al. (2005) found that social norms for PA were associated with walking 150 minutes a week in White participants (OR=2.51), but not African American participants. This suggests that more research is needed to determine whether social norms for PA are associated with LPA in accelerometry-based studies especially among African American populations.

There is some preliminary research on longitudinal relationships between social norms for PA and PA behaviors. Kowal and Fortier (2007) examined whether perceived

social norms for PA over the past 6 months were associated with change in weekly energy expenditure from PA in a sample of White women. They showed that women who were consistently active (≥1500 kcal/week) or moved from inactive (<1500 kcal/week) to active reported higher levels of social norms for PA compared to those who lowered their activity levels. Sallis, King, Sirard, and Albright (2007) used a prospective design to evaluate whether social norms for PA were associated with differences in PA at a six month follow-up. Results showed that reporting seeing others walking in the neighborhood was not associated with increased minutes of self-reported weekly MVPA at six months. Based on these two studies it is unclear if perceived social norms for PA are associated with changes in MVPA and change in energy expenditure over time, and the current study aimed to fill this research gap.

These studies provide preliminary support for a positive relationship between social norms for PA and MVPA and LPA behaviors. However, few investigators have examined these relationships specifically in underserved African American adult populations, and results have been inconsistent. Further research is needed in this population given the limitations of this research in relying primarily on self-report PA rather than accelerometer-measured MVPA and LPA.

Social Support for PA

Social support for PA has been identified as a key facilitator to engaging in adequate levels of PA in African American adults (Joseph, Ainsworth, et al., 2015; Vrazel, Saunders, & Wilcox, 2008). The current study conceptualized social support as a composite of emotional support (providing motivating encouragement or praise) and tangible support (providing resources or freeing up time for the individual to be active)

for PA. Sources of social support for PA included in the current study are specific to friends and neighbors.

Cross-sectional studies have demonstrated support for direct effects of social support for PA from friends on MVPA. Carlson et al. (2012) used accelerometry MVPA data to assess these relationships in older, predominantly White adults. Social support for PA from friends was positively associated with MVPA such that a one standard deviation increase was related to 14 additional weekly minutes of MVPA. Rovniak et al. (2010) evaluated whether social support for PA from friends was associated with being classified as being in the low active or active leisure group as measured by accelerometry in predominantly White adults. Differences in social support for PA from friends were large (d=0.53), with participants classified in the active leisure group being more likely to endorse receiving social support for PA. This relationship has been shown to be consistent across BMI categories as well, albeit with smaller effects for overweight and obese individuals. For example, Blanchard et al. (2005) demonstrated that social support for PA from friends was associated with self-reported MVPA, with the relationship being strongest for healthy weight adults compared to overweight adults or obese adults. Taken together, these studies suggest that social support for PA from friends is positively associated with MVPA in adults, but few studies have specifically focused on underserved African American populations.

Additional studies have also shown support for positive associations between social support for PA from friends and LPA. For example, Eyler et al. (1999) examined self-reported PA data in an ethnically diverse sample of adult women. Results showed that social support for PA from friends was positively associated with lifestyle activities

which included walking at work, vacuuming, and other household chores such that African American women who reported high social support for PA from friends (compared to low) were 2.58 as likely to obtain 300 minutes of LPA each week. The results were not significant for self-reported MVPA (30 minutes per day, 5 days a week). Saelens et al. (2012) also examined this relationship in a sample of predominantly White adults. Social support for PA from friends was positively associated with self-reported leisurely walking minutes, but was non-significant in a model using accelerometry data to measure MVPA. Self-reported walking for leisure was also related to social support for PA from friends in a sample of older adults (Carlson et al., 2012). In this study, a one standard deviation increase in social support was associated with 26 additional walking minutes per week compared to 14 minutes for accelerometry-measured MVPA. In a similar sample of older adults (Thornton et al., 2017), social support for PA from friends was also positively associated with self-reported walking with a much larger effect size for walking compared to accelerometry-measured MVPA (25.44 versus 1.61). These findings may suggest that social support for PA from friends has a larger effect on LPA compared to MVPA. However, the discrepancy in demonstrated relationships may also result from differences in measurement (self-report for LPA compared to accelerometry data for MVPA). The current study clarified these relationships by using accelerometry data for both outcomes.

Several studies have also examined the direct effects of social support for PA from friends on PA outcomes over time. Molloy, Dixon, Hamer, and Sniehotta (2010) utilized a large sample of young adults to assess whether social support for PA from friends affected self-reported MVPA over 7 weeks. Social support for PA from friends

measured at baseline positively predicted self-reported MVPA at time 2 for women, but not men. Scarapicchia and colleagues (2017) assessed the relationship between social support for PA from friends and self-reported weekly MVPA minutes over the course of one year in young adults. Within-person results suggested that participants engaged in higher amounts of MVPA when reporting higher levels of social support for PA from friends. Between-person results suggested that participants who reported higher levels of social support for PA from friends engaged in higher amounts of MVPA over the year than participants reporting low levels. Taken together, these studies suggest that social support for PA from friends may directly influence MVPA over time as well, yet little is known about the effects of social support for PA on LPA longitudinally.

Current research evaluating social support for PA from friends has been somewhat mixed, especially when considering differences in self-report versus accelerometry. However, numerous studies have reported positive effects for social support for PA from friends on MVPA and LPA-related behaviors. While limited research has been conducted evaluating the impacts of social support for PA from neighbors, qualitative research has identified improving social support for PA from neighbors as a strategy to improve PA in African American communities (Griffin, Wilson, Wilcox, Buck, & Ainsworth, 2007). There is little overlap in perceived social support for PA from friends and from neighbors in the current study (r = 0.26) so social support for PA from neighbors will be included as an additional analysis.

Neighborhood Satisfaction

Satisfaction with the neighborhood social environment has been defined as including social relationships, safety, and access to resources which is hypothesized to

lead to increases in PA behaviors (Saelens, Sallis, & Frank, 2003). However, there is currently limited research on the relationship between neighborhood satisfaction and PA outcomes among adult populations.

Several cross-sectional studies have examined relationships between neighborhood satisfaction and MVPA or total PA and shown inconsistent results. Strath et al. (2012) examined whether neighborhood satisfaction was associated with accelerometry-measured MVPA in a sample of older adults. Results suggested that increases in reported neighborhood satisfaction were positively associated with minutes of MVPA. Fleig et al. (2016) also evaluated the cross-sectional relationship between accelerometry-measured total PA (LPA + MVPA) and reported neighborhood satisfaction in a sample of older adults and found a positive correlation between these variables (but no association in the full models). Lee and Cho (2009) focused on self-reported vigorous PA (defined in this study as PA that makes people sweat or breathe hard) as an outcome in a sample of Korean adults. Results suggested that for women but not men, satisfaction with the neighborhood was associated with higher likelihood of engaging in vigorous PA (OR=1.08-1.13). These studies suggest that neighborhood satisfaction may be associated with MVPA, at least cross-sectionally.

In contrast to the above studies, two studies have demonstrated no significant association between neighborhood satisfaction and MVPA. Salvo et al. (2015) found no correlation between self-reported MVPA and neighborhood satisfaction in a large sample of Brazilian adults. Similarly, Halbert et al. (2014) examined whether reported neighborhood satisfaction was associated with self-reported weekly MVPA in African American adults and found non-significant results. Notably, this is the only study to date

that included a predominantly African American sample. These null findings highlight the need to replicate these results in an African American sample using more objective measures of PA.

Few investigators have examined the relationship between neighborhood satisfaction and LPA explicitly, but some studies have evaluated walking behavior. While Strath et al. (2012) found positive associations between accelerometry-measured MVPA and neighborhood satisfaction, neighborhood satisfaction was not significantly associated with accelerometry-measured LPA in their sample of older adults. Hall and McAuley (2010) also found no differences in walking based on neighborhood satisfaction in a sample of predominantly White older women. Groups recorded as reaching 10,000 steps per day as measured by accelerometry did not report significant differences in neighborhood satisfaction compared to women who made less than 10,000 steps. However, some studies showed positive associations among these variables. For example, Salvo et al. (2015) found a small positive correlation (r = 0.08) between reported neighborhood satisfaction and reported time spent walking for leisure in Brazilian adults. Van Cauwenberg et al. (2014) looked at relationships between neighborhood satisfaction and self-reported walking for transportation. They showed a positive correlation with participants who reported satisfaction with their neighborhood being 1.30 times as likely to report walking for transportation almost daily compared to less than almost daily. While these results are mixed for the relationship between neighborhood satisfaction and LPA and walking behavior, many of the study outcomes do not directly map onto continuous accelerometry-measured LPA (with the exception of Strath et al. (2012)) which the current study aimed to test in African American adults.

Current research on the relationship between neighborhood satisfaction and PA outcomes has been limited to cross-sectional data and has seldom utilized African American samples. However, strengths of the literature include some accelerometry-based studies. The present study built on the existing literature by looking at the relationship both cross-sectionally and over time in an underserved sample of African American adults.

1.3 Theoretical Foundations of Self-Efficacy as a Mediator

While describing the relationships between social environmental variables (social norms for PA, social support for PA from friends and neighbors, and neighborhood satisfaction) and PA is important to understanding PA behaviors, exploring potential mediators can help explain the mechanism through which these effects occur. Both social cognitive theory and bioecological models emphasize the importance of considering the influence that various systems have on each other and the behavioral outcome. In social cognitive theory, the principle of triadic reciprocal causation poses that personal, environmental, and behavioral factors interact and influence each other (Bandura, 1986). Further, Bandura urges that social influences of behavior must be understood through the "self-processes" on which they act (Bandura, 1986). Ecological systems theory similarly poses that the interactions between systems and between systems and individual characteristics must be considered when describing behavior (Bronfenbrenner, 1979). The current study aimed to examine relationships between neighborhood social environment and cognitive factors. Reviews have identified self-efficacy as a potential cognitive mediator in interventions targeting PA (French, Olander, Chisholm, & Mc Sharry, 2014; Lewis, Marcus, Pate, & Dunn, 2002; Olander et al., 2013). Specifically, the

current study tested whether social norms for PA, social support for PA from friends and neighbors, and neighborhood satisfaction influence perceived self-efficacy for PA which may serve as a potential mechanism for the relationship between these variables and MVPA and LPA.

Social cognitive theory suggests that self-efficacy, the belief in one's capabilities to perform a desired behavior, is an important predictor of behavior (Bandura, 1997). Self-efficacy for PA has been found to be directly related to PA outcomes in numerous studies based on recent reviews (Prince et al., 2016; Young et al., 2014). Self-efficacy influences behavior through improved motivation and self-regulation. High self-efficacy is associated with positive outcome expectations for engaging in a behavior which in turn increases motivation. In this way, perceived self-efficacy for a task impacts goal setting and the amount of effort expended to reach those goals. For example, someone who perceives themselves as capable of engaging in PA is more likely to set activity goals compared to others who are less confident and show positive outcomes from attempting to be active. Further, individuals with high self-efficacy are more likely to use problem solving strategies when faced with barriers to being active (as opposed to relapsing to inactivity) because they have stronger beliefs in their capabilities to succeed (Bandura, 1997). This is especially relevant in underserved populations that may experience more barriers to engaging in PA. The process of self-monitoring and self-regulation, which occurs as a result of high perceived self-efficacy beliefs, may lead to an increased likelihood of maintenance of healthy PA behavior, but few studies have explored these relationships in underserved African American adults.

Based on social cognitive theory (Bandura, 1997) self-efficacy beliefs are hypothesized to be derived from mastery experiences, vicarious experiences, verbal persuasion, and physiological or mood states. The neighborhood social environmental variables examined in the current study, social norms for PA, social support for PA from friends and neighbors, and neighborhood satisfaction, may facilitate improved self-efficacy for PA through these hypothesized sources. For example, seeing others walking in the neighborhood (social norms for PA) can increase self-efficacy through vicarious experiences (social learning). Seeing others who are similar to you successfully model PA behavior increases the belief that one is capable of engaging in that behavior as well and may provide information about overcoming barriers to PA. Preliminary research has demonstrated that self-efficacy mediates the relationship between perceived social norms and health behaviors (Stok, Verkooijen, de Ridder, de Wit, & de Vet, 2014; Walker, Neighbors, Rodriguez, Stephens, & Roffman, 2011), but demonstrated effects for this relationship and PA have been correlational in nature thus far and primarily in Whites (Beville et al., 2014; Heinrich, Jokura, & Maddock, 2008; Jackson, Smith, & Conner, 2003; Sassen, Kok, Schaalma, Kiers, & Vanhees, 2010). Social support for PA may increase self-efficacy through verbal persuasion. Encouragement to participate in PA from others reinforces that others have faith in one's abilities that may in turn improve self-efficacy for PA engagement. Other types of social support for PA, such as exercising together, may facilitate a mastery experience that provides evidence that the individual is capable of achieving PA goals. Several studies have found support for the hypothesized relationship between social support for PA, self-efficacy for PA, and PA outcomes, albeit with predominantly self-reported PA data (Duncan & McAuley, 1993; McAuley, Jerome,

Elavsky, Marquez, & Ramsey, 2003; McNeill, Wyrwich, et al., 2006; Motl, Dishman, Saunders, Dowda, & Pate, 2007; Resnick, Orwig, Magaziner, & Wynne, 2002; Rovniak, Anderson, Winett, & Stephens, 2002). Self-efficacy may also be influenced by mood or affective state with positive moods being associated with increased positive evaluations of self-efficacy (Bandura, 1997; Salovey & Birnbaum, 1989; Wright & Mischel, 1982). Neighborhood satisfaction may be linked to self-efficacy via positive affective states, such that those who are satisfied with the properties of their neighborhood may experience a more positive mood state while engaging in PA in that environment. This, in turn, would lead to improved self-efficacy for PA as a result of the positive cognitive associations. Limited research has tested this mechanism; however, Morris, McAuley, and Motl (2008) have shown that self-efficacy for PA mediated a relationship between changes in neighborhood satisfaction and changes in PA over time in older White women. The current study aimed to test these hypothesized mechanisms at baseline and over 24-months to clarify if self-efficacy for PA serves as a mediator between social norms for PA, social support for PA from friends and neighbors, and neighborhood satisfaction and MVPA and LPA in African American adults.

1.4 Previous Literature on Self-efficacy as a Mediator between Social Environment and PA

The majority of research evaluating the role of self-efficacy for PA as a potential mediator between social environment and PA has focused on social support for PA. Several cross-sectional studies have demonstrated positive associations between support for PA, self-efficacy for PA, and PA outcomes. Resnick et al. (2002) examined these relationships in a small sample of older White adults. PA was conceptualized as a

dichotomous outcome of self-reported engagement in 20 minutes of PA at least 3 times a week (vs. not). Social support for PA from friends indirectly affected reported PA through self-efficacy for PA in this sample. A direct effect was not demonstrated. Motl and colleagues (2007) examined these constructs in a sample of ethnically diverse young women (12th grade). PA was measured using a 3-day recall. In this study, social support for PA showed both direct effects on total PA and indirect effects on total PA through perceived self-efficacy. Sniehotta et al. (2013) also examined this relationship in a sample of older adults in Scotland using accelerometry-measured total PA. In this sample, receiving social support for PA was positively associated with total PA with self-efficacy completely mediating the effect. These studies provide support that self-efficacy is an important mediator between social support for PA and PA outcomes but do not provide information about potential differences in these effects for MVPA and LPA.

Several investigators have assessed different PA intensities in relation to social support for PA. For example, Ishii, Shibata, and Oka (2010) tested whether self-efficacy to engage in PA mediated the relationship between social support for PA and self-reported walking, moderate PA, and vigorous PA in a sample of Japanese adults. In this sample, social support for PA had an indirect effect on each PA outcome through self-efficacy for PA, and direct effects were not significant. Similarly, McNeill, Wyrwich, et al. (2006) tested three models of PA, one each for walking, moderate PA, and vigorous PA in a sample of African American and White adults. PA was measured using a self-report PA scale. For all three intensities of PA, social support for PA was indirectly related to PA outcomes. Self-efficacy did not directly mediate these relationships, but did indirectly through intrinsic motivation for PA. These two studies provide preliminary

support that self-efficacy may mediate the relationship between social support for PA and both MVPA and LPA.

Several studies have demonstrated evidence for self-efficacy mediating the relationship between social support for PA and PA outcomes over time as well. Duncan and McAuley (1993) sought to evaluate whether self-efficacy for PA mediated the effects of social support for PA on continued attendance of an exercise program for predominantly White, sedentary adults. Both social support for PA and self-efficacy for PA were measured 10 weeks into the program. Results from this study suggested that self-efficacy for PA mediated the effect of social support from the members of the exercise group on predicted attendance of the next 10 weeks of the program. Rovniak et al. (2002) also evaluated the relationship between social support for PA, self-efficacy for PA, and PA outcomes over time in predominantly White undergraduates. In this study, social support for PA from friends and self-efficacy for PA were measured at baseline while PA, conceptualized as a combination of self-reported level of exercise, number of types of PA activities, and self-reported energy expenditure, was measured at week 8 of the study. Results showed that the positive effect of social support for PA was completely mediated by self-efficacy for PA (largely through self-regulation). Finally, McAuley et al. (2003) examined this relationship over 12 months in older White adults participating in an exercise program. Perceived social support from members of the exercise program from the last month and self-efficacy for PA were measured at the end of the six month program, while self-reported total PA was assessed at 6- and 18-month follow-up. Results showed that social support for PA indirectly affected PA at both 6- and 18-month follow-

ups through self-efficacy for PA. Taken together, these results suggest that self-efficacy may mediate the relationship between social support for PA and PA over time.

Limited research has examined self-efficacy's role as a mediator between social norms for PA or neighborhood satisfaction. Morris et al. (2008) conducted a longitudinal study to look at relationships between neighborhood satisfaction, self-efficacy, and self-reported total PA over 6 months in older White women. All measures were completed at baseline and 6 month follow-up. Results suggested that there was not a significant relationship of neighborhood satisfaction with total PA at baseline. However, changes in neighborhood satisfaction between baseline and 6- month follow-up predicted changes in total PA with self-efficacy mediating this effect. No known studies to date to the best of our knowledge have examined whether self-efficacy for PA may mediate the relationship between social norms for PA and PA behavior. However, some studies have found positive correlations between social norms for PA, self-efficacy for PA, and PA outcomes (Beville et al., 2014; Heinrich et al., 2008; Jackson et al., 2003; Sassen et al., 2010). Demonstrating relationships between the predictor, the potential mediator, and the outcome is a preliminary step towards testing mediation (Baron & Kenny, 1986; Judd & Kenny, 1981); however, further research is needed. The current study aimed to build on this limited research by testing hypothesized mediated relationships between neighborhood satisfaction and PA and social norms for PA and PA outcomes cross-sectionally and over time specifically in underserved African American adults.

In sum, there is substantial evidence to suggest that self-efficacy for PA mediates the relationship between social support for PA and PA behaviors. However, literature is limited for social norms for PA and neighborhood satisfaction in understanding these

mediatd effects of self-efficacy on PA outcomes. Research is mixed as to whether self-efficacy for PA partially or completely mediates the relationship between social support for PA and PA outcomes. Further, current literature has not focused on African American samples or utilized accelerometry to measure MVPA or LPA.

1.5 Study Purpose and Hypotheses

Supported by social cognitive theory and bioecological systems theory, the current study expanded on previous research by examining the relationship between social environmental variables (including social norms for PA, social support for PA from friends and neighbors, and neighborhood satisfaction) and accelerometry-measured PA at baseline and over time (baseline, 12-, 18, and 24-month time points) utilizing data from the Positive Action for Today's Health (PATH) trial (Wilson et al., 2010; Wilson et al., 2015). Further, the current study aimed to test whether self-efficacy for PA mediates the relationships between social norms for PA, social support for PA from friends and neighbors, and neighborhood satisfaction and PA outcomes. The neighborhood social environment may positively influence self-efficacy for PA through social learning, verbal persuasion, or facilitating positive affective states related to PA (Bandura, 1997). Self-efficacy may then, in turn, be associated with improved self-regulation and goal setting leading to higher levels of PA over time. The current study included accelerometry estimates of both MVPA and LPA to broaden understanding of how social environment and cognitive mediators influence these outcomes over time. This may be particularly relevant for underserved and largely inactive populations, such as African American, overweight, or older adults that experience barriers to participating in PA (Powell et al., 2011). Thus, the specific aims and hypotheses for this study were:

Aim 1. To examine whether neighborhood social environment is associated with MVPA and LPA outcomes at baseline and change in MVPA and LPA over time.

Hypothesis 1. It was hypothesized that individuals who report positive perceptions of their neighborhood social environment (social norms for PA, social support for PA from friends, social support for PA from neighbors, and neighborhood satisfaction) would exhibit higher levels of MVPA and LPA at baseline and over time.

Aim 2. To examine whether self-efficacy for engaging in PA mediates the relationship between neighborhood social environment and MVPA and LPA outcomes at baseline and change in MVPA and LPA over time (see Figure 1).

Hypothesis 2. It was hypothesized that a) positive perceptions of neighborhood social environment (social norms for PA, social support for PA from friends, social support for PA from neighbors, and neighborhood satisfaction) will be associated with self-efficacy for engaging in PA at baseline, b) self-efficacy for engaging in PA will be associated with MVPA and LPA at baseline and change in MVPA and LPA, and c) self-efficacy for engaging in PA will mediate the relationship between neighborhood social environment and MVPA and LPA outcomes at baseline and change in MVPA and LPA over time.

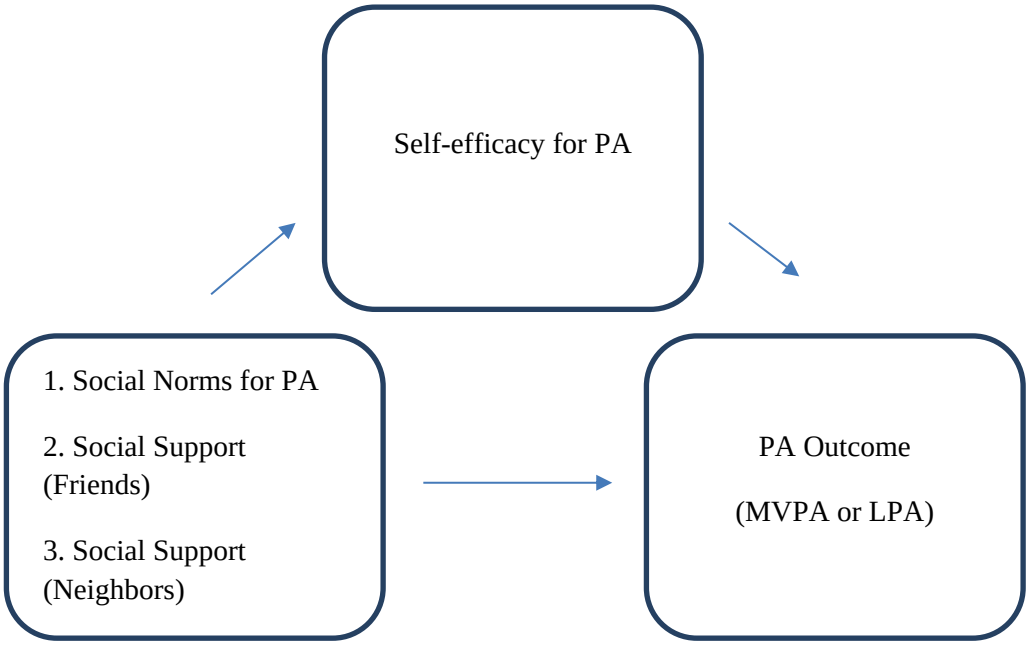

Figure 1.1. Model of self-efficacy as a mediator between neighborhood social environmental variables and PA for Aim 2.

CHAPTER 2

METHODS

2.1 Participants

Data collected from 417 adults who participated in the PATH trial (Wilson et al., 2010; Wilson et al., 2015) was used in the current study. Participants were recruited from three low-income, predominantly African American communities in South Carolina. Communities were matched on rates of crime, poverty status, percentage of African American residents, median household income, PA, and health index scores as calculated by the South Carolina Behavioral Risk Factor Surveillance Survey (see Table 2.1). Participants were recruited using two strategies. Letters detailing the study were mailed to households within each community identified through random sampling (provided by the University of South Carolina Survey Lab and Survey Sampling Group) and followed up by phone calls or in-person visits. A total of 1216 potential participants were contacted, 581 declined participation, and 635 were invited to participate. A total of 231 participants were ultimately enrolled using this method. Participants were also identified using advertisements in newspapers, churches, schools, and local businesses. A total of 203 participants were enrolled using this method resulting in a total sample of 434 participants. A total of 17 participants were dropped due to missing PA data at all time points. Inclusion criteria included 1) African American heritage, 2) aged 18 years or older, 3) plans to stay in the community for the study duration, 4) lack of conditions that would prevent PA participation, 5) residing in the census area, 6) availability to

participate in data collection throughout the study period, and 7) controlled blood pressure (<120/<110) and blood sugar (<300 non-fasting, ≤ fasting) levels.

Participant (n=417) baseline characteristics are described in Table 2.2. The majority of participants were female (63.31%). On average participants were 51.65 years old with a high school degree or equivalent level of education achieved (67.63%). A large percentage of participants were obese (54.92%) or overweight (24.70%). The majority of participants reported an annual family income of <$25,000 (65.23%).

2.2 Study Design

The current study was a secondary data analysis of the PATH trial which has been previously described (Wilson et al., 2010; Wilson et al., 2015). Briefly, the PATH trial examined the efficacy of an environmental intervention designed to improve safety and access to environmental supports for PA to facilitate walking and MVPA in underserved communities in South Carolina. Three communities were randomized to participate in the full PATH intervention, a police-patrolled walking program only community, or a general health education community using a nonequivalent control group design (Larger & Rodin, 1976). The full PATH intervention was guided by ecological theory and integrated social marketing strategies to impact the social environment in addition to a police-patrolled walking program. Communities randomized to receive the full PATH intervention and the police-patrolled walking program only received a police-patrolled walking program which included training community members as walking leaders, improving safety via off-duty police officer patrols, stray dog management, and marking a walking trial. The full PATH intervention also included a community-informed grass-roots social marketing campaign which highlighted messages about safety, improving

physical and mental health, building self-efficacy for walking, and community connectedness (described in Coulon et al. (2012)). The study was approved by University of South Carolina's institutional review board.

The PATH trial utilized a longitudinal study design to assess changes in PA behavior over 24 months and examine potential difference in PA behavior across communities. Baseline measurements were collected to examine potential differences between communities. Participants from the PATH intervention community were older than the walking program only community and were more likely to not be working or be retired compared to the other two communities (Wilson et al. 2010). Participants from the general health education community had higher diastolic blood pressure and higher perceptions of safety from crime compared to the full PATH intervention and walking program only communities. At 12 months, measures were collected to examine differences between communities at the end of the interventions (full PATH intervention including police-patrolled walking program and social marketing vs. police-patrolled marketing only vs. general health education), while 18- and 24-month measures were collected to examine whether potential changes in MVPA were sustained over time. There were no significant differences between communities in accelerometry-measured MVPA over 24 months, but the full PATH intervention community did show an increase in walkers during the trial (Wilson et al., 2015).

The current study utilized data collected at baseline, 12, 18, and 24 months across all three communities during the PATH trial. Using PA data over two years allowed for examination of potential effects of social environmental variables (social norms for PA, social support for PA from friends and neighbors, and neighborhood satisfaction) on

MVPA and LPA at baseline and for examination of potential effects of these variables on changes in MVPA and LPA over time. The current study used data from participants residing in all three communities but controlled for community to account for potential differences at baseline and any intervention effects.

2.3 Procedures

Informed consent for interested participants was conducted by trained and certified research staff members who provided information about the study and potential benefits and risks of participation. Participants who consented to the study attended measurement assessments at baseline, 12, 18, and 24 months conducted by trained and certified research staff. Measures were conducted during health screenings (blood pressure and blood glucose values were provided) at local community centers to encourage participation. These community centers also served as the location for community activities associated with the trial (walking trail starting points, locations of health education programs). Each measurement time point was conducted within a two-week window and was coordinated by directors of the community centers who served as community liaisons. At each measurement assessment, participants completed psychosocial questionnaires and received instructions for wearing accelerometers for 7 days to provide PA estimates. Other measures obtained included height, weight, waist circumference, and demographics. The current study utilized data from psychosocial questionnaires, height and weight measurements, and PA estimates. Participants received monetary incentives of $20 at baseline, 12, and 18 month measurement assessments and $40 at the final 24-month assessment.

2.4 Measures

Covariate Variables.

Community. To account for potential differences in participant characteristics at baseline and control for any intervention effects (as described above), community was used as a covariate in the models.

Demographic Information. Demographic information was self-reported via survey and included participant age, sex, education level, yearly income, marital status, employment, and how many children (17 and younger) were present in the household. Age and sex (at baseline) were used as covariates based on their known associations with PA levels.

Body Mass Index (BMI). Height was measured using a ShorrBoard while weight was measured using a SECA 880 scale. These measurements were taken twice by a trained and certified measurement team member. Height measurements were required to be within 0.1 cm, and weight measurements were required to be within 0.5kg or a third measurement was obtained. BMI was calculated from the two averaged height and weight measurements using the standard formula: weight (kg) / height $(m)^2$.

Season. A variable indicating whether baseline data were collected during the spring or fall was included to account for seasonal effects on PA.

Neighborhood Access to Places for PA. Neighborhood access to places for PA was included as a covariate in the present study given that the focus on understanding social environmental factors and that past research has shown that access to PA supports are also important for understanding PA engagement in adults. A subscale of the Neighborhood Environment Walkability Scale (NEWS; Saelens, Sallis, Black, & Chen,

2003) which measures places for walking and cycling in the neighborhood (access) was used to measure neighborhood access to places for PA. The subscale consists of 5 items measured on a 4-point Likert-type scale ranging from strongly disagree (1) to strongly agree (4) with higher scores indicating increased access to places to exercise. Example items included "There are sidewalks on most of the streets in my neighborhood" and "There is a grass/dirt strip that separates the streets from sidewalks in my neighborhood." Items from this measure have been shown to load onto the same latent factor of infrastructure for walking/cycling in a sample of adults (52% female, 27% African American, M_{age} = 46.6; Cerin, Conway, Saelens, Frank, & Sallis, 2009). Perceptions of neighborhood physical environment (as measured by this subscale) have also shown to be associated with other neighborhood measures in a sample of adults (74% female, M_{age} = 44.1; Leslie et al., 2005). For example, residents of a high-walkability neighborhood, as measured by geographic information systems data, reported higher scores on this measure of perceived neighborhood physical environment compared to residents of a low-walkability neighborhood. This measure has also shown concurrent validity in a study by Trumpeter & Wilson (2014) using the PATH data set with positive perceptions of neighborhood physical environment being significantly associated with higher self-reported daily walking levels. This measure has shown two-week test-retest reliability ranging from α= 0.58 -0.76 (Leslie et al., 2005; Saelens, Sallis, Black, et al., 2003). In the current sample the measure achieved reliability of α=0.79.

Physical Activity. PA was assessed using 7-day omni-directional Actical accelerometer estimates (Mini Mitter, Bend, OR). Previous literature has shown Actical accelerometry data to be a valid assessment of PA behavior. Accelerometry PA estimates

are less susceptible to self-report bias than survey data (Bassett et al., 2008; Murphy, 2009; Sallis & Saelens, 2000). Actical calibration studies often develop cut-points by comparing activity counts to PA behaviors with known metabolic outputs (such as calorimetry measurements or measured walking paces). Further, Actical measurements have been shown to be correlated with metabolic indicators in other laboratory settings. For example, in a study of 19 healthy young adults, Dannecker, Sazonova, Melanson, Sazonov, and Browning (2013) compared room calorimeter energy expenditure estimates to Actical-measured estimates and found no significant difference for sitting, standing, and walking behaviors. However, they found that the Actical device may underestimate more vigorous activities, consistent other studies (Crouter, Churilla, & Bassett, 2006; Johnson et al., 2015; Lyden, Kozey, Staudenmeyer, & Freedson, 2011). Actical accelerometers have also been shown to be reliable in laboratory settings with relatively low variability between different devices (9.6%) and trial (0.9%) for walking on a treadmill (Welk, Schaben, & Morrow, 2004). This study also demonstrated that height, weight, and BMI were not significantly correlated with differences in activity counts for the same activity. In sum, objective measures of PA using the Actical device allows for capturing valid and reliable duration and intensity of PA.

Accelerometer count data was collected in 60 second epochs which have been commonly used for adults (Trost, McIver, & Pate, 2005). Although some literature has begun to use shorter epochs (Colley, Harvey, Grattan, & Adamo, 2014; Nilsson, Ekelund, Yngve, & Sjostrom, 2002), these studies predominantly utilize a youth sample and national trials, such as NHANES, continue to use 60 second epochs (Troiano et al., 2008). Further, this is consistent with the calibration studies used to develop the cut-

points used in the current study (Trumpeter et al., 2012; Wong, Colley, Gorber, & Tremblay, 2011). Non-wear was defined as 60 consecutive zero counts. This criterion has been used nationally in the NHANES data (Troiano et al., 2008) and has been shown to most accurately reflect wear time and activity in comparison to 20 or 40 minute criteria (Evenson & Terry, 2009). Seven days of wear time was used for each measurement time point which, based on past research, is sufficient for capturing average PA levels and accounting for PA variability across week and weekend days (Hart, Swartz, Cashin, & Strath, 2011; Matthews, Ainsworth, Thompson, & Bassett, 2002; Trost et al., 2005). Minutes of activity were averaged across days of wear (with each day coded within time blocks of 6am-12pm, 12pm-4pm, 4pm-8pm, and 8pm-12am) to obtain a single measure representing average daily minutes of MVPA and LPA.

Actical cut points for MVPA were developed for use in the PATH trial for African American adult populations (Trumpeter et al., 2012). This cut-point (counts ≥ 1075/minute) was used to classify MVPA as time spent engaging in at or above a self-selected "walking for exercise" pace (2.0 miles per hour; mph). While this pace is lower than the commonly used MVPA cut-off of 3.0 mph (corresponding with > 3.0 METS), research has shown that older and overweight populations experience aerobic/cardiovascular demand at lower speeds compared to younger, healthy populations (Fitzsimons et al., 2005). The cut-point used for MVPA in this study is consistent with the guidelines that suggest that adjusted intensity based on subjective reports of physical demand may be more appropriate for individuals at lower fitness levels (Ainsworth et al., 2011; U.S. Department of Health and Human Services, 2008). This cut-point was developed in a sample of 51 African American participants (61% female; M_{age} (*SD*) =

60.1(9.9); M_{BMI} (*SD*) = 30.5(6.0)) who were demographically similar to the current sample.

LPA was not included as an outcome in the original PATH trial or in the calibration study developed for the PATH trial (Trumpeter et al., 2012). While there is some debate in the field about how to measure LPA, the present study considered LPA to include all PA between sedentary behavior and MVPA. The cut-point for LPA used in the present study was developed in a large calibration study (n= 2138) of adults aged 18-79 (Wong et al., 2011). This study compared a variety of cut-points (50, 100, and 800) to step-count data to establish a threshold between sedentary behavior and LPA. Wong and colleagues identified 100 counts per minute as an appropriate cut-point that correctly identified 96.8% of sedentary minutes when compared to step count data (0 steps per minute). This cut-point is consistent with large national studies, such as NHANES, and recent research examining associations between LPA and health outcomes (Buman et al., 2010; Colley et al., 2011; Fishman et al., 2016; Healy et al., 2008) which allows for comparison of results to other research.

Social Environmental Measures.

Social Norms for PA. Perceived social norms for PA in the neighborhood were measured using a 2-item scale developed for use in the PATH trial. Scale items included "I walk with my neighbors on a regular basis in my neighborhood" and "People in my neighborhood walk together on a regular basis." Each item was measured on a 4-point Likert-type scale which ranged from strongly disagree (1) to strongly agree (4), with higher scores indicating more positive neighborhood social norms for PA. This measure is similar to measures of social norms at the neighborhood level in other studies that have

been associated with self-reported PA outcomes (Ball et al., 2010; King et al., 2000; Timperio et al., 2015; Tsunoda et al., 2012; Wilcox et al., 2000) and self-reported changes in PA outcomes over time in men (Sallis et al., 2007). Construct validity was assessed by examining correlations between other social environmental measures related to normative PA behavior in the present study (social support for PA from friends r = 0.34; social support for PA from neighbors r = 0.23). The two items were moderately correlated (r = 0.54) and achieved a reliability of α=0.70 in the present study.

Social Support for PA. Social support for PA from friends and social support for PA from neighbors were measured using the Social Support for Exercise Scale (Sallis et al., 1987). These scales were developed from in-depth structured interviews with a multiethnic adult sample (M_{age} =36) which aimed to identify beneficial supportive behaviors from family and friends for health behavior change. Items asked how often either friends or neighbors engaged in PA support behaviors over the last 3 months and were measured on a 5-point Likert-type scale ranging from never (1) to very often (5) with higher scores indicating more perceived social support for PA.

Social support for PA from friends was measured using the friend support for exercise habits subscale. This measured included 5 items such as "During the past 3 months, my friends offered to do physical activity with me" and "During the past 3 months, my friends gave me helpful reminders to exercise." This scale was validated in a sample of young predominantly White adults (Sallis et al., 1987). Factor analyses support a single-factor structure for these 5 items. The measure was shown to be reliable (α=0.84; two week test-retest α=0.79). Concurrent validity was demonstrated in the validation sample by assessing the relationship between levels of perceived social support for PA

and self-reported vigorous exercise, with higher levels of social support for PA from friends positively associated with vigorous PA (r = 0.46; Sallis et al., 1987). Social support for PA from friends, as measured by this scale, has been shown to be reliable in African American populations (Sharma, Sargent, & Stacy, 2005; Wilcox, Bopp, Oberrecht, Kammermann, & McElmurray, 2003; Young & Stewart, 2006). In the current sample, the measure achieved reliability of α=0.89. The measure was positively correlated with related variables such as social support for PA from neighbors (r = 0.31) and social norms for PA (r = 0.34).

Social support for PA from neighbors was measured using a modified version of the family support for exercise habits scale. The modified version used in the current study used 12 items to assess support from neighbors instead of family members. Sample items included "During the past 3 months, my neighbors planned for exercise on recreational outings" and "During the past 3 months, my neighbors gave me encouragement to do physical activity." This subscale was validated using the same sample as the social support for PA friend friends subscale (young, predominantly White adults). Factor analysis supported a single-factor structure for these 12 items (Sallis et al., 1987). The measure was also shown to be reliable (α=0.91; two week test-retest α=0.77) and higher levels of perceived social support for PA were associated with self-reported vigorous exercise (r = 0.35), demonstrating concurrent validity (Sallis et al., 1987). The original measure has shown to be reliable in African American populations (α= 0.88-0.93; Bopp et al., 2009; Joseph, Keller, Adams, & Ainsworth, 2015; Joseph et al., 2016). In the current sample, the measure achieved reliability of α=0.92. The measure was

positively correlated with related variables such as social support for PA from friends (r = 0.31) and social norms for PA (r = 0.23).

Neighborhood Satisfaction. A subscale of the NEWS (Saelens, Sallis, Black, et al., 2003) was used to measure neighborhood satisfaction. The subscale consisted of 17 items measured on a 5-point Likert-type scale ranging from strongly dissatisfied (1) to strongly satisfied (5) that measure satisfaction with social connectedness, access to facilities, and safety from crime and traffic. Higher scores indicate higher neighborhood satisfaction. Example items include "How satisfied are you with the number of people you know in your neighborhood?" and "How satisfied are you with how easy and pleasant it is to walk in your neighborhood?" This measure has shown to be reliable in populations of older adults (Morris et al., 2008) and African American adults (Brownson et al., 2004; Halbert et al., 2014; McDaniel, Wilson, Coulon, Hand, & Siceloff, 2015; Strath et al., 2012; Trumpeter & Wilson, 2014) with reliability ranging from α=0.71-0.87 in these previous studies (test-retest reliability ICCs = 0.44-0.73 for individual items, ρ=0.85 for full scale). This measure has shown concurrent validity in older adults such that reported neighborhood satisfaction was positively associated with accelerometer-measured minutes of total PA and MVPA cross-sectionally (Strath et al., 2012). This measure has also shown predictive validity for changes in self-reported PA (Morris et al., 2008) such that changes in neighborhood satisfaction predicted changes in self-reported PA at 6 months in a sample of older women. In the current sample, the measure achieved reliability of α=0.77. The measure was positively correlated with related variables such as neighborhood access to places for walking and cycling (r = 0.12) and social support for PA from friends (r = 0.15).

Cognitive Mediator. Self-efficacy for PA was measured using a 16-item measure developed by Garcia and King (1991) based on social cognitive theory principles (Bandura, 1986). Participants were asked to rate how confident they were that they could exercise over the next six months when faced with barriers to PA such as when feeling tired, when feeling depressed, when on vacation, when their schedule is busy, or when their workout in not enjoyable. Responses were recorded as a percentage in 10 percent increments ranging from 0% (I cannot do it at all) to 100% (Certain that I can do it). All items were averaged with higher scores indicating greater self-efficacy to engage in PA. The single factor structure of this measure has been validated in a large sample (n=1919) and did not vary based on sex, race, age, weight, and education of the validation sample (Wilcox, Sharpe, Hutto, & Granner, 2005). Previous studies have shown this measure to have high internal consistency across demographic groups (α=0.90-0.94; Garcia & King, 1991; Wilcox et al., 2005). Garcia & King (1991) demonstrated the measure's predictive validity in a sample of predominantly White (92%) adults aged 50 to 64 years. Self-efficacy for engaging in PA in this sample was correlated with self-reported adherence to an exercise program over 6 (r = 0.42) and 12 (r = 0.44) months. Wilcox and colleagues (2005) found that higher levels of self-efficacy for engaging in PA (as conceptualized by this measure) was associated with a greater likelihood of being regularly physically active (as measured by self-report) in a diverse sample (34% African American, 58% female, 57% overweight or obese). In the current sample, the measure achieved reliability of α=0.96 and was significantly positively correlated with social environmental variables (social support for PA from friends r = 0.19, social support for PA from neighbors r = 0.11, social norms for PA r = 0.14, and neighborhood satisfaction r = 0.11).

2.5 Data Analytic Plan

The current study utilized a multilevel modeling approach using R Statistical software. This is a useful approach because it allows for analysis of nested data (time points within individual) and allows slope and intercepts to vary across individual as recommended by Fitzmaurice, Laird, and Ware (2012). The final model was developed using a stepwise approach which included both Time and $Time^2$ predictors to model the change in PA overtime.

Aim 1. To examine how neighborhood social environment predicts MVPA and LPA outcomes at baseline and change in MVPA and LPA over time, MVPA and LPA were regressed on social norms for PA, social support for PA from friends, social support for PA from neighbors, and neighborhood satisfaction. Time was coded such that baseline was equal to zero and subsequent time points were coded by year (1, 1.5, and 2). Based on known associations with PA, the following covariates were also included in the model: community, age, sex, BMI, season, neighborhood access to facilities for PA. MVPA and LPA outcomes was analyzed in separate models, with the model for MVPA shown below.

Level 1: $MVPA_{ij} = \beta 0_i + \beta_{1i}Time + \beta_{2i}Time_{ij}^2 + e_i$

Level 2:

$$\beta_{0i} = \gamma_{00} + \gamma_{01}Community_i + \gamma_{02}Age_i + \gamma_{03}Sex + \gamma_{04}BMI_i + \gamma_{05}Season_i +$$
$$\gamma_{06}NeighborhoodAccess_i + \gamma_{07}SocialNorm_i + \gamma_{08}FriendSocialSupport_i +$$
$$\gamma_{09}NeighborSocialSupport + \gamma_{010}NeighborhoodSatisfaction_i + u_0$$

$$\beta_{1i} = \gamma_{10} + \gamma_{11}\text{Community}_i + \gamma_{12}\text{Age}_i + \gamma_{13}\text{Sex} + \gamma_{14}\text{BMI}_i + \gamma_{15}\text{Season}_i + \gamma_{16}\text{NeighborhoodAccess}_i + \gamma_{17}\text{SocialNorm}_i + \gamma_{18}\text{FriendSocialSupport}_i + \gamma_{19}\text{NeighborSocialSupport} + \gamma_{110}\text{NeighborhoodSatisfaction}_i + u_1$$

$$\beta_{2i} = \gamma_{20} + \gamma_{21}\text{Community}_i + \gamma_{22}\text{Age}_i + \gamma_{23}\text{Sex} + \gamma_{24}\text{BMI}_i + \gamma_{25}\text{Season}_i + \gamma_{26}\text{NeighborhoodAccess}_i + \gamma_{27}\text{SocialNorm}_i + \gamma_{28}\text{FriendSocialSupport}_i + \gamma_{29}\text{NeighborSocialSupport} + \gamma_{210}\text{NeighborhoodSatisfaction}_i + u_2$$

In this model γ_{07} - γ_{010} represented the direct effects of neighborhood social environment on MVPA. Direct effects of neighborhood social environment on change on MVPA over time were represented by $\gamma_{17} - \gamma_{110}$ and $\gamma_{27} - \gamma_{210}$.

Aim 2. The second aim of the current study was to assess whether self-efficacy mediates the relationship between neighborhood social environmental variables and MVPA and LPA at baseline and change in MVPA and LPA over time. For this aim, a mediation model testing direct and indirect effects of social norms for PA, social support for PA from friends, social support for PA from neighbors, and neighborhood satisfaction on MVPA and LPA was used. For a mediation model, the relationship between the predictors and the mediator is specified (the relationships between the social environmental variables and self-efficacy for PA, termed the a paths) and the relationship between the mediator and the outcomes are specified (the relationships between self-efficacy for PA and MVPA and LPA, termed the b paths). These a and b paths are multiplied to estimate the mediated effect. Time was coded such that baseline was equal to zero and subsequent time points were coded by year (1, 1.5, and 2). Based on known associations with PA, the following covariates were also included in the model: community, age, sex, BMI, season, and neighborhood access to facilities for PA. MVPA

and LPA outcomes were analyzed in separate models, with the model for MVPA shown below.

Level 1: $MVPA_{ij} = \beta 0_i + \beta_{1i}Time + \beta_{2i}Time_{ij}^2 + e_i$

Level 2:

$$\beta_{0i} = \gamma_{00} + \gamma_{01}Community_i + \gamma_{02}Age_i + \gamma_{03}Sex + \gamma_{04}BMI_i + \gamma_{05}Season_i + \gamma_{06}NeighborhoodAccess_i + \gamma_{07}SocialNorm_i + \gamma_{08}FriendSocialSupport_i + \gamma_{09}NeighborSocialSupport + \gamma_{010}NeighborhoodSatisfaction_i + \gamma_{011}Self\text{-}Efficacy_i + u_0$$

$$\beta_{1i} = \gamma_{10} + \gamma_{11}Community_i + \gamma_{12}Age_i + \gamma_{13}Sex + \gamma_{14}BMI_i + \gamma_{15}Season_i + \gamma_{16}NeighborhoodAccess_i + \gamma_{17}SocialNorm_i + \gamma_{18}FriendSocialSupport_i + \gamma_{19}NeighborSocialSupport + \gamma_{110}NeighborhoodSatisfaction_i + \gamma_{111}Self\text{-}Efficacy_i + u_1$$

$$\beta_{2i} = \gamma_{20} + \gamma_{21}Community_i + \gamma_{22}Age_i + \gamma_{23}Sex + \gamma_{24}BMI_i + \gamma_{25}Season_i + \gamma_{26}NeighborhoodAccess_i + \gamma_{27}SocialNorm_i + \gamma_{28}FriendSocialSupport_i + \gamma_{29}NeighborSocialSupport + \gamma_{210}NeighborhoodSatisfaction_i + \gamma_{211}SelfEfficacy_i + u_2$$

An additional model was used to specify the relationships between the social environmental predictors and self-efficacy for PA (shown below).

$$Self\text{-}Efficacy = \beta_0 + \beta_1Community + \beta_2Age + \beta_3Sex + \beta_4BMI + \beta_5Season + \beta_6Neighborhood\ Access + \beta_7SocialNorm + \beta_8FriendSocialSupport + B_9NeighborSocialSupport + \beta_{10}NeighborhoodSatisfaction + \varepsilon$$

In these models γ_{07} - γ_{010} represented the direct effects of the neighborhood social environment variables on MVPA at baseline. This represents the c' path of the cross-

sectional mediation model. γ_{011} represented the direct effect of self-efficacy on MVPA at baseline, the b path of the cross-sectional mediation model. $\gamma_{17} - \gamma_{110}$ and $\gamma_{27} - \gamma_{210}$ represented the direct effects of the neighborhood social environment variables on predicted change in MVPA, the c' path of the longitudinal mediation model. γ_{111} and γ_{211} represented the direct effect of self-efficacy on predicted change in MVPA, the b path of the longitudinal mediation model. Because the impact of neighborhood social environmental variables on self-efficacy are believed to have already occurred at baseline, $\beta_1 - \beta_3$ represented the relationships between these variables (the a paths) for both the cross-sectional and longitudinal mediation model.

The indirect effect (mediated by self-efficacy) of social norms for PA, social support for PA from friends, social support for PA from neighbors, and neighborhood satisfaction were calculated by multiplying the a and b path coefficients. To test whether the mediation effect is significant, the product coefficient was compared to confidence intervals calculated using the distribution of the product method (MacKinnon & Fritz, 2007; MacKinnon, Lockwood, Hoffman, West, & Sheets, 2002) in the RMediation package (Tofighi & MacKinnon, 2011).

Missing data. Similar to previous cluster randomized trials (Taljaard, Donner, & Klar, 2008), the PATH trial utilized multiple imputations to address missing data. Imputation was performed using the MICE package (van Buuren & Groothuis-Oudshoorn, 2011) in R (R Development Core Team, Vienna, Austria). Multiple imputation requires that data be missing at random, and this assumption is met when predictors of missingness are included in the model. As such, covariates that were found to predict missingness of PA (age, sex, perception of crime, motivation for PA, and friend

social support for PA) were included in the model (see Wilson et al., 2015 electronic supplement). Twenty imputations were generated at the individual level. PA data was considered missing if 20% or more of the block was categorized as non-wear (as indicated by 60 consecutive zero counts). See Table 2.3 for a summary of missingness of PA data. If a participant was missing all MVPA data at a time point, a summary score representing average minutes of PA for the time point was imputed. A summary of missingness of psychosocial data for each time point is available in Table 2.4.

The existing PATH accelerometry data was reduced in SAS using an LPA cut-point (counts ≥ 100/minute) in addition to the previously used MVPA cut-point (counts ≥ 1075/minute; Trumpeter et al., 2012). For the present study additional imputation models were used to address missingness for LPA. Missingness for each PA block utilized in the MVPA imputation was used to code for missingness for LPA (see Table 2.3). The imputation model was conducted at the individual level. Each time point was imputed separately and included all demographic (sex, age, marital status, children in the household, employment, education, yearly income, BMI) and psychosocial variables (social support for PA from friends, social support for PA from neighbors, social norms for PA, neighborhood satisfaction, neighborhood access to places for exercise, perception of crime, motivation for PA) in addition to MVPA values available from the previous imputation. Imputations were first conducted at the block level for participants who were not missing all LPA data at a time point. Imputed values at the block level were then averaged across imputed data sets (20) to allow for imputation at the summary level. Similar to the previous imputation for MVPA, if a participant was missing all LPA data

at a time point, a summary score representing average minutes of PA for the time point was then imputed.

Preliminary analyses and assumptions. All preliminary data analyses and testing of model assumptions were conducted utilizing the statistical package R. Scores for each measure were calculated by norming each item contributing to the scale (converting each item score to a z-score) to allow each item to contribute equally to the overall scale score. These normed scores were then summed to create a summary score for the measure at each time point which are represented as z-scores. Internal consistency for each measure at baseline was assessed (see Table 2.5) and deemed adequate for the current study (α=0.70-0.96).

After imputation, diagnostics were conducted to test potential violations of the model before analyses using one imputation selected by a random number generator. Correlations between predictors were examined to assess for multicollinearity among independent variables (see Table 2.6). Effect sizes of correlations between predictors were small to medium indicating that this assumption was not violated. Histograms and scatterplots were examined to check for normal distribution of variables and residuals. The distribution of MVPA was significantly skewed and was transformed via a square-root transformation to improve normality. Examination of residual plots for each hypothesized relationship between predictor and outcome allowed for testing of linearity of the relationships. No other assumption violations were found. Potential clustering between the three communities was assessed prior to analyses and a dummy variable for community was included in each model as a covariate.

Model building and testing for influential cases were also conducted using the selected imputed data set. In order to determine how changes in PA over time should be included in the final models, three models were tested for each outcome which differed in how direct and random effects of time were specified (see Table 2.7 – 2.10). These models were specified to allow for random effects for the intercept and slope of MVPA and LPA across individuals and to test significance of fixed and random effects of time and time^2. Convergence of the models was not achieved using the full Tau matrix when trying to specify a random effect of time^2; thus, this model was specified using the diagonal of the Tau matrix only. Comparison of logLiklihood values indicated that adding random effects of time^2 did not improve model fit, and as a result this term was not included in the final models. Direct effects of time and time^2 and random effects of time were significant for both MVPA and LPA models. Therefore, all reported models will include these terms using the full Tau matrix.

Further models were tested to determine potential covariates and interactions with time. Participant income and education were investigated as potential covariates but did not significantly predict PA outcomes and thus were dropped. The quadratic slope of time showed no evidence of interaction with social norm, friend social support, neighbor social support, or neighborhood satisfaction for either MVPA or LPA. Because these terms were not significant, they were not included in the final analysis. Influential cases were examined by calculating Cook's distance values, DFBETAS, and percentile change scores for parameters of each model. No cases were deemed to be significantly influential so final models include all 417 participants. All reported final models represent results averaged across all 20 imputations.

Table 2.1 *Baseline Variables for Matching the Three Communities*

Variable	Full intervention	Walking only	General health
African American (%)	99	99	93
Median household income	$16,804	$22,088	$17,695
Poverty status (%)	38	32	39
Murders	1	1	1
Rapes	4	4	2
Aggravated assault	87	67	65
Breaking and entering	160	141	149
Index total per capita (crime)	0.0058	0.0057	0.0068
Physical inactivity	30	38	38
Health index score	124	129	134

Note: Crime data are population rates; crime stats for each county from: http://www.ors2.state.sc.us/abstract/chapter6/crime4.asp; Census data from www.census.gov; Health status from the South Carolina Behavioral Risk Factor Surveillance Survey.

Source: Wilson et al., (2010)

Table 2.2 *Descriptive Baseline Data*

Variable	Value
Sex (Female), *N (%)*	264 (63.31%)
Age *M(SD)*	51.65 (15.46)
18-24	28 (6.71%)
25-44	101 (24.22%)
45-64	198 (47.48%)
65-85	90 (21.58%)
Marital Status, *N (%)*	
Married	98 (23.50%)
Separated	57 (13.67%)
Divorced	48 (11.51%)
Widowed	81 (19.42%)
Never Married	105 (25.18%)
Unmarried Couple	28 (6.71%)
Children in Household (Yes), *N (%)*	146 (34.77%)
Employment, *N (%)*	
Working	169 (40.53%)
Laid off/Unemployed	98 (23.50%)
Retired	101 (24.22%)
Disabled	35 (8.39%)
Homemaker	13 (3.11%)
Student	11 (2.64%)
Education, *N (%)*	
< High School Degree	112 (26.86%)
High School or Equivalent	170 (40.77%)
Some College / Technical Training	89 (21.34%)
College Degree	22 (5.28%)
Graduate / Professional Degree	24 (5.76%)
Yearly Income *N (%)*	
< $10,000	127 (30.46%)
$10,000 - $24,999	145 (34.77%)
$25,000 - $39,999	81 (19.42%)
$40,000 - $54,999	34 (8.15%)
≥ $54,000	31 (7.43%)
BMI *M(SD)*	31.18 (8.41)
<25	85 (20.38%)
25-<30	103 (24.70%)
≥30	229 (54.92%)
MVPA *M(SD)*	31.25 (41.27)
LPA *M(SD)*	210.03 (83.74)

Note. *N*=417, MVPA=moderate-to-vigorous physical activity, LPA= light physical activity.

Table 2.3 *Missing PA Data*

Measurement Period	Participants Missing PA Data	Percentage of Missing PA Data
Baseline	45	10.37%
12 months	158	36.41%
18 months	139	32.03%
24 months	134	30.88%

Note. PA=physical activity, *N*=434
Source: Wilson et al., (2015) Electronic Supplement

Table 2.4 *Missing Psychosocial Data*

Variable	Percent of Participants Missing Data
Social Norms for PA	0.48%
Social Support for PA from Friends	0.48%
Social Support for PA from Neighbors	20.14%
Neighborhood Satisfaction	
Items 1-6	0.48%
Items 7-17	20.14%
Neighborhood Access for Places to Walk	0.48%
Self-efficacy for PA	0.48%

Note. Items 1-6 were obtained using the original psychosocial measure in the PATH trial. Items 7-17 were included in a supplement survey which accounts for differences in missingness values.

Table 2.5 *Internal Consistency of Measures*

Scale Name	Cronbach's α Value
Social Norms for PA	0.70
Social Support for PA from Friends	0.89
Social Support for PA from Neighbors	0.92
Neighborhood Satisfaction	0.77
Neighborhood Access for Places to Walk	0.79
Self-efficacy for PA	0.96

Note. Reliability values are presented as calculated for the measures at baseline.

Table 2.6 *Correlations at Baseline to Assess Multicollinearity*

	Social Norms	SS. Friends	SS. Neighbors	N. Satisfaction	N. Access
Social Support Friends	0.34*	-			
Social Support Neighbors	0.23*	0.26*	-		
Neighborhood Satisfaction	0.23*	0.15*	0.02	-	
Neighborhood Access	0.33*	0.20*	0.18*	0.15*	-
Self-efficacy for PA	0.13*	0.19*	0.10*	0.11*	0.05

Note. * indicates correlations significant with alpha criteria of 0.05. Column headings correspond to row names

Table 2.7 *Changes in MVPA over Time Model Estimation*

	Model 1	Model 2	Model 3
Fixed Effects			
Intercept	4.76 (0.16)*	4.59 (0.17)*	4.59 (0.17)*
Time	0.00 (0.08)	0.96 (0.27)*	0.93 (0.27)*
$Time^2$	-	-0.48(0.14)*	-0.48 (0.14)*
Random Effects			
Intercept	2.32	2.33	2.35
Slope of Time	0.00	0.00	0.00
Slope of $Time^2$	-	-	0.00
e_{ti}	2.45	2.45	2.45
Model FIT (logLik)	-4185.26	-4178.96	-4178.96

Note. MVPA was transformed using a square-root transformation; Model 3 was specified using the diagonal of the Tau matrix only for convergence; *p <0.05

Table 2.8 *Comparison of Time Estimation Models for MVPA*

Model	df	AIC	BIC	logLik	Test	ChiSq	p value
Model 1	6	8282.5	8415.0	-4185.3			
Model 2	7	8371.9	8409.8	-4178.9	1 v 2	12.6	0.05
Model 3	7	8371.9	8409.8	-4178.9	2 v 3	0	1

Note. Model 2 significantly improved model fit over Model 1 (p <0.05), but adding a random effect of time^2 (Model 3) did not significantly improve model fit.

Table 2.9 *Changes in LPA over Time Model Estimation*

	Model 1	Model 2	Model 3
Fixed Effects			
Intercept	216.22 (3.87)*	211.28 (4.06)*	211.28 (4.04)*
Time	12.08 (2.39)*	38.74 (7.04)*	38.74 (7.05)*
$Time^2$	-	-13.83 (3.43)*	-13.83 (3.44)*
Random Effects			
Intercept	54.62	55.15	54.55
Slope of Time	24.09	24.75	24.20
Slope of $Time^2$			0.00
e_{ti}	62.68	62.12	62.25
Model FIT (logLik)	-9643.88	-9635.83	-9635.85

Note. Model 3 was specified using the diagonal of the Tau matrix only for convergence; *p <0.05

Table 2.10 *Comparison of Time Estimation Models for LPA*

Model	df	AIC	BIC	logLik	Test	Chi Sq	*p* value
Model 1	6	19300	19332	-9643.9			
Model 2	7	19286	19324	-9635.8	1 vs 2	16.10	0.00
Model 3	7	19286	19324	-9635.8	2 vs 3	0	1

Note. Model 2 significantly improved model fit over Model 1 (p <0.05), but adding a random effect of time^2 (Model 3) did not significantly improve model fit.

CHAPTER 3

RESULTS

3.1 Correlation Analyses

Several social environmental predictors (measured at baseline) were significantly correlated with PA outcomes (see Table 3.1). Social norms for PA were positively correlated with MVPA minutes at all time points (r = 0.21-0.27) with the relationship strongest with baseline MVPA. Other relationships were not consistent across measurement time points. For example, social support from friends was significantly positively correlated with MVPA minutes only at baseline (r = 0.10) and 18-months (r = 0.12) and social support from neighbors was significantly positively correlated with MVPA minutes only at baseline (r = 0.16) and 12-months (r = 0.11). Social norms for PA and social support from neighbors were significantly correlated with LPA minutes at 18-months only (r = 0.10 and r = 0.10, respectively). Relationships between neighborhood satisfaction and PA outcomes were either not significant or in unexpected directions; neighborhood satisfaction was significantly negatively correlated with MVPA (r = -0.12) and LPA (r = -0.10) minutes at 12-months and with LPA at 24-months (r = -0.10). All other correlations with PA outcomes were not significant. MVPA and LPA minutes were significantly positively correlated with each other in the expected direction at all time points (r = 0.43-0.49).

3.2 Aim 1

To answer the research questions in aim 1, whether neighborhood social environmental predictors predict MVPA and LPA at baseline and over time, separate hierarchical multilevel models for each outcome were examined. Model 1 included only the effects of time and covariates, Model 2 added social environmental predictors of PA at baseline, and Model 3 added social environmental predictors of change in PA overtime (interactions between the social environmental predictors and time). Using hierarchical multiple regression allowed for testing of improvements in model fit to the data with the addition of each set of variables.

For MVPA, Model 1 examined the relationship between time and covariates (community, season, age, sex, BMI, and neighborhood access) and MVPA minutes (see Table 3.2). The linear and quadratic components of time did not significantly predict MVPA (see Figure 2). Participant age (γ = -0.08, *SE* = 0.01), sex (γ = -1.46, *SE* = 0.25), and BMI (γ = -0.05, *SE* = 0.02) predicted MVPA minutes at baseline in the expected directions such that participants who were older, female, and had higher BMI scores had lower predicted minutes of MVPA. Neighborhood access was also a significant predictor (γ = 0.22, *SE* = 0.11) such that higher reported access to facilities for exercise was associated with higher predicted minutes of MVPA at baseline. Model 2 included neighborhood social environmental predictors in addition to the time variables and covariates and significantly improved model fit (F (4, 1199.79) = 4.04, $p < 0.05$). Social norm for PA was significantly associated with predicted MVPA minutes (γ = 0.37, *SE* = 0.12) such that reporting positive social norms was associated with higher baseline MVPA. Neighbor social support for PA was also significantly associated with predicted

MVPA minutes ($\gamma = 0.37$, $SE = 0.13$) such that reporting higher amounts of neighbor social support was associated with higher predicted baseline MVPA. Friend social support for PA and neighborhood satisfaction were not significantly associated with predicted baseline MVPA minutes. Model 3 added interactions between time and the neighborhood social environment predictors to assess how these variables may be associated with predicted MVPA minutes over time. The addition of these interactions did not significantly improve model fit (F (4, 641.22) = 0.20, $p > 0.05$) and none of the interaction terms were significant predictors of MVPA minutes.

For LPA, model 1 examined the relationship between time and covariates (community, season, age, sex, BMI, and neighborhood access) and LPA minutes (see Table 3.3). Both the linear ($\gamma = 39.08$, $SE = 7.67$) and quadratic components of time ($\gamma = -13.60$, $SE = 3.70$) significantly predicted LPA minutes (see Figure 3). Participant age ($\gamma = -1.84$, $SE = 0.20$) and sex ($\gamma = -16.04$, $SE = 6.67$) predicted LPA minutes at baseline in the expected directions such that participants who were older and female had lower predicted minutes of LPA. Participant BMI and neighborhood access were not significant predictors of baseline LPA minutes. Model 2 included neighborhood social environmental predictors in addition to the time variables and covariates, but did not significantly improve model fit (F (4, 9100.52) = 2.07, $p > 0.05$). However, because the p-value approached 0.05 ($p = 0.08$), neighborhood social environmental predictors were examined as these terms answer the research question for aim 1 of whether neighborhood social environment predict baseline LPA minutes. Neighbor social support for PA was significantly associated with predicted LPA minutes ($\gamma = 8.01$, $SE = 3.38$) such that reporting higher amounts of neighbor social support was associated with higher baseline

LPA. Social norms, friend support for PA, and neighborhood satisfaction did not emerge as significant predictors. Model 3 added interactions between time and the neighborhood social environment predictors to assess how these variables may be associated with predicted LPA minutes over time. The addition of these interactions did not significantly improve model fit (F (4, 3086.72) = 1.06, $p > 0.05$) and none of the interaction terms were significant predictors of LPA minutes.

3.3 Aim 2

To answer the research questions in aim 2, whether self-efficacy mediated relationships between neighborhood social environmental variables and MVPA and LPA, three additional regression models were examined to calculate the a and b paths (see Tables 3.4-3.7). Because no interactions between predictors and time significantly predicted MVPA or LPA and models which included these terms did not significantly improve model fit, these terms were not included in the models and only cross-sectional mediation was examined. To calculate the a paths for both outcomes, self-efficacy was regressed on the social environmental variables (see Table 3.6). There was a significant positive relationship between social norms and self-efficacy (B = 0.08, SE = 0.03). A significant positive relationship was also found between friend social support for PA and self-efficacy (B = 0.15, SE = 0.03) and neighborhood satisfaction and self-efficacy (B = 0.07, SE = 0.03). Neighbor social support for PA was not significantly associated with self-efficacy (B = 0.05, SE = 0.03, $p > 0.05$).

Results from the mediation analyses for baseline MVPA are summarized in Table 3.4. To calculate the b and c' for the MVPA model, MVPA was regressed on the social environmental variables and self-efficacy (see Table 3.7). There was no significant

relationship between self-efficacy and MVPA (b-path; γ = 0.14, *SE* = 0.11, *p* > 0.05). The mediated effects of social norms on MVPA through self-efficacy (*B*= 0.01, *SE*= 0.01, *CI*= -0.01-0.03), friend social support on MVPA through self-efficacy (*B*= 0.02, *SE*= 0.02, *CI*= -0.01-0.06), neighbor social support on MVPA through self-efficacy (*B*= 0.00, *SE*= 0.01, *CI*= -0.01-0.03), and neighborhood satisfaction on MVPA through self-efficacy (*B*= 0.01, *SE*= 0.01, *CI*= -0.01-0.03) were not significant.

Results from the mediation analyses for baseline LPA are summarized in Table 3.5. To calculate the b and c' for the LPA model, LPA was regressed on the social environmental variables and self-efficacy (see Table 3.7). There was no significant relationship between self-efficacy and LPA (b-path; γ = 0.30, *SE* = 3.04, *p* > 0.05). The mediated effects of social norms on LPA through self-efficacy (*B*= 0.02, *SE*= 0.25, *CI*= -0.48-0.54), friend social support on LPA through self-efficacy (*B*= 0.04, *SE*= 0.46, *CI*= -0.86-0.96), neighbor social support on LPA through self-efficacy (*B*= 0.01, *SE*= 0.18, *CI*= -0.36-0.41), and neighborhood satisfaction on LPA through self-efficacy (*B*= 0.02, *SE*= 0.22, *CI*= -0.43-0.49) were not significant.

3.4 Power Analysis

A post-hoc power analysis was conducted to determine whether the study was powered to find meaningful effects of the predictors on MVPA and LPA for the relationships that were insignificant. Effects were calculated using an α criteria of 0.05 and power criteria of 0.80 (Cohen, Cohen, West, & Aiken, 2003) using methods described by Murray (1998). Critical t values were calculated using conservative estimates of degrees of freedom for each model, either the sample size minus two or the lowest degrees of freedom adjusted for imputation, and this value was multiplied by the

standard error of each predictor (shown in Table 3.8). Power estimates were then used to calculate the size of an effect that could be detected with 80% probability given that an effect exists. To do this, the regression equation was solved for a participant who was low (z-score of -1, one standard deviation below the mean) and high (z-score of +1, one standard deviation above the mean) on the predictor of interest, given that they were female, in the control community, and of average age and BMI (so that the other predictors zeroed out). The equations were also adjusted for slight differences from zero in the grand mean of the other social environmental predictors due to variability in the imputed data sets. Because models for MVPA were specified using a square-root transformed MVPA outcome, final outcomes from the low and high equations were back transformed into minutes to calculate the detectable effect in meaningful terms. Power analyses for the mediation paths with self-efficacy in the outcome were reported as z-score differences.

For MVPA, an effect of 10 minutes was selected as meaningful as PA guidelines suggest that increase PA in 10-minute bouts has meaningful health benefits (U.S. Department of Health and Human Services, 2008). In the current sample, this represents about 0.22 standard deviations from the mean of MVPA. The current study was adequately powered to detect meaningful effects for social environmental predictors of baseline MVPA (see Table 3.8). For example, the current study was powered at 0.80 to detect an effect of 6.74 minutes of MVPA for a change from low to high friend social support. The current study was also powered at 0.80 to detect an effect of 6.37 minutes of MVPA for a change from low to high neighborhood satisfaction. The current study was also adequately powered to find significant meaningful effects for changes in MVPA

over time. The study was powered at 0.80 to find an effect of 6.07 minutes of MVPA for a change in social norms from low to high, an effect of 5.85 minutes of MVPA for a change in friend social support for PA from low to high, an effect of 6.23 minutes of MVPA for a change in neighbor social support for PA from low to high, and an effect of 6.18 minutes of MVPA for a change in neighborhood satisfaction from low to high. This suggests that the study was powered to find meaningful effects for social environmental predictors on MVPA at baseline and over time if the effects existed in the data.

While research on the impacts of LPA is more novel and recommendations for LPA have not yet been made, some studies have shown health benefits associated with specific amounts of LPA which will be used to determine whether adequate power was achieved. For LPA, an effect of 30 minutes was selected as a meaningful medium effect as research has demonstrated that a shift of 30 minutes from sedentary behavior to LPA has effects on body weight (Mekary, Willett, Hu, & Ding, 2009), waist circumference, HDL-cholesterol, and blood pressure (Knaeps et al., 2017) and self-reported health and well-being (Buman et al., 2010). In the current sample, this represents about 0.34 standard deviations from the mean of LPA. An effect of 10 minutes was selected as a meaningful small effect as research has demonstrated that a shift of 10 minutes from sedentary behavior to LPA has significant effects on body weight over time (Gonze et al., 2017), and 10 minute bouts of LPA have been associated cancer markers in men (Loprinzi & Kohli, 2013) and cardiovascular risk factors in older adults (Loprinzi & Pariser, 2013). In the current sample, this represents about 0.11 standard deviations from the mean of LPA. The current study was adequately powered to detect meaningful medium effects for social environmental predictors of baseline LPA (see Table 3.8). Post-

hoc power analysis revealed that the current study was powered at 0.80 to find an effect of 19.85 minutes of LPA for a change in social norms for PA from low to high. Similarly, the study was powered at 0.80 to find an effect of 18.31 minutes for a change in friend social support from low to high. The current study was also powered at 0.80 to find an effect of 18.47 for a change in neighborhood satisfaction from low to high. The current study was also adequately powered to find medium meaningful effects for changes in LPA over time. For example, the study was powered at 0.80 to find an effect of 15.98 minutes of LPA over time for a change in social norms for PA from low to high, an effect of 15.69 minutes of LPA over time for a change in friend social support for PA from low to high, an effect of 15.53 minutes of LPA over time for a change in neighbor social support for PA from low to high, and an effect of 15.53 minutes of LPA over time for a change in neighborhood satisfaction from low to high. This suggests that the study was powered to find meaningful medium-sized effects for social environmental predictors on LPA at baseline and over time if the effects existed in the data, but was underpowered to detect smaller effects.

Finally, power for insignificant paths in the mediation analyses for MVPA and LPA at baseline was examined (Aim 2; see Table 3.8). Insignificant findings were found for only one a path, the relationship between neighbor social support for PA and self-efficacy for PA. Post-hoc power analysis showed that the study was powered at 0.80 to find a small effect of 0.19. Because both measures were standardized into z-scores, this represents a change in self-efficacy for PA equal to 0.19 standard deviations for a change from low to high in neighbor social support for PA. The study was also significantly powered for the insignificant b paths. Meaningful effects were defined as specified in

Aim 1. Post-hoc power analysis revealed that the current study was powered to find an effect of 6.08 minutes of MVPA and 17.10 minutes of LPA for change in self-efficacy for PA from low to high. This suggests that the study would have found an effect if it were to exist in the data.

Table 3.1 *Correlations between Social Environmental Variables and PA Outcomes*

PA Time point		Social Norms	SS. Friends	SS. Neighbors	N. Satisfaction	Self-Efficacy	MVPA
Baseline	s.MVPA	0.27*	0.10*	0.16*	-0.04	0.09	-
	LPA	0.06	-0.05	0.09	0.02	0.02	0.49*
12-Months	s.MVPA	0.22*	0.06	0.11*	-0.12*	0.02	-
	LPA	0.05	0.05	0.08	-0.10*	0.01	0.47*
18-Months	s.MVPA	0.21*	0.12*	0.09	-0.02	0.06	-
	LPA	0.10*	0.04	0.10*	-0.06	0.02	0.46*
24-Months	s.MVPA	0.21*	0.03	0.08	-0.01	0.00	-
	LPA	0.02	0.02	0.09	-0.10*	-0.08	0.43*

Note. * indicates correlations significant with alpha criteria of 0.05.

Table 3.2 *Parameter Estimates in the Full Model Predicting s.MVPA*

	Model 1	Model 2	Model 3
Fixed Effects			
Intercept	5.16 (0.29)*	4.97 (0.30)*	4.96 (0.30)*
Time	0.93 (0.53)	0.93 (0.53)	0.93 (0.53)
$Time^2$	-0.40 (0.28)	-0.40 (0.28)	-0.40 (0.28)
TXwalk	0.69 (0.28)*	0.65 (0.28)*	0.65 (0.28)*
TXfull	0.46 (0.29)	0.66 (0.29)*	0.66 (0.29)*
Age	-0.08 (0.01)*	-0.08 (0.01)*	-0.08 (0.01)*
Sex (Female)	-1.46 (0.25)*	-1.31 (0.25)*	-1.31 (0.25)*
BMI	-0.05 (0.02)*	-0.04 (0.02)*	-0.04 (0.02)*
Season	-0.11 (0.23)	0.02 (0.24)	0.02 (0.24)
Neighborhood Access	0.22 (0.11)*	0.09 (0.11)	0.09 (0.11)
Social Norm	-	0.37 (0.12)*	0.44 (0.16)*
Friend Social Support	-	0.04 (0.12)	0.03 (0.15)
Neighbor Social Support	-	0.26 (0.13)*	0.25 (0.16)
Neighborhood Satisfaction	-	-0.15 (0.12)	-0.10 (0.16)
Social Norm*time	-	-	-0.08 (0.11)
Friend Social Support*time	-	-	0.02 (0.11)
Neighbor Social Support*time	-	-	0.01 (0.11)
Neighborhood Satisfaction*time	-	-	-0.05 (0.11)
Random Effects			
Intercept	1.32	1.27	1.27
Slope of Time	0.35	0.35	0.35
e_{ti}	2.51	2.51	2.51

Note. $*p < 0.05$; Model 2 fit the data significantly better than Model 1 ($p < 0.05$). Model 3 did not significantly improve model fit over Model 2 ($p > 0.05$).

Table 3.3 Parameter *Estimates in the Full Model Predicting LPA*

	Model 1	Model 2	Model 3
Fixed Effects			
Intercept	213.29 (8.13)*	211.97 (8.38)*	211.90 (8.39)*
Time	39.08 (7.67)*	39.07 (7.67)*	39.16 (7.69)*
$Time^2$	-13.60 (3.70)*	-13.60 (3.70)*	-13.60 (3.70)*
TXwalk	4.97 (7.27)	3.91 (7.38)	3.91 (7.38)
TXfull	3.50 (7.56)	3.94 (7.69)	3.94 (7.69)
Age	-1.84 (0.20)*	-1.86 (0.21)*	-1.86 (0.21)*
Sex (Female)	-16.04 (6.67)*	-15.21 (6.76)*	-15.21 (6.76)*
BMI	-0.24 (0.37)	-0.19 (0.38)	-0.19 (0.38)
Season	6.81 (6.26)	8.99 (6.40)	8.99 (6.40)
Neighborhood Access	2.75 (3.06)	3.38 (3.23)	3.38 (3.23)
Social Norm	-	-1.86 (3.54)	-1.56 (4.44)
Friend Social Support	-	-4.57 (3.26)	-8.31 (4.18)*
Neighbor Social Support	-	8.01 (3.38)*	8.50 (4.23)*
Neighborhood Satisfaction	-	-2.24 (3.29)	1.73 (4.30)
Social Norm*time	-	-	-0.33 (2.85)
Friend Social Support*time	-	-	4.04 (2.80)
Neighbor Social Support*time	-	-	-0.52 (2.77)
Neighborhood Satisfaction*time	-	-	-4.30 (2.77)
Random Effects			
Intercept	49.40	48.97	48.89
Slope of Time	26.28	26.28	26.11
e_{ti}	61.92	61.92	61.92

Note. *$p < 0.05$. Compared to Model 1, Model 2 did not provide a significantly better fit to the data (p =0.08). Model 3 did not provide a better fit to the data than Model 2 (p >0.05).

Table 3.4 *Summary of cross-sectional mediation effects for s.MVPA*

	Coefficient	SE	Lower 95% CL	Upper 95% CL
c paths (direct effects)				
Social Norms → s.MVPA	0.37*	0.12	0.12	0.61
Friend Social Support → s.MVPA	0.04	0.12	-0.20	0.29
Neighbor Social Support → s.MVPA	0.26*	0.13	0.00	0.52
Neighborhood Satisfaction → s.MVPA	-0.15	0.12	-0.38	0.08
a paths				
Social Norms → Self-efficacy	0.08*	0.03	0.02	0.13
Friend Social Support → Self-efficacy	0.15*	0.03	0.09	0.20
Neighbor Social Support → Self-efficacy	0.05	0.03	-0.02	0.11
Neighborhood Satisfaction → Self-efficacy	0.07*	0.03	0.01	0.12
b path				
Self-efficacy→s.MVPA	0.14	0.11	-0.09	0.36
c' paths				
Social Norms → s.MVPA	0.36*	0.12	0.11	0.60
Friend Social Support → s.MVPA	0.02	0.12	-0.22	0.27
Neighbor Social Support → s.MVPA	0.26	0.13	0.00	0.52
Neighborhood Satisfaction → s.MVPA	-0.16	0.12	-0.39	0.08
*Mediated Paths (ab)***				
Social Norms→Self-efficacy→ s.MVPA	0.01	0.01	-0.01	0.03
Friend Social Support→Self-efficacy→ s.MVPA	0.02	0.02	-0.01	0.06
Neighbor Social Support→Self-efficacy→ s.MVPA	0.00	0.01	-0.01	0.03
Neighborhood Satisfaction→Self-efficacy→ s.MVPA	0.01	0.01	-0.01	0.03

Note. *$p < 0.05$; Asymmetric confidence intervals obtained from RMediation

Table 3.5 *Summary of cross-sectional mediation effects for LPA*

	Coefficient	SE	Lower 95% CL	Upper 95% CL
c paths (direct effects)				
Social Norms → LPA	-1.86	3.54	-8.93	5.21
Friend Social Support → LPA	-4.57	3.26	-11.09	1.96
Neighbor Social Support → LPA	8.01	3.38	1.25	14.78
Neighborhood Satisfaction → LPA	-2.24	3.29	-8.82	4.33
a paths				
Social Norms → Self-efficacy	0.08*	0.03	0.02	0.13
Friend Social Support → Self-efficacy	0.15*	0.03	0.09	0.20
Neighbor Social Support → Self-efficacy	0.05	0.03	-0.02	0.11
Neighborhood Satisfaction → Self-efficacy	0.07*	0.03	0.01	0.12
b path				
Self-efficacy→LPA	0.30	3.04	-5.79	6.39
c' paths				
Social Norms → LPA	-1.88	3.55	-2.59	5.21
Friend Social Support → LPA	-4.61	3.30	-11.20	1.98
Neighbor Social Support → LPA	8.00*	3.39	1.22	14.78
Neighborhood Satisfaction → LPA	-2.26	3.30	-8.86	4.33
*Mediated Paths (ab)***				
Social Norms→Self-efficacy→ LPA	0.02	0.25	-0.48	0.54
Friend Social Support→Self-efficacy→ LPA	0.04	0.46	-0.86	0.96
Neighbor Social Support→Self-efficacy→ LPA	0.01	0.18	-0.36	0.41
Neighborhood Satisfaction→Self-efficacy→ LPA	0.02	0.22	-0.43	0.49

Note. $*p < 0.05$, **Asymmetric confidence intervals obtained from RMediation

Table 3.6 *Parameter Estimates in the Model Predicting Self-Efficacy (a paths)*

	Parameter Estimate
Intercept	0.17 (0.06)*
TXwalk	-0.15 (0.06)*
TXfull	0.05 (0.06)
Age	0.00 (0.00)
Sex (Female)	-0.11 (0.06)
BMI	0.01 (0.00)
Season	-0.12 (0.05)*
Neighborhood Access	-0.03 (0.03)
Social Norm	0.08 (0.03)*
Friend Social Support	0.15 (0.03)*
Neighbor Social Support	0.05 (0.03)
Neighborhood Satisfaction	0.07 (0.03)*

Note. *$p < 0.05$.

Table 3.7 *Parameter Estimates in the Models including Self-efficacy (b and c' paths)*

	PA Outcome	
	s.MVPA	LPA
Fixed Effects		
Intercept	4.94 (0.30)*	211.92 (8.40)*
Time	0.93 (0.53)	39.07 (7.67)*
$Time^2$	-0.40 (0.28)	-13.60 (3.70)*
TXwalk	0.67 (0.28)*	3.96 (7.40)
TXfull	0.65 (0.29)*	3.93 (7.70)
Age	-0.08 (0.01)*	-1.86 (0.21)*
Sex (Female)	-1.29 (0.25)*	-15.19 (6.78)*
BMI	-0.04 (0.02)*	-0.20 (0.38)
Season	0.03 (0.24)	9.03 (6.43)
Neighborhood Access	0.10 (0.11)	3.39 (3.24)
Social Norm	0.36 (0.12)*	-1.88 (3.55)
Friend Social Support	0.02 (0.12)	-4.61 (3.30)
Neighbor Social Support	0.26 (0.13)	8.00 (3.39)*
Neighborhood Satisfaction	-0.16 (0.12)	-2.26 (3.30)
Self-efficacy	0.14 (0.11)	0.30 (3.04)
Random Effects		
Intercept	1.25	49.03
Slope of Time	0.36	26.28
e_{ti}	2.51	61.92

Note. $*p < 0.05$.

Table 3.8 *Post-hoc Power Analysis with 0.80 Power and α=0.05*

Parameter	Power	Effect Able to Detect
MVPA		
Social Norms → s.MVPA	0.315662	6.21
Friend Social Support → s.MVPA	0.343846	6.74
Neighbor Social Support → s.MVPA	0.369211	7.27
Neighborhood Satisfaction → s.MVPA	0.326935	6.37
Social Norms → Δs.MVPA	0.310640	6.07
Friend Social Support → Δs.MVPA	0.299344	5.85
Neighbor Social Support → Δs.MVPA	0.319112	6.23
Neighborhood Satisfaction → Δs.MVPA	0.316288	6.18
LPA		
Social Norms → LPA	9.926934	19.85
Friend Social Support → LPA	9.154683	18.31
Neighbor Social Support → LPA	9.494473	18.79
Neighborhood Satisfaction → LPA	9.233312	18.47
Social Norms → ΔLPA	7.989286	15.98
Friend Social Support → ΔLPA	7.854493	15.69
Neighbor Social Support → ΔLPA	7.764632	15.53
Neighborhood Satisfaction → ΔLPA	7.764632	15.53
Mediation Analyses		
Social Norms → Self-efficacy	0.081980	0.16
Friend Social Support → Self-efficacy	0.076326	0.15
Neighbor Social Support → Self-efficacy	0.096115	0.19
Neighborhood Satisfaction → Self-efficacy	0.079153	0.16
Self-efficacy→s.MVPA	0.312826	6.08
Self-efficacy → LPA	8.548115	17.10

Note. Effect able to detect is in minutes for MVPA and LPA and z-score for self-efficacy

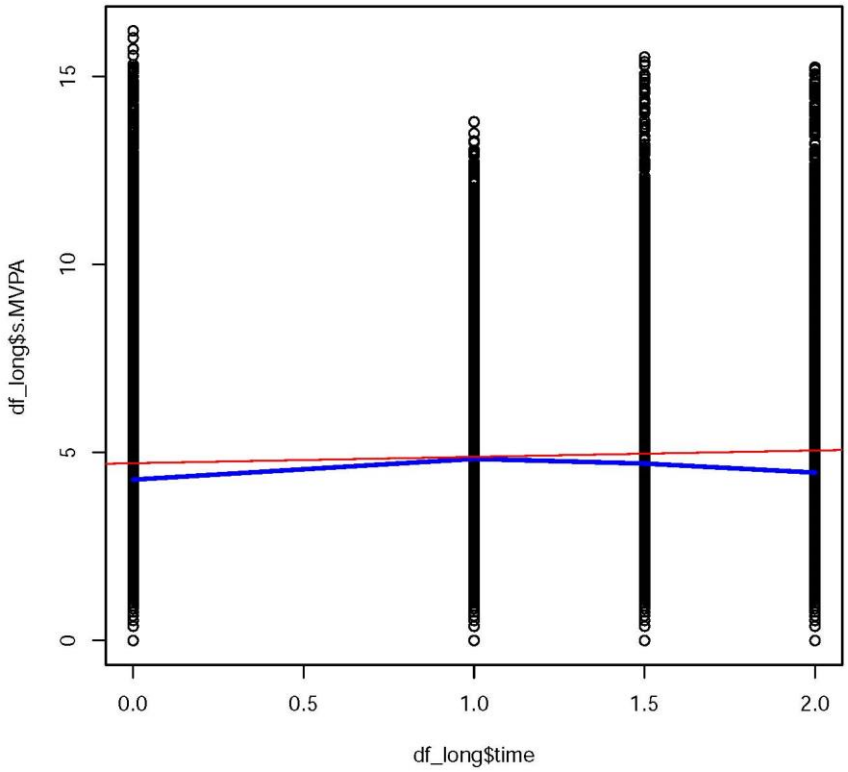

Figure 3.1. Average MVPA minutes (using a square root transformation) over time.

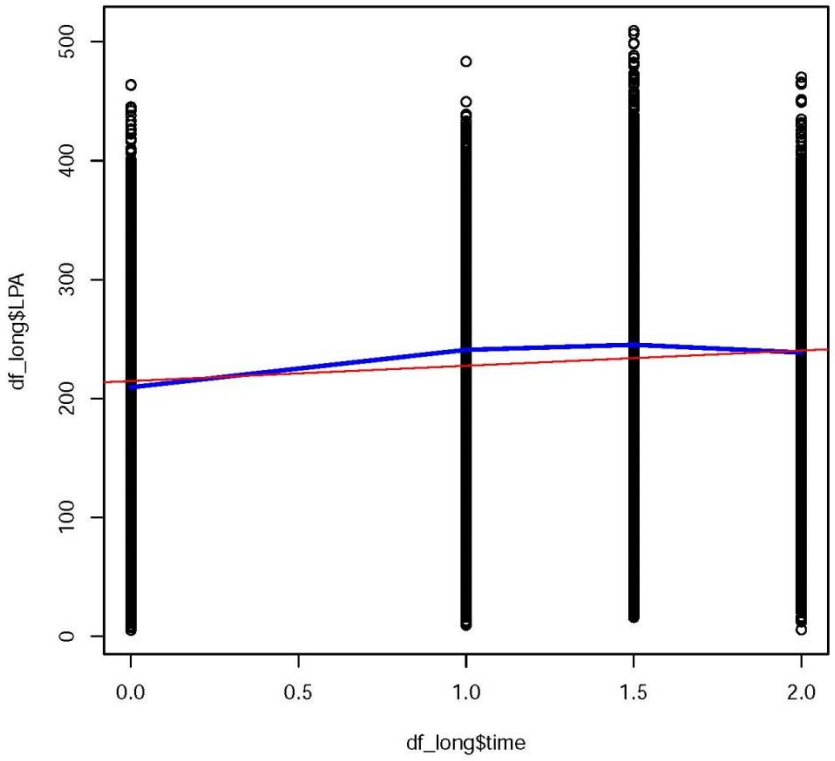

Figure 3.2. Average LPA minutes over time.

CHAPTER 4

DISCUSSION

The current study examined relationships between social environmental variables (social norms for PA, social support for PA from friends, social support for PA from neighbors, and neighborhood satisfaction), self-efficacy for PA, and MVPA and LPA in underserved African American adults. It was hypothesized that social environmental variables would predict baseline values and changes over time of MVPA and LPA and that self-efficacy would mediate these relationships. However, results of the study only partially supported this hypothesis. Results showed that some social environmental variables were associated with predicted baseline PA values, but these variables were not associated with predicted changes in MVPA or LPA over time. Specifically, social norms for PA and social support for PA from neighbors were positively associated with predicted baseline MVPA values while only social support for PA from neighbors was positively associated with predicted baseline LPA values. No other direct effects were significant. Further, social norms for PA, friend social support for PA, and neighborhood satisfaction were all significantly associated with higher reported self-efficacy for PA; however, mediation of the social environmental variables through self-efficacy for both MVPA and LPA was not supported.

4.1 Direct Effects

Cross-sectional relationship between social norms and PA. The current study is one of the first studies to demonstrate that neighborhood social norms for PA are associated with higher levels of accelerometry-measured MVPA in African American adults. The results are consistent with previous studies that have reported positive associations between descriptive norms for PA within the neighborhood and MVPA outcomes using self-report measures (Ball et al., 2010; Firestone et al., 2015; King et al., 2000; Wilcox et al., 2000). For example, Ball et al., (2010) found a positive relationship between self-reported social norms for exercising and self-reported leisure-time for MVPA in women from low socioeconomic status neighborhoods. King et al. (2000) also found that African American women who reported seeing others exercise in their neighborhood were more likely to engage in self-reported MVPA (compared to being in a sedentary group). However, some studies that have included African American populations have also shown inconsistent or null findings. For example, Wilcox et al. (2000) examined this relationship in a population of diverse urban and rural women (27% African American) and found that frequently seeing others in the neighborhood exercise was significantly associated with reporting greater MVPA for rural, but not urban women. Similarly, Eyler et al. (2003) found that women who lived in rural, but not urban neighborhoods were more likely to meet recommendations for MVPA (self-reported) if they endorsed seeing other people exercising in their neighborhood. Furthermore, Hooker et al. (2005) found no relationship between reported social norms for PA and meeting PA guidelines (measured by self-reported MVPA) in African American adults. The findings from the current study replicate and expand of the previous literature by providing

evidence that social norms for PA are associated with MVPA minutes in African American adults using accelerometry data.

These findings in the current study suggest that targeting descriptive social norms may be an effective strategy for promoting MVPA in underserved African American adults. Two recent intervention studies have provided preliminary evidence that encouraging positive social norms for PA may be associated with positive PA outcomes (Koeneman, Chorus, Hopman-Rock, & Chinapaw, 2017; Priebe & Spink, 2015). One intervention study demonstrated that passive exposure to positive social norms for PA (reports of peers in their community being active) was associated with greater self-reported PA three months later in older adults (Koeneman et al., 2017). Additionally, Priebe & Spink (2015) demonstrated that messaging about social norms for PA within a work setting was associated with reduced self-reported sedentary behavior among middle aged adults. Future research should examine similar interventions in the neighborhood setting with African American populations as this may be a novel intervention element to promote MVPA in hard to reach populations.

In contrast to the MVPA model, an association was not found between neighborhood social norms for PA and LPA at baseline. This is consistent with one previous study that also found no relationship between social norms for PA and reporting walking at least 150 minutes per week in African American adults (Hooker et al., 2005). However, several other studies have shown positive associations between social norms for PA and walking (a common LPA activity) behavior (Ball et al., 2010; Nehme et al., 2016; Timperio et al., 2015). For example, relationships have been found between social norms for PA and meeting walking recommendations (≥ 150 minutes/week; Timperio et

al., 2015) and self-reported walking (Ball et al., 2010) in Australian populations. Nehme et al., (2016) found similar findings within a sample of adults (approximately 85% White) such that reporting seeing others in the neighborhood being active was associated with reporting some (versus no) walking for recreation. A few factors may explain the null findings in the current study. First, this is one of the first studies to examine this relationship using accelerometry LPA data. The MVPA cut-off used in this study was associated with "walking for exercise" and was lower than the standard MVPA cut-off METs equivalents (2.0 mph vs. 3.0 mph). Due to this, it is possible that the significant relationship between social norms for PA and MVPA found is capturing most walking behavior that would typically be self-reported. Second, studies finding positive relationships have predominantly used White samples and this relationship may function differently in underserved African American adults. Third, the study was underpowered to find small effects (10 minutes) for LPA; there may be a small effect that was not able to be detected by the current study. Finally, it is possible that social norms for PA, which are most commonly operationalized as walking or more strenuous exercise behaviors, are not associated with accelerometry-measured LPA, which is often associated more with an active lifestyle than intentional exercise behaviors. Based on these results, social norms for PA were not associated with LPA but were associated with more intense forms of PA (MVPA) in this sample.

Cross-sectional relationship between social support for PA and PA. This study is one of the first to examine the relationship between neighbor social support for PA and PA outcomes. Results from the current study demonstrated that social support for PA from neighbors was positively associated with both MVPA and LPA daily minutes.

These findings are in contrast to research by Tamers et al. (2013) which evaluated relationships between social support and self-reported PA behaviors in low-income adults (38% African American). Their study found no relationship between general social support from neighbors and self-reported MVPA. However this study did not evaluate social support from neighbors specific to PA, and the current study utilized a composite measure of emotional and tangible support specific to PA behaviors. These findings highlight improvement of neighborhood social supports as a potential mechanism for encouraging PA in African American adults.

While traditional research on social support for PA has focused on friends or family members as sources, the results of this study suggest that support from neighborhood systems should be considered as well. One system that may be particularly relevant for this demographic group is religious organizations, which serve as important sources of support in rural, African American communities (Chatters, Taylor, Lincoln, & Schroepfer, 2002). Several studies have found evidence for a positive influence of emotional and tangible social support for PA from church members on self-reported MVPA outcomes (Drayton-Brooks & White, 2004; Kanu, Baker, & Brownson, 2008; Kegler, Swan, Alcantara, Wrensford, & Glanz, 2012) and informational support from church members on accelerometer-measured LPA outcomes (Baruth et al., 2013) for African American samples. Limited research has also explored work contexts and emotional and tangible support for PA from coworkers as a potential influence of self-reported PA behavior (Sarkar, Taylor, Lai, Shegog, & Paxton, 2016). Based on these previous studies and the current findings, future studies and interventions should consider broadening their definitions of social support for PA to include all culturally-relevant

systems and groups and institutional supports. While replications of the current findings are needed, this study makes an important contribution to the literature by demonstrating a positive relationship between social support for PA from neighbors and accelerometry-measured MVPA and LPA.

Surprisingly, friend social support for PA was not significantly associated with MVPA or LPA in the current sample. This is in contrast to numerous studies that have found significant relationships between social support for PA from friends and accelerometry measured MVPA and self-reported LPA (Blanchard et al., 2005; Carlson et al., 2012; Rovniak et al., 2010; Saelens et al., 2012; Thornton et al., 2017) in predominantly White samples. For example, Carlson et al. (2012) found that social support from friends (as reported with a composite measure of emotional and tangible support similar to the current study) was associated with accelerometry measured MVPA and self-reported walking in older adults (71% White). These results were replicated using a similar methodology and sample by Thornton et al. (2017). Rovniak et al. (2010) performed a cluster analysis in urban adults (75% White) and demonstrated that belonging to the active group (as measured by self-report and accelerometry measured MVPA) was associated with reporting higher levels of social support for PA (using an abbreviated version of the measure in the current study). However, not all studies have found associations between social support for PA from friends and accelerometry measured MVPA. Saelens et al. (2012) did not find a significant relationship between social support for PA from friends using accelerometry measured MVPA in a sample of predominantly White adults, but did find a positive association with self-reported walking.

This study expands the current body of research by examining the relationship between social support for PA from friends and accelerometry measured MVPA and LPA in African American adults. Studies examining these constructs in African American samples have largely been limited to composite measures of social support for PA and results have been mixed (Bopp et al., 2006; Eyler et al., 1999; Gothe, 2018). The current study builds on the current literature in adults by using social support for PA from friends measured separately and accelerometry data. In a sample of African American women, social support for PA from friends and family (a composite of emotional and tangible support) was not associated with meeting MVPA guidelines based on self-reported activity but was related to lifestyle activity (housework, leisure or work-related PA; Eyler et al., 1999). Bopp et al. (2006) found that social support for PA (measured from a range of sources) was not associated with self-reported walking or MVPA in a sample similar to the currents study. Notably, Gothe (2018) included accelerometry data as a latent factor of PA in a study of African American adults who were similar to the current sample in age range and average BMI. In their study, social support for PA from friends and family, measured using the Sallis et al. (1987) measure, was not significantly associated with MVPA. These results suggest that the relationship between social support for PA and PA outcomes may function differently in predominantly African Americans compared to White samples. Future research may consider further exploring this relationship to clarify these differences across race using measures that separate sources of social support for PA and objective PA estimates.

Cross-sectional relationship between neighborhood satisfaction and PA.

Contrary to hypotheses, no relationship was found between neighborhood satisfaction and MVPA. This finding is consistent with some self-report studies that operationalized neighborhood satisfaction in the same way in Brazilian (Salvo et al., 2015) and African American (Halbert et al., 2014) adults. For example, Halbert et al., (2014) found that neighborhood satisfaction was not associated with being in inactive, low PA, medium PA, or high PA groups as measured self-reported MVPA in African American adults. However, other studies using accelerometry-measured MVPA found positive correlations or associations with neighborhood satisfaction using similar measures (Fleig et al., 2016; Strath et al., 2012). Strath et al. (2012) demonstrated a positive relationship between neighborhood satisfaction and accelerometry-measured MVPA in a sample of older, predominantly White adults. Fleig et al. (2016) found positive bivariate correlations between accelerometry-measured total PA, but it failed to achieve significance as a predictor in the full model. An important difference between these studies and the current analyses is that these studies examined the relationship between neighborhood satisfaction and accelerometry-measured MVPA in older, White adult samples. It is important to note that a recent study which utilized a subset of the PATH data set specifically looking at older adults found a small negative effect of neighborhood satisfaction on MVPA (Sweeney, Wilson, & Van Horn, 2017). This suggests that there may be racial differences in the effect of neighborhood satisfaction on MVPA as this result is different from past studies using White samples.

Similarly, neighborhood satisfaction was not associated with baseline LPA. This is consistent with two studies that found no relationship between accelerometry-measured

LPA in older, White adults (Strath et al., 2012) or Brazilian adults (Goncalves, Hallal, Hino, & Reis, 2017) and one study that related neighborhood satisfaction to meeting accelerometry-measured step goals (Hall & McAuley, 2010), all of which measured neighborhood satisfaction in the same way as the current study. There have been two studies that found positive relationships between neighborhood satisfaction and LPA (Salvo et al., 2015; Van Cauwenberg et al., 2014). These studies used self-reported walking data and international samples. One study which utilized a subset of the PATH trial (Trumpeter & Wilson, 2014) found a an interaction with sex such that women's predicted walking decreased as neighborhood satisfaction increased while men's predicted walking increased as neighborhood satisfaction increased. It is important to note in this literature the discrepancy between accelerometry-measured LPA studies which had null findings and self-report LPA studies which had significant associations.

There have been few studies examining the relationship between neighborhood satisfaction and accelerometry-measured PA outcomes in African American adults, and the current study fills this gap in the literature. The results suggest that satisfaction with the neighborhood environment is not associated with MVPA or LPA minutes in this population. However, some findings in the literature have been mixed (although significant findings have predominantly been in self-reported data or in dissimilar samples), and the current study was underpowered for small effects in LPA. Therefore, results should be replicated. Social cognitive theory hypothesizes that increased neighborhood satisfaction may make PA engagement more pleasant and thus increase likelihood of participating in PA. However, based on the current results, neighborhood satisfaction alone is not likely sufficiently motivating to influence PA for those who live

in underserved communities that have few supports for PA or have other environmental barriers (safety, accessibility).

Longitudinal relationships. No associations were found between neighborhood social environment variables and changes in MVPA or LPA over time. Further, time was not a significant predictor of MVPA. Longitudinal cohort studies have demonstrated that MVPA is stable throughout middle adulthood for a majority of adults (with declines shown in the transition to old age; Aggio et al., 2018; Friedman et al., 2008; Morseth, Jorgensen, Emaus, Jacobsen, & Wilsgaard, 2011; Salin et al., 2017). Additionally, studies examining rates of PA over time (as measured by pedometer) in African American adults have found stability over a period of six months (Newton et al., 2012). It is possible that due to relative stability of PA within this developmental stage and the measurement time periods of the study (24 months) significant changes in MVPA were not observed.

While some studies have demonstrated relationships between social norms for PA (Kowal & Fortier, 2007) and social support for PA (Molloy et al., 2010; Scarapicchia et al., 2017) and PA outcomes over time, these studies have significant differences in samples and methodology from the current study. Each of the three studies utilized self-reported MVPA outcomes at only two measurement periods. Participants were also dissimilar to the current sample. Participants were predominantly White or Asian; two of the study samples were limited to university students while the other was limited to adult women who wished to increase their activity.

There are several potential reasons why the current findings did not support longitudinal relationships with MVPA and LPA in addition to not capturing significant MVPA changes over time. First, self-reported PA, compared to accelerometry, may be

more likely to relate to self-reported perceptions of environment (Dishman, Darracott, & Lambert, 1992; Wang, Baranowski, Lau, Chen, & Zhang, 2016). Second, African American adults, especially those living in underserved communities, likely have increased barriers to engaging in PA that may limit the positive effect of neighborhood social environmental supports over time. This is consistent with the one longitudinal study with a more similar sample to the current study (middle aged inactive adults, 1/3 minorities) that found no significant positive effect of neighborhood social environment on MVPA over time (Sallis et al., 2007). Third, it is possible that these effects are co-temporal. This study looked at neighborhood social environment at baseline and the relationship with changes in MVPA and LPA. While social norms for PA measured at baseline were correlated with all time-points of MVPA, the effect decreased at later measurements. Similarly, social support for PA from neighbors measured at baseline was correlated with MVPA at baseline and 12-months but not later time-points. This suggests that perceptions of the neighborhood social environment may be more predictive of co-occurring PA behaviors in comparison to longer-term changes.

In summary, little previous research has examined longitudinal relationships between neighborhood social environment and MVPA and LPA, and there are limitations to these studies. The current study did not find evidence for a relationship between these variables (social norms for PA, social support for PA from friends and neighbors, and neighborhood satisfaction) and changes in MVPA or LPA over two years in African American adults. Future research should replicate these results with accelerometry data, in similar populations, and with designs powered to detect small effects. Research may

also consider investigating how timing of neighborhood social environment perceptions influence these relationships and include longer follow-up periods than the current study.

4.2 Mediated Effects

The results of the current study did not support cross-sectional mediated relationships between neighborhood social environment and MVPA and LPA through self-efficacy for PA. While the current literature examining these relationships is somewhat limited, many studies supported the hypothesized mediation of self-efficacy between social support for PA (Duncan & McAuley, 1993; Ishii et al., 2010; McNeill, Wyrwich, et al., 2006; Middelweerd et al., 2017; Morris et al., 2008; Motl et al., 2007; Resnick et al., 2002; Rovniak et al., 2002; Sniehotta et al., 2013) and neighborhood satisfaction (Morris et al., 2008) and PA outcomes. However, only one of these studies used accelerometry data as an outcome (Sniehotta et al., 2013) and very few included African Americans (<45% total participants) in their samples (McNeill, Wyrwich, et al., 2006; Motl et al., 2007). Thus, no previous work has demonstrated the hypothesized relationship in a sample of African American adults with accelerometry data.

The findings from this study do, however, replicate some of the findings in the previous literature, specifically the significant relationships between neighborhood social environment and self-efficacy for PA (a-paths in the mediation models). Based on social cognitive theory, it was hypothesized that perceptions of the neighborhood social environment would positively influence self-efficacy for PA through vicarious experiences (for social norms), verbal persuasion (for social support), or positive affective states (for neighborhood satisfaction; (Bandura, 1977). Findings support these relationships for social norms for PA, social support for PA from friends, and

neighborhood satisfaction, lending support for this hypothesis. This also suggests that these relationships operate in a similar way in overweight, African American adults compared to samples in previous studies. However, it is important to note that these findings are cross-sectional, thus it is unclear whether perceived greater neighborhood social environment supports for PA lead to improved self-efficacy for PA or if these supports are more salient for adults who are more confident in their ability to maintain PA behaviors.

Where the current study deviates from the previous literature is the nonsignificant findings for the relationship between self-efficacy for PA and MVPA and LPA. While self-efficacy has been hypothesized as a major positive influence on PA behavior, this relationship has not been found in all studies (Prince et al., 2016; van Stralen, De Vries, Mudde, Bolman, & Lechner, 2009; Young et al., 2014). Numerous studies have found positive relationships between reported self-efficacy for PA and self-reported PA behaviors in African American adults (Baruth & Wilcox, 2015; Cromwell & Adams, 2006; Komar-Samardzija, Braun, Keithley, & Quinn, 2012; Rogers, McAuley, Courneya, Humphries, & Gutin, 2007; Sharma et al., 2005; Sharpe et al., 2008), but a significant gap in the literature is the lack of studies with accelerometry PA outcomes. Self-reported PA behaviors are likely influenced by social desirability bias (Adams et al., 2005; Brenner & DeLamater, 2016; Taber et al., 2009), and there is evidence that controlling for social desirability greatly impacts observed relationships between self-efficacy for PA and PA outcomes (Watson et al., 2006). Therefore, researchers should interpret studies utilizing only self-report data with caution and replicate the findings of the current study with objective PA data. Further, work examining influences of self-efficacy for PA, barriers to

PA, and PA outcomes in similar samples (low-income, African American adults) has found that reported barriers were differently associated with behavior change compared to self-efficacy (Mansyur, Pavlik, Hyman, Taylor, & Goodrick, 2013), suggesting that perhaps focusing on self-efficacy alone is not sufficient for positive PA outcomes.

4.3 Study Limitations and Strengths

Limitations of this study should be considered when interpreting the results. While internal consistency of most measures was adequate, the social norms for PA measure was limited due to the low number of items (2) and achieved marginal reliability ($\alpha = 0.70$). However, the majority of the current literature on social norms for PA also utilize single-item questions (i.e. "I often see other people exercising in my neighborhood") which is similar to the current study (Ball et al., 2010; Eyler et al., 2003; Firestone et al., 2015; Hooker et al., 2005; King et al., 2000; Nehme et al., 2016; Timperio et al., 2015; Wilcox et al., 2000). Future studies should consider using a more comprehensive measure of social norms around PA to further support the relationship between social norms and MVPA and clarify the relationship between social norms and LPA. Additionally, while it is likely that neighborhood environmental supports would be related to PA within the neighborhood environment, the current study did not utilize geospatial data to determine where the measured MVPA and LPA took place. The current study was underpowered to detect small effects for LPA, and future work should test for these smaller effects. Because only cross-sectional mediation was examined, the assumption of temporal precedence of mediation analyses was not fulfilled. Therefore, significant paths in the model (such as the association between social norms and self-efficacy) should not be considered causal effects but simply associations. Finally, there

may be generalizability limitations due to the sample of the current study. Participants were a small sample of African American adults from underserved communities, and demonstrated relationships may differ in other populations.

Despite some limitations, there are many strengths of the current work. The use of accelerometry data yields more reliable estimates of PA compared to self-report data, and multiple imputation was used to address missing data which is an effective strategy to include all available data, preserve power, and to provide unbiased estimates of missing data (McCleary, 2002). The study design, which included four measurement time points for PA, offered the ability to explore whether social environmental variables predicted PA outcomes cross-sectionally and across time which is less common in previous literature. Further, inclusion of multiple intensities (MVPA and LPA) of PA as outcomes is novel. Few studies have examined LPA as an outcome, yet LPA may confer many health benefits, especially for individuals are typically less active (Pate et al., 2008; Powell et al., 2011; Smith et al., 2015). The inclusion of analyses for both MVPA and LPA allowed for exploration of whether predictors of these behaviors differed based on intensity which is important as some recent literature has shown differential effects of predictors of these outcomes (Huffman et al., 2018; Lawman & Wilson, 2014). Examining several types of variables related to neighborhood social environment fills a gap in the literature especially when testing potential mediation through self-efficacy for which the literature is not as robust. Finally, this research utilized an underserved often understudied population of predominantly older, overweight or obese, rural African American adults who are most likely to experience chronic disease outcomes related to inactivity.

4.4 Conclusions

In summary, there are large public health implications of the high rates of physical inactivity in adults (Lee et al., 2012; Lim et al., 2012; Sallis & Carlson, 2015; World Health Organization, 2009), and African American adults face disparities in meeting PA recommendations which places them at increased risk of related chronic diseases (Tucker et al., 2011). The current study filled a gap in the literature by examining how social environment was related (or not) to MVPA and LPA cross-sectionally and over time. Overall, study results indicated that some components of the neighborhood social environment, specifically social norms for PA and neighbor social support for PA, were positively associated with accelerometry-measured MVPA minutes, while neighbor social support for PA was also positively associated with LPA minutes. These preliminary results suggest that the neighborhood social environment may be a relevant system to study further both in descriptive and intervention studies. Future studies examining these constructs should consider longer measurement periods that may allow for capturing changes in PA over time and better understanding of timing of potential mediators such as self-efficacy for PA. Future studies should also continue to consider multiple intensities of PA as outcomes as the current results suggest that associations between environmental predictors and these outcomes may vary between MVPA and LPA. These results also have implications for future interventions that may aim to improve perceived norms and support for PA within underserved communities that are typically less active to facilitate higher levels of PA to improve health and quality of life.

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APPENDIX A

SOCIAL NORMS FOR PA MEASURE

Items

1. I walk with my neighbors on a regular basis in my neighborhood.
2. People in my neighborhood walk together on a regular basis.

Response Options

1. Strongly disagree
2. Somewhat disagree
3. Somewhat agree
4. Strongly agree

APPENDIX B

SOCIAL SUPPORT FOR PA FROM FRIENDS MEASURE

Items

During the past 3 months my friends

1. Did physical activity with me
2. Offered to do physical activity with me
3. Gave me encouragement to do physical activity
4. Gave me helpful reminders to exercise
5. Changed their schedules so we could exercise together

Response Options

1. Never
2. Rarely
3. Sometimes
4. Often
5. Very often

APPENDIX C

SOCIAL SUPPORT FOR PA FROM NEIGHBORS MEASURE

Items

During the past 3 months my neighbors

1. Did physical activity with me
2. Offered to do physical activity with me
3. Gave me encouragement to do physical activity
4. Gave me helpful reminders to exercise
5. Changed their schedules so we could exercise together
6. Planned for exercise on recreational outings
7. Discussed exercise with me
8. Talked about how much they like to exercise
9. Helped plan activities around my exercise
10. Asked me for ideas on how they can get more exercise
11. Took over chores so I had more time to exercise
12. Made positive comments about my physical appearance

Response Options

1. Never
2. Rarely
3. Sometimes

4. Often
5. Very often

APPENDIX D

NEIGHBORHOOD SATISFACTION MEASURE

Items

1. How satisfied are you with how many friends you have in your neighborhood?
2. How satisfied are you with the number of people you know in your neighborhood?
3. How satisfied are you with how easy it and pleasant it is to walk in your neighborhood?
4. How satisfied are you with the amount and speed of traffic in your neighborhood?
5. How satisfied are you with your neighborhood as a good place to raise children?
6. How satisfied are you with your neighborhood as a good place to live?
7. How satisfied are you with the highway access from your home?
8. How satisfied are you with the access to public transportation in your neighborhood?
9. How satisfied are you with your commuting time to work/school?
10. How satisfied are you with the access to shopping in your neighborhood?
11. How satisfied are you with how easy and pleasant it is to bicycle in your neighborhood?
12. How satisfied are you with the quality of schools in your neighborhood?
13. How satisfied are you with access to entertainment in your neighborhood (restaurants, movies, clubs, etc.)?

14. How satisfied are you with the safety from threat of crime in your neighborhood?
15. How satisfied are you with the noise from traffic in your neighborhood?
16. How satisfied are you with the number and quality of food stores in your neighborhood?
17. How satisfied are you with the number and quality of restaurants in your neighborhood?

Response Options

1. Strongly dissatisfied
2. Somewhat dissatisfied
3. Neither satisfied nor dissatisfied
4. Somewhat satisfied
5. Strongly satisfied

APPENDIX E

SELF-EFFICACY FOR PA MEASURE

Items

1. I am confident I could exercise over the next 6 months **when tired.**
2. I am confident I could exercise over the next 6 months **during of following a personal crisis.**
3. I am confident I could exercise over the next 6 months **when feeling depressed.**
4. I am confident I could exercise over the next 6 months **when feeling anxious.**
5. I am confident I could exercise over the next 6 months **during bad weather.**
6. I am confident I could exercise over the next 6 months **when slightly sore from the last time I exercised.**
7. I am confident I could exercise over the next 6 months **when on vacation.**
8. I am confident I could exercise over the next 6 months **when there are competing interests (like my favorite TV shows are on TV).**
9. I am confident I could exercise over the next 6 months **when I have a lot of work to do.**
10. I am confident I could exercise over the next 6 months **when I haven't reached my exercise goals.**
11. I am confident I could exercise over the next 6 months **when I don't receive support from my family/friends.**

12. I am confident I could exercise over the next 6 months **when I have not exercised for a long period of time.**
13. I am confident I could exercise over the next 6 months **when I have no one to exercise with.**
14. I am confident I could exercise over the next 6 months **when my schedule is busy.**
15. I am confident I could exercise over the next 6 months **when my exercise workout is not enjoyable.**
16. In general, I believe I could exercise three to five times per week for 30 to 40 minutes daily over the next 6 months.

Response Options

Confidence rating 0-100%:

0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
I cannot Do it at all				Moderately certain I can do it					Certain that I can do it	

APPENDIX F

NEIGHBORHOOD ACCESS TO PLACES FOR PA MEASURE

Items

1. There are sidewalks on most of the streets in my neighborhood.
2. The sidewalks in my neighborhood are well maintained (paved, even, and not a lot of cracks).
3. There are bicycle or walking trails in or near my neighborhood that are easy to get to.
4. Sidewalks are separated from the road/traffic in my neighborhood by parked cars.
5. There is a grass/dirt strip that separates the streets from the sidewalks in my neighborhood.

Response Options

1. Strongly disagree
2. Somewhat disagree
3. Somewhat agree
4. Strongly agree