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Exposure to a Natural Disaster (Hurricane Ike) and Children's Diet and Activity Levels

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EXPOSURE TO A NATURAL DISASTER (HURRICANE IKE) AND CHILDREN'S DIET AND ACTIVITY LEVELS

By

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Objective: Utilizing a conceptual model of the impact of disasters on children's functioning, the current study examined unhealthy diet and sedentary activity levels of children exposed to Hurricane Ike. Exposure stressors (perceived and actual life threat) and recovery stressors (hurricane-related stressors and major life events), were hypothesized to be associated with unhealthy diet and sedentary activity. Exposure stressors, recovery stressors, and child demographic characteristics were also expected to be associated with posttraumatic stress (PTS) symptoms. It also was predicted that physical activity would attenuate the relationship between recovery stressors and children's PTS symptoms. Finally, the feasibility of collecting health behavior information from children was examined. **Method:** Utilizing a cross-sectional design, 204 children (51% girls; *M* age = 9.23, *SD* = .79; grades 3 and 4) from Galveston, Texas were evaluated 8 months after Hurricane Ike (Time 1). At Time 1, children completed self-report measures of traumatic experiences, major life events, PTS symptoms, height and weight, and health behaviors. 53 children were reevaluated two weeks later (Time 2) to examine the stability and validity of health-related measures. Children completed a second measure of their height, weight, and health behavior measures, and actual measurements of height and weight were also taken. **Results:** Consistent with expectations, exposure and recovery stressors were associated with sedentary activity and PTS symptoms. Exposure stressors were indirectly related to sedentary activity and PTS symptoms through recovery stressors. However, contrary to expectations, stressors were not associated with unhealthy diet. African American ethnicity, Hispanic ethnicity, and female gender were related to PTS symptoms through recovery stressors. Physical activity did not attenuate the relationship between recovery stressors and children's PTS symptoms. In terms of health behaviors, children's self-reported weight was both stable and valid from Time 1 to Time 2. Self-reported height was stable but invalid. Measures of children's unhealthy diet and sedentary activity showed moderate stability. The measure of physical activity exhibited low stability and low validity. **Conclusions:** Sedentary activity may be a particularly important health behavior to examine after disasters. Implications for schools, families, and future research are discussed. Alternative measures of physical activity should be considered.

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CHAPTER 1: INTRODUCTION

Natural disasters devastate and disrupt the lives of children and their families. Following natural disasters, children may present with posttraumatic stress (PTS) symptoms, depression, and anxiety (La Greca, Silverman, Vernberg, & Prinstein, 1996; Russoniello et al., 2002; Vernberg, La Greca, Silverman, & Prinstein, 1996). Children also report health problems following other types of disasters (e.g., war; Llabre & Hadi, 1994). However, no known studies have directly examined the health *behaviors* of children exposed to natural disasters, despite well-documented connections between stress, diet, and activity levels (e.g., Pugliese & Tinsley, 2007; Stice, Shaw, & Marti, 2006). Thus, very little is known about the health behaviors of children following natural disasters and other traumatic events.

Natural Disasters and Children

Natural disasters provide a unique opportunity to examine how traumatic stressors affect children and their families. Traumatic stressors (e.g., divorce, community violence) often differentially affect families (e.g., families with a history of depression, high levels of behavior problems, alcoholism; Cherlin et al., 1991; Hill & Muka, 1996). In contrast, natural disasters affect all children and families in a geographic area, regardless of their prior functioning (Russoniello et al., 2002). Thus, natural disasters present a rare opportunity to understand how stressors affect all types of children and families.

The stressors associated with natural disasters are numerous. Natural disasters cause widespread physical destruction and loss; Hurricane Ike, the focus of the current study, was no exception. Hurricane Ike, a high category 2 hurricane, made landfall in Galveston, Texas on September 13, 2008. The storm surge from Hurricane Ike topped

Galveston's 17 foot seawall, which faces the Gulf of Mexico (Dorrell & Leinwand, 2010). In its wake, Hurricane Ike destroyed roads, homes, buildings, sanitation systems, and plunged Galveston underneath seven feet of rainwater (Meserve et al., 2009). After Hurricane Ike, broken sewage systems and power failures rendered the city uninhabitable. Even residents who had defied initial evacuation orders were forced to evacuate Galveston (Walsh, 2008). Experts estimate that Hurricane Ike caused $16 billion worth of property damage (Walsh, 2008). The death toll following Hurricane Ike stands at 36 (Dallas Morning News, 2008).

In addition to destruction and loss, natural disasters also severely disrupt the lives of children and their families. After Hurricane Ike, Galveston's public elementary schools remained closed for one month (Galveston Independent School District, 2009). When schools reopened, two of the elementary schools remained uninhabitable. These schools were required to merge with other schools. Overall, only 65% of the children enrolled in schools were able to return to the school system (Galveston Independent School District, 2009). This drop in the student population resulted in an estimated $17 million loss in funding for Galveston's public school system (Lozano, 2009). The current study focused on children exposed to Hurricane Ike from Galveston, Texas.

Psychological Impact

The impact of natural disasters extends far beyond destruction and disruption. Natural disasters are associated with psychological distress in children, who may exhibit anxiety, depression, and/or posttraumatic stress (PTS) symptoms after a disaster (e.g., Goenjian et al., 2005; Lonigan et al., 1994; Russoniello et al., 2002). Overall, PTS symptoms in children are among the most commonly studied reactions to natural disasters.

High levels of PTS symptoms have been reported in studies following natural disasters. For example, La Greca et al. (1996) found that nearly a third of 442 children reported severe to very severe levels of PTS symptoms 3 months after Hurricane Andrew. High levels of PTS symptoms have also been found following other natural disasters, including earthquakes (Goenjian et al., 2005), bushfires (Yelland et al., 2010), and floods (Bokszczanin, 2007).

PTS symptoms generally decline over time. In a review by Norris and colleagues (2002), they examined 51 post-disaster samples of adults and children that were followed longitudinally for at least two timepoints. They found that subjects' postdisaster symptomatology declined over time in 79% of the samples (27 samples). Although this finding was not limited to PTS symptomotology, they show that generally, people improve over time after a disaster. Nevertheless, in a significant minority of youth, PTS symptoms persist over time, and have been observed in children as long as 5 years post-disaster (Goenjian et al., 2005).

Disaster-Related Outcomes: Health Behaviors

In addition to psychological distress, children exposed to disasters also report health problems (Llabre & Hadi, 1994, Llabre & Hadi, 1997). For example, Llabre and Hadi (1997) examined 151 Kuwaiti children two years after the Gulf crisis. Children exposed to high levels of trauma (e.g., their fathers were killed, fathers were missing, or children were arrested or their parents were arrested) had higher levels of health complaints (e.g., headaches, nausea, rashes) than controls. Recent data from Hurricane Charley showed that children who experienced more life threatening events and disaster-related stressors the first year after the hurricane reported greater somatic symptoms 21 months post-disaster (La Greca, Lai, Siegel, Bailey, & Silverman, 2008).

Although there is some research on health outcomes, very little is known about the health *behaviors* of children following natural disasters and other traumatic events. The present study addressed this gap in the literature by examining unhealthy diet and activity levels following a catastrophic natural disaster.

Gathering health behavior data alongside psychological data may provide a more comprehensive picture of children's reactions in the aftermath of a natural disaster (Russoniello et al., 2002). In addition, health behaviors (e.g., eating and activity patterns) may provide information about short and long term risk and resilience factors in children (Ferreira et al., 2005; Hu et al., 2001). In the short term, unhealthy diet and higher levels of sedentary activity may be related to lower self-esteem and may minimize growth and development (Goldfield et al., 2007). In the long-term, unhealthy eating and sedentary activity patterns developed in childhood may continue to adulthood and are associated with morbidity and mortality (Serdula et al., 1993). In contrast, better eating and physical activity behaviors may help children manage their stressors more effectively and reduce the health care burden of natural disasters. Given the millions of children affected by natural disasters (USA Today, 2006), findings related to health behaviors present crucial public health information.

Natural Disasters and Diet

Examining the effects of traumatic stressors on children's diet is vital, as the diet habits developed in childhood continue through adulthood (Pugliese & Tinsley, 2007). In addition, optimal intake of nutrients and energy is essential for healthy development and may decrease long-term risks for chronic diseases such as diabetes, heart disease, and overweight (Croll, Nuemark-Sztainer, & Story, 2001). Unhealthy eating can lead to being overweight, which has been linked to numerous negative health consequences, including hyperlipidemia, hypertension, and impaired glucose tolerance (Story, 1999). Overweight is a major cause of excess morbidity and mortality among children and adolescents (Gortmaker et al., 2008).

Although unexplored in the literature, natural disasters are likely to be associated with poor diet. First, hurricanes create barriers that disrupt access to healthier food choices. For example, some of the problems associated with the aftermath of a hurricane include being unable to return to one's home, non-working refrigerators, destroyed grocery stores, and blocked roads (e.g., Goenjian et al., 2001; Pina et al., 2008). School closures may also affect children's diet, as children eat at least one meal a day in school.

Second, the presence of numerous stressors following natural disasters has been well documented (e.g., Goenjian et al., 2001; La Greca et al., 1996; Vernberg et al., 1996), and stressors are associated with poor diet. When stressed, people prefer foods with higher fats contents, and tend to eat more sweet or salty foods (Kandiah, Yake, & Willett, 2008). Stress is also associated with increases in children's energy intake and the use of "comfort" snacks (Kandiah, Yake & Willett, 2008; Roemmich, Wright, Epstein, 2002). Children also report that they eat unhealthy foods to relieve stress

(O'Dea, 2003). In addition, families may intentionally choose unhealthy options during times of stress (Young, Northern, Lister, Drummond, & O'Brien, 2007). Surprisingly, the Federal Emergency Management Agency (FEMA) *recommends* that following a disaster, families keep "comfort/stress foods" such as cookies, hard candy, sweetened cereals, and lollipops on hand (FEMA, 2009).

In summary, natural disasters are likely to be associated with poor diet habits, despite the dearth of research in this area. Thus, the current study extended the literature on stress and eating by examining associations between stressors and their relationship to poor dietary practices (i.e., eating more unhealthy foods) among children after a natural disaster. It was expected that stressors would be directly, positively associated with unhealthy diet.

Natural Disasters and Activity Levels

Similar to diet, physical and sedentary activity patterns developed in childhood may continue into adulthood (Myers, Strikmiller, Webber, Berenson, 1996). Physical activity has been linked to both short and long term positive health benefits (Hallal, Victora, Azevedo, & Wells, 2006). In contrast, high levels of sedentary activity have been linked to childhood obesity (Utter, Neumark-Sztainer, Jeffrey & Story, 2003). Decreasing sedentary activity has been shown to decrease the risk of becoming overweight (Must & Tybor, 2005).

Stressors associated with natural disasters are likely to impact children's activity levels. Natural disasters ravage children's play spaces (e.g., destroy playgrounds, gymnasiums; Hall, 2008; Ortega & Raley, 2009), which are especially important for elementary-aged children's physical activity (Farley et al., 2007; Sallis et al., 1993).

Further, after a disaster, parents may limit children's outdoor play due to safety concerns about outdoor spaces (Associated Press, 2008). In turn, this may increase children's sedentary activity. In addition, recovery stressors associated with a hurricane (e.g., parental job loss, changing schools, living in tents or motor homes) may limit time and resources available for children to play. Further, stressors are associated with increased sedentary activity among children (e.g., Roemmich, Gugrol & Epstein, 2003). However, no known literature has examined stressors and activity levels among children exposed to a natural disaster.

The current study addressed this gap in the literature by examining whether higher levels of stressors were related to higher levels of sedentary activity in children after a natural disaster. Specifically, it was expected that stressors would be directly, positively associated with sedentary activity.

Models of Risk Following Disasters

Conceptual models of risk examining children's reactions following disasters have noted that multiple factors play a role in the development of PTS symptoms: stressors related to initial exposure to the event, stressors related to aspects of the post-disaster recovery environment, and preexisting child demographic characteristics (La Greca et al., 1996; Norris, Friedman, Watson, Byrne, Diaz, & Kaniasty, 2002; Yelland et al., 2010; see La Greca & Prinstein, 2002 for a summary). Models examining risk and resilience have primarily been applied to understanding children's psychological functioning (e.g., PTS symptoms, depression, and anxiety) following disasters (Silverman & La Greca, 2002). For example, Vernberg and colleagues (1996) applied this conceptual model to understanding PTS symptoms in 568 elementary school children three months following Hurricane Andrew, a Category 5 hurricane with sustained winds that exceeded 160 miles per hour. Using this conceptual framework, La Greca and colleagues (1996) followed 442 of the same children 3, 7, and 10 months after Hurricane Andrew. Findings from these studies of children post-disaster will be discussed below. The conceptual framework used in these studies guided the hypotheses of the current study.

Exposure stressors. In disaster-related conceptual models of risk, exposure stressors associated with hurricanes include children's perception of life threat during the disaster (e.g., thinking they might die) and actual life threat (e.g., objective life threatening events). These exposure stressors have been shown to predict post-disaster functioning in children (La Greca et al., 1996; Lonigan et al., 1994; Vernberg et al., 1996). The proposed study examined exposure stressors and their association with diet and activity levels. It was expected that children with higher levels of exposure stressors would have higher levels of unhealthy diet and sedentary activity after a natural disaster. In addition, the current study sought to replicate past findings from the literature: it was expected that exposure stressors would be positively related to PTS symptoms among children.

Recovery stressors. Children may experience numerous stressors in the period following a hurricane. Hurricane-related recovery stressors include initial loss and disruption following the disaster (e.g., damage to homes, loss of possessions), and ongoing loss and disruption related to the disaster (e.g., lost possessions, friends who have moved). When children were followed prospectively, initial hurricane-related loss and disruption predicted children's PTS symptoms 7 and 10 months following a natural disaster, Hurricane Andrew (La Greca et al., 1996). These same children also reported ongoing loss and disruption events; all of the children in the study reported at least one event related to ongoing loss and disruption seven months post-hurricane. In addition, 44% of the 442 children in this study reported one to two ongoing hurricane-related stressors, and 10% reported three or more of these stressors (La Greca et al., 1996). Ongoing hurricane-related stressors were associated with higher levels of PTS symptoms among children (Vernberg et al., 1996).

In addition to hurricane-related stressors, children may also experience major life events after a disaster. These are recovery stressors that are not necessarily directly related to the hurricane (e.g., new siblings, parental divorce). Conceptual models of disasters have described these non-hurricane related stressors as aspects of the postdisaster recovery environment (La Greca & Prinstein, 2002). In models of risk, major life events have accounted for 3% and 2% of the variance in PTS symptoms 7 and 10 months post-disaster, respectively (La Greca et al., 1996).

The present study extends the literature on recovery stressors and disasters by testing recovery stressors as an intervening variable that may serve as a potential mediator of the relationship between exposure stressors and children's health behaviors. In keeping with past studies on disaster, it was expected that there would be a direct relationship between recovery stressors and health behaviors, and also an indirect relationship from exposure stressors to health behaviors through recovery stressors. In addition, the current study sought to replicate past findings related to PTS symptoms among children. It was expected that exposure and recovery stressors would be directly related to PTS symptoms, and that exposure stressors would be indirectly related to PTS symptoms through recovery stressors.

Preexisting child demographic characteristics. *Gender.* Studies have reported that girls are more at risk for developing PTS symptoms post-disaster (Hoven et al., 2005; Lonigan et al., 1994; Weems et al., 2007). For example, Norris et al. (2002), reviewed 49 disaster studies of children and adults showing significant gender differences in posttraumatic stress, distress, or disorder. In 46 (94%) of these studies, females were more adversely affected. In part, this may be due to females experiencing higher levels of recovery stressors. In the current study, it was expected that female gender would be directly, positively related to PTS symptoms. It was also expected that there would be an intervening variable effect, whereby gender was related to PTS symptoms through recovery stressors.

Ethnicity. Studies regarding ethnic differences in PTS symptoms post-disasters have been mixed. Minority children have been found to report more PTS symptoms post-disaster than White children (La Greca, Silverman, & Wasserstein, 1998; March et al., 1997; Shannon et al., 1994; see Norris et al., 2002 for a review). However, studies have also reported no ethnic differences in distress among children post-disaster (Jones, Frary, Cunningham, Weddle, & Kaiser, 2001; Pina et al., 2008). Null findings may reflect low power in some studies. For example, in the Pina et al. (2008) article, only 15 minority youth were examined in a sample of 46 youth after Hurricane Katrina.

Ethnic differences in outcomes post-disaster may be due to the fact that minority children may experience differential amounts of stressors in the recovery environment

(Shannon, Lonigan, Finch, & Taylor, 1994). It may also be that children from ethnic minority backgrounds may have more difficulty finding resources to help cope with recovery stressors (e.g., rebuilding one's home, finding a new job; Silverman & La Greca, 2002). Both of these explanations suggest that recovery stressors mediate the relationship between minority status and child outcomes post-disaster. Based on these hypotheses from the literature, it was expected that there would be a direct, positive relationship from minority status to PTS symptoms. It was also expected that there would be an intervening variable effect, whereby ethnicity was related to PTS symptoms through recovery stressors.

Physical Activity, Stressors, and PTS Symptoms

Substantial research has documented an association between stressors and children's reports of PTS symptoms following disasters (e.g., La Greca et al., 1996; Neria, Nandi, & Galea, 2008; Vernberg et al., 1996). A growing body of research suggests that physical activity may play a role in the development and maintenance of anxiety and depression in youth. Specifically, among adolescents, exercise may attenuate PTS symptoms, depression, and anxiety (Diaz & Motta, 2008; Manger & Motta, 2005; Motl, Birnbaum, Kubik, & Dishman, 2004; Newman & Motta, 2007). Diaz and Motta (2008) conducted a 15-session moderate aerobic exercise program with 12 female adolescents, finding that aerobic exercise decreased PTS symptoms. Motl and colleagues (2004) studied 4,594 young adolescents (i.e., 7th and 8th graders) for a period of two years, finding that naturally occurring changes in physical activity were negatively related to depressive symptoms over the course of two years.

This research is in keeping with the adult literature; significant negative associations have been found between regular physical activity and both depression and anxiety disorders (Goodwin, 2003; Ströhle, 2009). In addition, among adults, aerobic exercise decreases medically induced panic symptoms (Strohle et al., 2005).

The current study sought to extend and apply this literature to the disaster field by examining physical activity as a moderator of the relationship between recovery stressors and PTS symptoms. It was expected that higher levels of physical activity would attenuate the relationship between recovery stressors and PTS symptoms.

Potential Covariates Related to Health Behaviors

Several child characteristics that have been related to children's health behaviors were also examined as covariates in this study. Specifically, in the current study, gender, ethnicity, and weight were treated as covariates.

Gender. The literature is mixed on the relationship between gender and health behaviors. Parents tend to restrict and regulate unhealthy food consumption more for girls than boys (Birch & Fisher, 1998). However, studies have also found no gender differences in reported nutrition behaviors (Grund, Krause, Siewers, Rieckert, & Muller, 2001). The literature on the relationship between sedentary activity and gender is also mixed. Studies have reported that among elementary school-aged children, boys and girls engage in roughly the same amounts of sedentary activity (Anderson et al., 1998). However, other studies have found that boys engage in more sedentary behavior in the elementary school years (Berkey et al., 2000). In terms of gender differences in physical activity, findings are more consistent. Boys tend to engage in more physical activity than girls in the elementary school years (for a review, see Sallis, Prochaska, & Taylor, 2000). As children age, these differences become larger as girls begin to be less active (Anderson et al., 1998).

Ethnicity. Findings regarding ethnic differences in health behaviors are also mixed. Some studies have found that children of African American ethnicity have more unhealthy diets than White children. For example, data from the Bogalusa Heart Study showed that African American children had higher total energy intake and consumed more cholesterol, fat, and carbohydrates than White children (Nicklas, Yang, Baranowski, Zakeri, & Berenson, 2003). However, other large-scale studies have found no ethnic differences among White, Hispanic, and African American children in unhealthy diets (Munoz, Krebs-Smith, Ballard-Barbash, Cleveland, 1997). In terms of activity levels, there do appear to be some differences among children from different ethnic groups. African American and Hispanic children engage in more sedentary activity than White children (Anderson et al., 1998; CDC 2004). Rates of physical activity are higher among White children than among African American and Hispanic children (Anderson et al., 1998; Sallis et al., 2000).

Weight. Finally, differences in health behaviors for children of different weights have been shown. The consumption of high fat or high sugar foods has been positively associated with weight in children (Mellin, Neumark-Sztainer, Story, Ireland, & Resnick, 2002; Niklas et al., 2003). Further, children who engage in higher amounts of sedentary activity tend to be heavier (Anderson et al., 1998; Eisenmann et al., 2002; Maffeis, Talamini, Tato, 1998; Steinbeck, 2001). In addition, a negative relationship has generally been found between weight and children's physical activity (Eisenmann, Bartee, &

Wang, 2002; Must & Tybor, 2005; Patrick et al., 2004; Steinbeck, 2001). Overweight children tend to engage in less physical activity than their non-overweight peers (Trost et al., 2003).

Summary and Study Hypotheses

In summary, to our knowledge, the current study was the first systematic examination of children's health behaviors following a disaster. This study, guided by a conceptual model, examined exposure and recovery stressors and their relationship to unhealthy diet and sedentary activity. This study also replicated past findings that exposure and recovery stressors relate to PTS symptoms. Physical activity was examined as a moderator of the relationship between stress and PTS symptoms. Secondary goals of the current study related to exploring the feasibility of collecting self-reported height, weight, and health behavior information from children after a disaster.

Hypothesis 1 (see Figure 1). It was expected that higher levels of exposure stressors (i.e., perceived life threat and actual life threat) and recovery stressors (i.e., initial loss/disruption, ongoing loss/disruption, major life events) would be directly associated with children's reports of eating higher amounts of unhealthy foods. It was also expected that there would be an indirect relationship between exposure stressors and children's reports of unhealthy dietary behaviors through recovery stressors.

Hypothesis 2 (see Figure 3). It was expected that higher levels of exposure stressors and recovery stressors would be directly associated with children's reports of higher levels of sedentary activity. It was also expected that there would be an indirect relationship between exposure stressors and children's reports of sedentary activity through recovery stressors.

Hypothesis 3a (see Figure 5). This study sought to replicate past findings showing recovery stressors as a mediator of the relationship between exposure stressors and children's reports of PTS symptoms. It was expected that there would be a direct, positive relationship between exposure stressors and PTS symptoms and recovery stressors and PTS symptoms. It was also expected that there would be an indirect relationship between exposure stressors and PTS symptoms through recovery stressors.

Further, it was expected that there would be significant direct effects from ethnicity and gender to PTS symptoms. In addition, it was expected that there would be a significant indirect relationship from ethnicity (i.e., African American and Hispanic ethnicity) to PTS symptoms through recovery stressors, and a significant indirect relationship from gender (i.e., identifying as female) to PTS symptoms through recovery stressors.

Hypothesis 3b (see Figure 7). Physical activity was expected to moderate the relationship between stressors and PTS symptoms tested in Hypothesis 3a such that higher levels of physical activity were expected to attenuate the relationship between stressors and PTS symptoms.

CHAPTER 2: Method

Participants

Participants were 204 third (49%) and fourth graders (51%) who were recruited from all six public elementary schools in the Galveston Independent School District (GISD). This school district enrolls students from primarily low-income families, as reflected by the fact that 66% of children in all GISD schools (i.e., in elementary, middle or high school) are eligible for free lunch. In contrast, 47% of children across Texas are eligible for free lunch (Local School Directory, 2010).

Children were 51% female, and ranged in age from 7 to 11 years (M = 9.23, SD = .79). Children were diverse with regards to ethnicity: 35% Hispanic, 27% White, 22% African-American, 4% Asian, and 13% "Mixed" or "Other" race/ethnicity. 116 (57%) children lived in two-parent homes, 83 (41%) children lived with only one parent, and 5 (2%) children lived with neither their mother nor their father. 176 (86%) children were born in the United Sates, 22 (11%) children were born outside of the United States, and 6 (3%) children did not answer this question. When children reported the primary language spoken at home, 139 (69%) reported English, 43 (21%) reported Spanish, and 19 (10%) reported "Other."

Procedures

Approval for the current study was obtained from the University of Texas Medical Branch (UTMB) Institutional Review Board (IRB), the University of Miami IRB, and the GISD public school review board to conduct this study as part of a larger investigation of children's reactions to Hurricane Ike (Annette La Greca, principal investigator). Older children from the larger study (i.e., children in grades three and four) completed measures for the current study. Younger children from the larger study (i.e., children in the second grade), were excluded from the current study.

Time 1: general questionnaire study. Principals of all six participating elementary schools distributed parental consents to teachers of children in grades three and four. Teachers distributed parental consent forms to each student along with a letter informing parents of the current study. 865 parental consent forms were distributed to children and 304 (35%) were returned. Of the consent forms returned, 212 (70%) reflected parental permission for child participation.

Time 1 data collection occurred during one week in early May of 2009. On the scheduled data collection days, research staff administered questionnaires to children in the cafeteria of each of the six elementary schools in groups of approximately 25 – 40 children. Children who did not have parental permission to participate remained in their regularly scheduled classrooms.

Of the 212 children that had parental permission to participate, 204 (96%) participated. The primary reason for non-participation was absence (seven children were absent on the days of testing, and one student did not complete the questionnaires). Questionnaires took 1 hour to complete. Questionnaires were distributed only after children provided written assent.

Data collection was overseen by graduate assistants from the University of Miami and the University of Houston Clearlake, as well as two to three child psychologists from the University of Miami or UTMB. Approximately one adult was available for every five children. Questionnaires were read to children while they completed questionnaires.

As part of the consent process, parents were informed that they would be recontacted if their child experienced high levels of distress, so that parents could seek services or speak to their children. Of the children tested in this study, 46 (23%) met criteria for "severe" symptom levels of PTSD. Their parents were given letters with referral information, provided for by the school system and UTMB. Experienced child researchers were present at all times during the study procedures.

Time 2: height, weight, and re-test of health behaviors. At the Time 1 testing, all 204 children participating were given parental consent forms to participate in a follow-up assessment at Time 2 that involved measurement of height and weight, retesting of health behaviors, and providing a saliva sample for genetic testing; 55 (27%) children returned the consent forms. Of those returned, 53 (96%) children had parental permission to participate in Time 2.

Time 2 occurred in June 2009, approximately two weeks after the Time 1 questionnaire collection. Children's height and weight measurements were obtained and children completed a second administration of a self-reported questionnaire assessing height and weight, diet, and activity. Of the 53 children with parental permission to participate in Time 2, 53 (100%) children provided assent for participation.

During Time 2, children participated in groups of three to five children. In a small room, children completed the self-report questionnaire related to height, weight, diet, and activity patterns. Children also were individually measured for height and weight in a private corner of the room. This entire procedure took approximately 10 minutes.

Measures (see Appendices for measure questions)

Child demographics. A self-report *Background Information Questionnaire* (see Appendix A) was used to assess children's demographic characteristics. These characteristics included child age, gender, and ethnicity. Gender was coded as girls = 1, boys = 0. Ethnicity was coded as a set of three dummy variables, with White children as the reference group, and African American, Hispanic, and children of "Other" ethnicities as the identified groups, respectively.

Exposure stressors. Exposure stressors were assessed through a child-report measure called the Hurricane Related Traumatic Experiences-Revised (HURTE-R; Vernberg, La Greca, Silverman, & Prinstein, 1996; Appendix B). The HURTE-R assesses three aspects of children's experiences with hurricanes: *life threat during the hurricane* (actual and perceived), *initial loss/disruption after the hurricane* (first 2 months), and *ongoing loss/disruption* (continuing since the hurricane). Previous disaster research supports the validity of the HURTE-R for assessing children's exposure and disaster-related stressors (La Greca et al., 1996, 1998; Shannon et al., 1994; Vernberg et al., 1996). The HURTE-R has also been adapted for use with other disaster populations, including children affected by bushfires (Yelland et al., 2010).

Exposure stressors were conceptualized as *perceived life threat* and *actual life threat. Perceived life threat* is measured from the question, "At any time during the hurricane, did you think you might die?" and is rated as a "yes" (coded as 1) or "no" (coded as 0) response. *Actual life threat* is measured from six "yes" (coded as 1) or "no" (coded as 0) questions related to objective, observable and potentially life-threatening events occurring during the hurricane (e.g., "Did windows or doors break in the place you stayed during the hurricane?," "Did a pet you liked get hurt of die during the hurricane?," "Did you get hit by anything falling or flying during the hurricane?). These six items were summed to create a summary score (possible scores ranging from zero to six), representing the number of life-threatening events occurring during the hurricane.[1]

Recovery stressors. *Hurricane-related stressors. Initial loss/disruption* and *ongoing loss/disruption* caused by Hurricane Ike were measured using two subscales of the HURTE-R described above (see Appendix B). Initial loss/disruption was measured from 10 "yes" or "no" questions related to loss and disruption in the first or second month following the hurricane (e.g., "Was your home damaged badly or destroyed by the hurricane?," "Did you have to go to a new school because of the hurricane?," "Did one of your parents lose his or her job because of the hurricane?"). These 10 items were summed to create a summary score, with possible scores ranging from 0 to 10, representing the number of initial loss/disruption events occurring immediately after the hurricane. Internal consistency for initial loss/disruption was .59.

Ongoing loss/disruption was measured from six items pertaining to children's reports of continuing loss/disruption (e.g., "Are you living in a house that still has damage because of the hurricane?," "Do you have to travel a lot longer to get to your school now than you did before the hurricane?"). Five items were rated as "yes" or "no." Two of these items were reversed scored (i.e., "Has almost all the damage to your house from the hurricane now been fixed?" and "Are you now living in the house you lived in before the hurricane?"). One additional item asked, "How many times have you moved

[1] Internal consistency for actual life threat was low, .23. However, it was not expected that internal consistency would be high, as items were not necessarily expected to be intercorrelated. Internal consistency was not calculated for perceived life threat as this is a one item question.

since the hurricane?" Item responses of "twice" or "three or more" were scored as zero. Responses of "none" or "once" were coded as zero. Items were then summed to create a summary score, with possible scores ranging from zero to six, representing the number of ongoing loss/disruption events since Hurricane Ike. Internal consistency for ongoing loss/disruption was .37.

Major life events. Major life events (e.g., parental separation, death of a family member) were measured using a short form, child-report measure of the Life Events Checklist (LEC; Johnson & McCutcheon, 1980; Appendix C). Major life events are events that were not conceptualized to be directly related to the hurricane. Nevertheless, it is possible that some major life events may have been related to the hurricane. The short form of the LEC contains 14-items that may be rated as "yes" or "no". Questions pertain to personal loss (e.g., death of a family member or loved one), long separations from family members (e.g., separation or divorce, serious illness), and other major stressful events (e.g., birth of a sibling). A total summary score was calculated indicating the number of major life events a child has experienced; scores may range from 0 to 14. Past research with the LEC over a 2-week interval has shown that the test-retest reliability of the LEC is .72 and provides evidence of the validity of the LEC as a measure of major life events among youth (Greenberg, Siegle, & Leitch, 1983). In this study, internal consistency was .54.

Posttraumatic stress symptoms. Children's post traumatic stress symptoms were assessed with the Posttraumatic Stress Disorder-Reaction Index, Revision 1, for Children (PTSD-RI-R1; Steinberg, Brymer, Decker, & Pynoos, 2004; Appendix D). The PSTD-RI-R1 for children is a 17 item child-report questionnaire yielding a total PTS severity score. Given that children in the current study were in the 3rd and 4th grades, the 5-point response scale was simplified (0 = none of the time, 2 = some of the time, 4 = most of the time). Simplified scaling has been used with earlier versions of the PTSD-RI-R in previous hurricane studies (La Greca et al., 1996; La Greca et al., in press) and following bushfires (Yelland et al, 2010). A cutoff score of 38 or greater on the PTSD-RI-R has been used as a criterion for Posttraumatic Stress Disorder (Rodriguez, Steinberg, Saltzman, Pynoos, 2001; Steinberg et al., 2004). The PTSD-RI has been shown to have adequate internal consistency in past research with children following disasters, including Hurricane Andrew (i.e., internal consistency in Vernberg et al., 1996 was .89). When used following Hurricane Hugo (Shannon et al., 1994), the PTSD-RI showed internal consistency of .83. In this study, internal consistency was .87.

Next, children's Reaction Index – Revised responses were used to calculate reported symptom clusters of posttraumatic stress: reexperiencing, avoidance, and hyperarousal. Utilizing scoring instructions for the PTSD Reaction Index – Revised, (Steinberg et al., 2004), reexperiencing symptoms were measured by five questions (e.g., "When something reminds me of what happened, I get very upset, afraid, or sad."). For symptom clusters, children were counted as endorsing an item if they endorsed that they experienced the symptom "most of the time." Potential scores for endorsing reexperiencing symptoms could range from zero to five. Avoidance symptoms were measured by eight questions (e.g., "I try not to talk about, think about, or having feelings about the hurricane."), with two questions serving as alternate items relating to endorsing restricted affect (i.e., if children endorsed either question 10 or 11, they were counted as endorsing restricted affect. Only the highest score from question 10 or 11 was counted.).

Potential scores for endorsing avoidance symptoms could range from zero to seven. Hyperarousal symptoms were measured by five questions (e.g., "I have trouble going to sleep or I wake up often in the night."). Potential scores for endorsing hyperarousal symptoms could range from zero to five. Mean cluster endorsement scores were also calculated to facilitate interpretation.

Whether a child "met criteria" for a symptom cluster was also calculated. Children who endorsed "most of the time" for at least one reexperiencing symptom, three avoidance symptoms, or two hyperarousal symptoms were considered to "meet criteria" for that particular symptom cluster. In addition, the number of children meeting criteria for all three symptom clusters was calculated. These cluster scores were used to approximate criteria used to determine a PTSD diagnosis. Caution should be used in interpreting this information, as determining a PTSD diagnosis would require a more in-depth interview.

Health Behaviors. Health behavior questions related to children's unhealthy diet, sedentary activity, and physical activity (see Appendix E).

Unhealthy diet. A modified version of the CDC's *Youth Risk Behavior Surveillance System* (CDC, 2003; Appendix E) was used in the current study to assess children's levels of unhealthy diet. Children answered 4-questions about the frequency of consumption of unhealthy food items (e.g., "fast food", chips, non-diet sodas, sports drinks). All unhealthy food questions were rated on a 6-point scale indicating how often children have eaten various food items, ranging from 0 = "I did not have any in the past 7 days" to 5 = "4 or more times per day". Items for the food frequency questionnaire were related to items on the new food pyramid guidelines from the United States Department of Agriculture (www.mypyramid.com). *Unhealthy diet* was assessed by summing unhealthy food item scores, with possible scores ranging from 0 to 20. High scores indicate high levels of unhealthy food intake. Food frequency questionnaires have been used as self-report measures with elementary-school aged children (McPherson, Hoelscher, Alexander, Scanlon, & Serdula, 2000). Past studies using similar measures have found low internal consistency (.52; Mackey & La Greca, 2007). However, in the current study, internal consistency was .77 and .88 at Time 1 and Time 2, respectively.

Physical and sedentary activity were assessed through a 9-item child-report questionnaire adapted from the Child and Adolescent Trial for Cardiovascular Health (CATCH) study (Nader, Sellers, Johnson, & Perry, 1996; Webber, Osganian, Feldman, & Wu, 1996; Appendix E). *Physical activity* was assessed through 3 questions examining type, duration, and intensity of physical activity over the previous 7 days (i.e., vigorous exercise, moderate exercise, gym classes). Questions were rated on an 8 point scale ranging from “0 days” to “7 days”. A summary score with possible scores ranging from 0 to 21 was calculated for physical activity. Higher scores indicated more physical activity. Past studies using similar measures of self-reported physical activity among adolescents found adequate internal consistency, Chronbach’s $\alpha = .66$ (Mackey & La Greca, 2007). Child-report physical activity measures have been used with elementary school aged children (see Sallis et al., 2000 for a review). Chronbach’s α for physical activity was .36 and .46 at Time 1 and Time 2, respectively.

Sedentary activity was assessed through 3 questions pertaining to amounts of sedentary activity (e.g., “How many hours do you usually spend on the computer away from school?”) Questions were rated on a 7-point scale ranging from “0” to “6 or more hours". A total summary score with possible scores ranging from 0 to 18 was calculated to indicate amounts of sedentary activity, with higher scores indicating greater amounts of sedentary activity. Self-reported activity measures have been used with elementary school aged children (Myers et al., 1996; Nader et al., 1999) and have been shown to be valid (Sallis et al., 1993). Chronbach's α for sedentary activity was .65 and .60 for sedentary activity at Time 1 and time 2, respectively.

Height and weight in children was assessed using child-report. Children were asked to self-report their height (in feet and inches) and their weight (in pounds), see Appendix A. At Time 2, 26% of the sample (53 children) self-reported their height and weight. Next, actual height and weight measurements were obtained. This subsample served as a validity check for self-reported height and weight, a methodology used in past research (e.g., Ezzati, Martin, Skjold, Hoorn, & Murray, 2006). This subsample of children, tested at Time 2, was asked to remove shoes, sweaters, and outerwear. Height was measured to the nearest .1 inch on a portable stadiometer. Weight was measured to the nearest .1 pound on a digital scale. Past research with young adolescents, aged 12 – 16 years, has shown that the correlations between actual and self-reported height ranged from .82 - .91. Correlations between actual and self-reported weight ranged from .87 to .94 in the same study (Strauss, 1999). In the current study, correlations between actual height and self-reported height at Time 1 and Time 2 were .23 and .12, respectively. Correlations between actual weight and self-reported weight at Time 1 and Time 2 were .82 and .89, respectively.

Data Analytic Plan

First, self-reported height and weight measurements were inspected for stability and validity. Second, measures of unhealthy diet, physical activity, and sedentary activity were also inspected for stability from Time 1 to Time 2. Third, preliminary analyses were conducted for means and standard deviations of variables, outliers, and normality. Bivariate correlations for all study variables were also obtained.

Finally, a preliminary model testing the relationship between exposure and recovery stressors was examined. The three key study hypotheses were then tested using MPlus, version 5.2. Overall model fit for Hypotheses 1 through 3a was examined with the chi-square goodness of fit index, comparative fit index (CFI), root mean square approximation (RMSEA), and Standardized Root Mean Squared Residual (SRMR). If no direct paths were significant, indirect effects were not examined. For Hypothesis 3b, depicted in Figure 7, a Latent Moderated Structural Equation (LMS) approach was utilized, and a latent interaction effect was tested within the structural equation model (Klein, Moosbrugger, & Goethe, 2000).

CHAPTER 3: RESULTS

Stability and Validity of Health Behavior-Related Measures

The validity of children's self-reported height and weight was assessed by examining the subsample of 53 children who participated in both Time 1 and Time 2 assessments. For these children, self-reported height and weight measurements were available at both Time 1 and Time 2. In addition, their actual height and weight measurements were obtained at Time 2.

Differences were examined between this subsample of children participating in both timepoints and children who only participated in Time 1. Children participating in both timepoints self-reported heavier weights (M = 88.10, SD = 27.91) than children who only participated in Time 1 (M = 79.10, SD = 19.10), t (153) = 2.27, p = .02. No other differences between this subsample of children and the larger sample of children who only participated in Time 1 were found on any study variables.

Stability of self-reported height and weight. Reliability of self-reported height and weight was examined by comparing bivariate correlations for self-reported height and weight measures for Time 1 and Time 2. Results indicated that children's reports of their height and weight were consistent across Time 1 and Time 2, r = .92, p = <.001 and r = .85, p = <.001 respectively.

Validity of self-reported height and weight. Criterion validity of self-report measures was examined by obtaining bivariate correlations of self-reported with actual measures of height and weight. Children's self-reported height was not significantly correlated with their actual height at either Time 1, $r = .23$, $p = .15$, or Time 2, $r = .12$, $p = .45$. This indicates low criterion validity for children's self-reported height. Thus, height was not used in remaining study analyses.

Next, children's self-reported weight was correlated with their actual measured weight at both Time 1, $r = .82$, $p = <.001$, and Time 2, $r = .89$, $p = <.001$. This indicates good criterion validity for children's self-reported weight.

Examination of normality and outliers for self-reported weight. Self-reported weight had acceptable skewness and kurtosis at Time 1 (skewness = .80, kurtosis = 4.70) and Time 2 (skewness = 2.17, kurtosis = 5.45).

Although self-reported weight measurements were normally distributed, a few children reported weights falling well outside of the normal range (e.g., one child reported a weight of 4 pounds at Time 1). Thus, conservative cutoffs were employed to determine which outliers should be removed from self-reported weight measures. Using CDC growth charts (Chronic Disease and Health Prevention, 2000), children reporting a weight of less than the 5th percentile for 7 year olds (i.e., 40 pounds for boys and girls) were recoded as missing at Time 1 (i.e., 9 children) and Time 2 (no children were below cutoff criteria at Time 2). No upper limit cutoff was implemented due to the presence of children in the sample whose actual weight measurements exceeded the 95th percentile for weight for 12 year olds (i.e., 130 pounds for boys, 132 pounds for girls). When lower limit cutoffs were employed, the correlation between Time 1 self-reported weight and actual weight measurement was $r = .91$, $p < .001$. As no Time 2 outliers were found, no new correlations were examined. It was determined that children's self report of weight was valid for use in the current study. Self-reported weight at Time 1, with the 9 outliers removed, was used in all subsequent analyses.

Diet and activity measures. For the 53 children participating in assessments conducted at Time 1 and Time 2, bivariate correlations of reports of unhealthy diet, physical activity, and sedentary activity measures from Time 1 and Time 2 were examined for stability. It was not expected that there would be high stability between the two time-points as these measures queried about two separate weeks that were at least one week apart in time. Nevertheless, unhealthy diet and sedentary activity showed moderate test-retest reliability, $r = .56$, $p < .001$, and $r = .67$, $p < .001$, respectively. Physical activity showed low test-retest reliability, $r = .18$, $p = .20$. Further, physical activity was slightly positively correlated to unhealthy diet, $r = .15$, $p < .05$, and was not correlated with any other study variables, suggesting that this measure of physical activity may not be valid.

Preliminary Analyses

All other study variables were examined for outliers and normality. No other outliers were identified and variables were normally distributed. Means and standard deviations were computed for all study variables by gender and for the total sample (see Table 1).

Descriptive statistics. Regarding child-reported height and weight, at Time 1, after outliers were removed, girls reported a higher average weight ($M = 84.59$, $SD = 24.52$) than boys ($M = 77.50$, $SD = 17.80$), $t\,(153) = -2.01$, $p = .05$.

Regarding *exposure stressors* (see Appendix B), only 6% of the sample reported that they were at home during the hurricane. 84% of the children reported that they left Galveston during Hurricane Ike. This high level of evacuation may distinguish this sample from other samples of children following hurricanes. For example, in a study of children exposed to Hurricane Charley (La Greca et al., in press), 54% (n = 211) of this sample remained in their homes and only 8% (n = 31) of children evacuated Charlotte County, Florida.

On average, children reported approximately one actual life-threatening event during Hurricane Ike (M = .72, SD = .86). The most frequently endorsed event was, "Did you see anyone get hurt badly," which was endorsed by 49 children (24% of the sample). Levels of actual life threat are slightly lower than that reported after Hurricane Andrew, where children reported an average of 1.2 (SD = 1.2) actual life threatening experiences. When asked about perceived life threat, 62 children (31% of the sample) indicated that they thought they might die during the hurricane. Levels of perceived life threat in the current study were lower than that found in other studies. For example, after Hurricane Andrew, 60% of children reported that they thought they might die (Vernberg et al., 1996). Overall, there were no gender differences in levels of exposure stressors.

Regarding *hurricane-related recovery stressors* (see Appendix B), children reported an average of three to four initial loss and disruption events (M = 3.49, SD = 2.10). The most frequently endorsed event related to having clothing or toys destroyed by the hurricane (54%), followed by having a home badly damaged by the hurricane (53%), and going to a new school because of the hurricane (51%). Girls, in comparison to boys, reported higher levels of initial loss and disruption events, t (201) = 2.74, $p < .01$.

In terms of ongoing loss/disruption, children reported between one to two ongoing loss and disruption events following Hurricane Ike (M = 1.60, SD = 1.70). The most frequently endorsed ongoing loss and disruption event was having to move two or more times after the hurricane (34%). No gender differences were found in terms of ongoing loss and disruption events.

Regarding major *life events* (see Appendix C), children reported an average of one to two major life events not directly related to the hurricane (M = 1.57, SD = 1.62). The most frequently endorsed major life events were change in a job by a parent (25%) and the death of a pet (18%). No gender differences in terms of major life events were found.

Posttraumatic Stress Symptoms (see Appendix D). On average, children's PTSD-RI total scores fell below the clinical cutoff of 38 (M = 22.97, SD = 14.31). 20% (n = 40) reported PTS symptom scores equal to or greater than 38, the recommended cutoff score for meeting PTSD criteria (Steinberg et al., 2004). In comparing levels of PTS symptoms reported in the current study, girls reported higher levels of PTS symptoms than boys, t (201) = 2.21, p = .03.

When examining PTS symptom clusters (see Table 2), 89 children (44%) met criteria for the reexperiencing cluster, 36 children (18%) met criteria for the avoidance cluster, and 67 children (33%) met criteria for the hyperarousal cluster. Overall, 24 children (12%) met criteria for all three clusters. In comparison to children who were examined 7-months after Hurricane Andrew, fewer children in the current sample met criteria for each symptom cluster, and fewer children in this study met criteria for all three symptoms clusters. For example, 7-months after Hurricane Andrew, 24% of children met criteria for all three symptom clusters (La Greca et al., 1996).

Unhealthy diet (see Appendix E). With regards to unhealthy diet at Time 1, children reported eating unhealthy food items over the previous 7 days. 45% (n = 91) of children reported drinking soda more than 4 times in the past week, 32% (n = 65) reported eating fast food more than 4 times in the past week, 38% (n = 78) reported eating sweets more than 4 times in the past week, and 34% (n = 70) reported eating chips more than 4 times in the past week.

Mean total scores for unhealthy diet, M = 6.37, SD = 4.71, in the current sample were comparable to those found in Mackey and La Greca (2007), M = 5.97, SD = 3.40, t(907) = 1.34, p = .82, a study which examined unhealthy diet among older adolescents, and which used a similar measure of unhealthy diet. No gender differences in levels of unhealthy diet were found.

Sedentary activity (see Appendix E). Sedentary activity scores had a mean of 5.91 and a standard deviation of 4.60. 61% (n = 124) of children reported engaging in sedentary activity (e.g., watching television, using the computer, playing video games) for 4 or more hours on average. Boys reported engaging in higher levels of sedentary activity than girls, t (199) = -3.53, p = .001.

Levels of sedentary activity reported in this sample are higher than those found in other non-disaster studies. In the current study, children reported spending an average of 5.91 hours a day engaged in sedentary activity. Berkey and colleagues (2000) found that 9 year old children reported spending and average of 23.94 hours engaged in sedentary activity over the previous seven days. However, it is difficult to compare the levels of sedentary activity in this study to levels of sedentary activity in other samples, as there have been no previous studies examining activity levels among children post-disasters.

Physical activity (see Appendix E). Physical activity scores had a mean of 8.52 and a standard deviation of 3.91. 71% (n = 145) of children reported engaging in vigorous activity (i.e., activity that led to sweating or breathing hard for at least 20 minutes), 3 or more times a week over the 7 days that were queried. 31% (n = 64) reported attending at least 3 gym classes over the past 7 days queried. No gender differences in levels of physical activity were found.

Overall, levels of physical activity reported in this sample are slightly lower than those found in other non-disaster studies. In the current study, children reported spending an average of 8.52 hours in the previous week engaged in physical activity. A study by Sallis and colleagues (1993) found that 5th graders reported an average of 13.83 hours engaged in physical activity when given 7 day physical activity recall questionnaire (Sallis et al., 1993). Another study by Berkey and colleagues (2000), found that 9 year old children reported spending an average of 11.55 hours engaged in physical activity over the previous seven days. However, it is difficult to compare the levels of physical activity in this study to levels of physical activity in other samples, as there have been no previous studies examining activity levels among children post-disasters.

Examining additional potential covariates. Based on gender differences in study variables, discussed above, and past research (Anderson et al., 1998; Birch & Fisher, 1998; Norris et al., 2002), gender was included as a covariate in all analyses.

Study variables were also examined by school, ethnicity, and weight. Omnibus testing was conducted to see if study variables differed by school. No significant differences were found. School was not included as a covariate in study analyses.

In terms of weight, no study variable was significantly correlated with self-reported weight. However, in keeping with the literature on health behaviors (e.g., Anderson et al,1998; Eisenmann et al., 2002; Mellin et al., 2002; Steinbeck, 2001), weight was included as a covariate of health behaviors.

Finally, omnibus testing was conducted to examine whether children differed by ethnicity on key study variables. Omnibus testing showed that children of different ethnicities differed in terms of their sedentary activity, F (3, 192) = 6.82, $p < .001$. Bonferonni corrected t-tests showed that in comparison to White children (M = 4.06, SD = 3.66), African American (M = 7.86, SD = 4.71) and Hispanic children (M = 6.54, SD = 4.97) reported engaging in more sedentary activity, $t(199) = 3.80$, $p < .001$, and $t(199) = 2.49$, $p = .01$, respectively. No other differences were found. Due to these differences in sedentary activity and past research on both PTS symptoms and health behaviors (e.g., Anderson et al., 1998; La Greca et al., 1998; Sallis et al., 2000), identifying with Hispanic, African American, and “Other” ethnicity were examined as covariates in study analyses.

Correlations. Correlations among study variables are presented in Table 3. Regarding outcome variables (i.e., PTS symptoms, unhealthy diet, sedentary activity, and physical activity), PTS symptoms were positively related to experiences of both exposure and recovery stressors, as well as unhealthy diet and sedentary activity. Unhealthy diet was positively related to major life events, physical activity, and sedentary activity.

Sedentary activity was positively related to actual life threatening events during Hurricane Ike, initial loss and disruption events, and major life events. In addition, boys reported engaging in higher levels of sedentary activity than girls.

Preliminary modeling: Examining exposure and recovery stressors. Prior to testing the main study hypotheses, a preliminary model was tested to examine relationships between exposure and recovery stressors. This model fit the data: χ^2 (10) = 7.23, p = 0.70, CFI = 1.00, RMSEA < .001, and SRMR = 0.02.

Direct effects tested between exposure and recovery stressors. Exposure stressors (i.e., perceived life threat and actual life threat) were related to recovery stressors. Children who thought they might die (i.e., perceived life threat) reported .57 more recovery stressors in their lives, b = .57, SE = .22, p < .01. For every additional actual life threatening event, children reported .76 additional recovery stressors, b = .76, SE = .14, p < .001.

Recovery stressors. Initial loss/disruption events set the metric for the recovery stressors latent variable. Ongoing loss/disruption events significantly loaded onto each indicator (i.e., initial loss/disruption, ongoing loss/disruption, and major life events). For every 1 standard deviation increase in the latent variable for recovery stressors, initial loss/disruption events increased .63 standard deviation units (p <.001), ongoing loss/disruption events increased .52 standard deviation units (p < .001), and major life events increased .65 standard deviation units (p < .001).

When examining additional covariates for the recovery stressors latent variable, girls reported higher levels of recovery stressors than boys (b = .57, SE = .21, p <.01). African American children reported higher levels of recovery stressors than White children (*b* = .73, *SE* = .30, *p* = .02). Hispanic children also reported higher levels of recovery stressors than White children, (*b* = .58, *SE* = .27, *p* =.03). Children of "Other" ethnicity did not differ from White children.

Main Study Analyses

Hypothesis 1: Exposure and recovery stressors relate positively to unhealthy diet. The hypothesized structural model examining exposure and recovery stressors and their relationship to unhealthy diet is presented in Figure 1. The hypothesized model fit the data: $\chi^2(15) = 10.49$, $p = 0.79$, CFI = 1.00, RMSEA < 0.001, and SRMR = 0.02, and explained 11% of the variance in unhealthy diet (see Figure 2 for estimates for final model).

Direct effects: Exposure and recovery stressors to unhealthy diet. Contrary to expectations, children's reports of perceived and actual life threat (i.e., exposure stressors) were not directly related to their report of unhealthy diet, *b* = -.55, *SE* = .78, *p* = .48 and *b* = .13, *SE* = .53, *p* = .81, respectively. In addition, and contrary to expectations, recovery stressors did not directly relate to unhealthy diet, *b* = .52, *SE* = .49, *p* = .29.

Indirect effects: Exposure stressors to unhealthy diet through recovery stressors. As there were no significant direct effects from exposure or recovery stressors to unhealthy diet, indirect effects were not tested.

Unhealthy diet and covariates. Children's levels of unhealthy eating did not differ by gender or weight, and Hispanic children and children of "Other" ethnicity did not differ from White children. However, African American children reported eating significantly higher levels of unhealthy food than White children (b = 2.79, SE = 1.03, p <.01).

Hypothesis 2: Exposure and recovery stressors relate positively to sedentary activity. The hypothesized structural model examining exposure and recovery stressors and their relationship to sedentary activity is presented in Figure 3. The hypothesized model fit the data: $\chi^2(15) = 8.72$, $p = 0.89$, CFI = 1.00, RMSEA < 0.001, and SRMR = 0.02, and explained 24% of the variance in sedentary activity.

Direct effects: Exposure stressors, recovery stressors, and covariates to sedentary activity. Contrary to expectations, perceived and actual life threat were not directly related to children's reports of sedentary activity, b = -.34, SE = .73, p = .64, and b = -.34, SE = .52, p =.51, respectively. However, consistent with expectations, recovery stressors were directly related to children's reports of sedentary activity, b = 1.09, SE = .49, p =.03.

Direct effects from covariates to sedentary activity were significant. African American and Hispanic children reported higher levels of sedentary activity than White children, b = 2.74, SE = .95, p <.01 and b = 1.68, SE = .83, p =.04, respectively. Children of "Other" ethnicity did not differ from White children in their levels of sedentary activity. Boys reported higher levels of sedentary activity than girls, b = -3.05, SE = .67, p < .001. Sedentary activity levels did not differ by child weight.

As there were nonsignificant paths in the hypothesized model, a nested model that did not contain nonsignificant paths from exposure stressors to sedentary activity (see Figure 4) was tested against the hypothesized model depicted in figure 3. The model with paths removed fit the data: $\chi^2(17) = 9.32$, $p = 0.93$, CFI = 1.00, RMSEA < 0.001, and SRMR = 0.02, and explained 22% of the variance in sedentary activity. A chi-square difference test between this model and the hypothesized model was performed, $\chi^2(2) = .61$, $p = .74$. As there was no significant difference between the two models, the more parsimonious model depicted in Figure 4, with no direct paths between exposure stressors and sedentary activity, was retained as the final model and is discussed for subsequent tests of relationships between sedentary activity, stressors, and covariates.

In the final model for stressors and sedentary activity, recovery stressors were directly related to children's sedentary activity, $b = 0.83$, $SE = .30$, $p < .01$. For every additional loss and disruption event, children were engaging in 0.83 more hours of sedentary activity.

Indirect effects: Exposure stressors relate to sedentary activity through recovery stressors. In keeping with hypothesis 2, the indirect effect of perceived life threat to sedentary activity in the final model was significant, $b = 0.47$, $SE = .24$, $p = .05$. In addition, the indirect effect of actual life threat to sedentary activity was significant, $b = .63$, $SE = .23$, $p < .01$. These indirect effects are consistent with mediation (i.e., with recovery stressors as a potential mechanism linking exposure stressors and sedentary activity).

Sedentary activity and covariates. In the final model, boys engaged in approximately 2.86 more hours of sedentary activity than girls ($b = -2.86$, $SE = .61$, $p < .001$). Also, African American children engaged in roughly 2.86 hours more of sedentary activity than White children, ($b = 2.86$, $SE = .92$, $p < .01$), and Hispanic children engaged in 1.81 more hours of sedentary activity than White children ($b = 1.81$, $SE = .79$, $p = .02$).

Children of "Other" ethnicity did not differ from White children in terms of levels of sedentary activity. Levels of sedentary activity also did not differ by child weight.

Indirect effects from child demographic characteristics to sedentary activity through recovery stressors were also examined. The indirect effect from gender was significant, $b = .48$, $SE = .24$, $p = .05$. Indirect effects from African American and Hispanic ethnicity approached significance, $b = .60$, $SE = .32$, $p = .07$, and $b = .47$, $SE = .27$, $p = .08$, respectively. The indirect effect from "Other" ethnicity was not significant, $b = .46$, $SE = .30$, $p = .13$. These tests of the indirect effect lack statistical power due to the skewed distribution of indirect effects (Shrout & Bolger, 2002).

Hypothesis 3a: **Exposure and recovery stressors relate positively to PTS symptoms.** Past findings that recovery stressors mediate the relationship between exposure stressors and PTS symptoms was tested (La Greca et al., in press; see Figure 5 for hypothesized model). The overall model fit the data, $\chi^2(12) = 13.11$, $p = 0.36$, CFI = 1.00, RMSEA = 0.02, and SRMR = 0.02.

Direct effects: Exposure stressors, recovery stressors, and covariates to PTS symptoms. Contrary to expectations, perceived and actual life threat were not directly related to children's reports of PTS symptoms, $b = -.67$, $SE = 2.49$, $p = .79$, and $b = -2.87$, $SE = 2.03$, $p = .16$, respectively. However, consistent with expectations, children's report of recovery stressors was significantly related to their reports of PTS symptoms, $b = 8.69$, $SE = 2.21$, $p < .001$. In addition, the direct effects between covariates and PTS symptoms were also examined. Contrary to expectations, there were no significant direct effects (i.e., ethnicity and gender) from covariates to PTS symptoms.

As there were several nonsignificant paths in the hypothesized model, a nested model (see Figure 6) in which nonsignficant paths were removed (i.e., direct paths between exposure stressors and covariates to PTS symptoms) was tested against the hypothesized model depicted in Figure 5. This model also fit the data: $\chi^2(18) = 17.73$, $p = 0.47$, CFI = 1.00, RMSEA <.001, and SRMR = 0.03. A chi-square difference test between these two models was performed, $\chi^2(6) = 4.62$, $p = .59$. As there was no significant difference between the two models, the more parsimonious model, which did not contain direct paths between exposure stressors and covariates to PTS symptoms, was retained as the final model for tests of the relationships between stressors and PTS symptoms.

Children's report of recovery stressors was significantly related to their report of PTS symptoms, $b = 6.92$, $SE = 1.01$, $p < .001$, indicating that for every additional loss and disruption event, children endorsed 6.92 more units of symptoms on the PTSD-RI-R1 scale, which equates to endorsing either more PTS symptoms, or higher levels of PTS symptoms.

Indirect effects: Exposure stressors relate to PTS symptoms through recovery stressors. An examination of the indirect effect of exposure stressors on PTS symptoms through recovery stressors was performed using the final model (see Figure 6). Consistent with hypotheses, the indirect effect of perceived life threat to PTS symptoms was significant, $b = 4.05$, $SE = 1.53$, $p < .01$. In addition, and consistent with hypotheses, the indirect effect of actual life threat to PTS symptoms was significant, $b = 5.00$, $SE = .86$, $p < .001$. These indirect effects are consistent with mediation and are in keeping with past conceptual models (La Greca et al., 1996; La Greca et al., in press) showing recovery stressors as a mechanism linking exposure stressors and PTS symptoms.

Additional analyses of indirect effects: Covariates relate to PTS symptoms through recovery stressors. The indirect effects of ethnicity and gender through recovery stressors to PTS symptoms were also tested. Consistent with hypotheses, the indirect effects of African American ethnicity and Hispanic ethnicity through recovery stressors to PTS symptoms were significant, $b = .18$, $SE = 0.06$, $p < .001$ and $b = 0.14$, $SE = .06$, $p = .01$, respectively. The indirect effect of "Other" ethnicity to PTS symptoms through recovery stressors was not significant. There was also a significant indirect effect from gender to PTS symptoms through recovery stressors, $b = .15$, $SE = .05$, $p < .001$, consistent with hypotheses.

Hypothesis 3b: Activity moderates the relationship between exposure and recovery stressors and PTS symptoms. Building upon the final model tested above in Hypothesis 3a (see Figure 6), physical activity was expected to attenuate the relationship between recovery stressors and PTS symptoms. A Latent Moderated Structural Equation (LMS) approach was employed to test physical activity as a moderator (Klein & Moosbrugger, 2000).

When taking an LMS approach, it is important to note that this approach has two limitations. First, the LMS approach does not allow indirect effects to be examined. Second, an LMS approach requires that variables contain full information on all variables. Thus, the sample used for this model contained 149 children, representing a loss of 55 children from the larger sample.

This subsample of children with all data differed from the 55 children who did not have full information in several important ways. Children with all data reported fewer actual life threatening events (*M* = 0.63, *SD* = .81) than children with missing data (*M* = 0.98, *SD* = .97), $t(201) = 2.56$, $p = .01$. In addition, children with all data reported marginally fewer ongoing loss/disruption stressors (*M* = 1.46, *SD* = 1.80) than children with missing data, (*M* = 1.96, *SD* = 1.36), $t(201) = 1.86$, $p = .07$. They also reported engaging in less sedentary activity (*M* = 5.53, *SD* = 4.38) than children with missing data, (*M* = 7.04, *SD* = 5.08), $t(199) = 2.05$, $p = .04$. This sample with all data also had fewer minorities (32% White, 18% African American, 31% Hispanic, and 19% Other) than the sample with missing data (10% White, 31% African American, 48% Hispanic, and 10% Other), $\chi^2(3) = 13.65$, $p = < .01$. Thus, the subsample of children with all data, used in moderation analyses, was a sample with fewer stressors, fewer minority children, and a sample that reported less sedentary activity.

To test Hypothesis 3b, a model difference test compared a model containing an interaction term (i.e., physical activity crossed with the latent variable for recovery stressors, see Figure 7) to a model in which the path between the interaction terms and PTS symptoms was set to zero. Results showed that contrary to hypotheses, physical activity did not moderate the relationship between recovery stressors and PTS symptoms. The model difference test was not significant, *Δ-2Loglikelihood* = 0.18, $p = .67$, indicating that a model estimating the path for the interaction term to PTS symptoms did not fit the data better than a model with this path set to zero. Although the LMS approach lowers power to detect significant results, this did not appear to be an issue for this analysis as the difference test was not close to significant, $p = .67$.

Physical activity and covariates. Physical activity was positively related to weight, $b < .01$, $SE = < .01$, $p = .03$. No other covariates were significantly related to physical activity.

Follow-up Analyses

Sedentary activity as a moderator of the relationship between stressors and PTS symptoms. In a follow-up analysis, sedentary activity was examined as a moderator of the relationship between recovery stressors and PTS symptoms. Using an LMS approach, a model containing an estimated path for PTS symptoms regressed on an interaction term for sedentary activity and recovery stressors was compared to a model that set this path to zero. The difference between these two models was not significant, *Δ-2Loglikelihood* = 2.08, $p = .15$. Sedentary activity did not moderate the relationship between physical activity and recovery stressors, contrary to expectations. Again, although the LMS approach lowers power to detect significant results, this did not appear to be an issue in this analysis as the difference test was not close to significant.

PTS symptoms as a mediator of relationship between exposure stressors and sedentary activity. Follow-up analyses were conducted examining PTS symptoms as a potential mediator of the relationship between recovery stressors and sedentary activity. It was expected that PTS symptoms would be significantly positively related to sedentary activity. It was also expected that, in keeping with earlier analyses showing a significant indirect effect from actual life threat to sedentary activity through recovery stressors (see Hypothesis 2, Figure 4), and in keeping with analyses showing an indirect effect from actual life threat to PTS symptoms through recovery stressors (see Hypothesis 3a, Figure 6), there would be a significant indirect relationship from perceived life threat to sedentary activity, and a significant indirect effect from actual life threat to sedentary activity through recovery stressors and PTS symptoms. The model fit the data: $\chi^2(26) = 18.96$, $p = 0.84$, CFI = 1.00, RMSEA < 0.001, and SRMR = 0.02, and explained 26% of the variance in sedentary activity.

However, the direct path between recovery stressors and sedentary activity was not significant in this model, $b = .38$, $SE = .39$, $p = .34$. Therefore, this model was tested against a nested model in which this path was removed. This new model (see Figure 8) fit the data, $\chi^2(27) = 19.90$, $p = 0.83$, CFI = 1.00, RMSEA < 0.001, and SRMR = 0.02, and explained 25% of the variance in sedentary activity. A chi-square difference test indicated no significant differences between the two nested models, $\chi^2(1) = .94$, $p = 0.33$. Thus, the model which removed the path between recovery stressors and sedentary activity was retained as the final model (shown in Figure 8).

Consistent with expectations, PTS symptoms were significantly related to sedentary activity, $b = .10$, $SE = .02$, $p <.001$. For every 1 point increase in PTS symptoms, children reported spending approximately .10 more hours engaged in sedentary activity.

In keeping with expectations, the total indirect effect from perceived life threat to sedentary activity was significant, $b = .39$, $SE = .17$, $p = .02$. In addition, as anticipated, the specific indirect effect of actual life threat to sedentary activity through recovery stressors and PTS symptoms was also significant, $b = .48$, $SE = .13$, $p < .001$. In addition, the indirect paths from African American ethnicity and Hispanic ethnicity to sedentary activity were significant, $b = 0.59$, $SE = .24$, $p = .01$ and $b = .40$, $SE = .19$, $p = .03$, respectively. Further, the indirect path from gender to sedentary activity was also significant, $b = .41$, $SE = .16$, $p = .01$. The indirect path from "Other" ethnicity to sedentary activity was not significant.

CHAPTER 4: DISCUSSION

The current study represents the first systematic investigation of children's health behaviors following disasters. The examination of children's health behaviors provides information about risk and resilience factors post-disaster (Ferreira et al., 2005; Hu et al., 2001). This information is crucial, as the health behavior patterns developed in childhood have both short and long term consequences. In the short term, higher levels of unhealthy diet and sedentary activity may minimize growth and development (Goldfield et al., 2007). In the long term, higher levels of unhealthy diet and sedentary activity are associated with excess morbidity and mortality (e.g., Croll et al., 2001; Pugliese & Tinsley, 2007; Serdula et al., 1993; Utter et al., 2003).

The purpose of the current study was to apply conceptual models of children's reactions to disasters to the examination of children's diet and activity levels after a natural disaster. The study also replicated past models of factors related to children's PTS symptoms after disasters, and examined whether physical activity attenuated the relationship between recovery stressors and PTS symptoms. In addition, this study sought to examine the feasibility of collecting height, weight, and health behavior data after a natural disaster.

When applying a conceptual model of children's disaster reactions to the examination of health behaviors and PTS symptoms post-disaster, results supported some study hypotheses, while other hypotheses were not supported. In keeping with hypotheses, higher disaster exposure and recovery stressors were associated with higher levels of sedentary activity among children. In addition, higher levels of disaster exposure and recovery stressors were associated with higher levels of children's PTS symptoms. Further, the study replicated the link between minority status and female gender and PTS symptoms, and further showed that this relationship was best accounted for by recovery stressors. Yet, physical activity levels did not moderate these relationships, contrary to hypotheses. Also contrary to hypotheses, unhealthy diet was not associated with children's levels of disaster exposure or to their recovery stressors.

Results also provided initial information about the feasibility of collecting height, weight, and health behavior data from children, ages 8 to 10 years. Children were valid and reliable reporters of their weight. However, their self-reported height was stable, but not valid. Unhealthy diet and sedentary activity exhibited good stability across time. Physical activity was not stable over time, and other options for measuring physical activity may need to be explored in future studies. Below, these key findings are discussed along with their implications for future research.

Are Disaster Experiences Associated with Children's Health Behaviors?

Testing Hypothesis 1: Stressors and unhealthy diet. Overall, disaster or hurricane exposure and recovery stressors were not directly or indirectly related to children's reports of an unhealthy diet. These findings imply that, at least 8 months after a disaster, children's unhealthy diet is not associated with stress. Overall, findings related to stressors and unhealthy diet are contrary to the study hypotheses and also are different from findings in previous research on the associations between stressors and diet.

Kandiah and colleagues (2008) found that stressed individuals prefer to eat more sweet or salty foods. When stressed, individuals also tend to eat more "snacks" (Oliver & Wardle, 1999) and foods higher in fat (McCann, Warnick, & Knopp, 1990). Research has also shown that stressed individuals who tend towards emotional eating prefer foods higher in fat (Oliver, Wardle, & Gibson, 2000). Among youth, stress is associated with more fatty food intake and more snacking (Cartwright et al., 2003).

However, these studies differ from the current study in two important ways. First, the majority of studies examining stress and diet are conducted among adults (e.g., Kandiah et al., 2008; Oliver et al., 1999; Oliver et al., 2000). In contrast, the current study focused entirely on elementary school-aged children. Nevertheless, results of the current study remain surprising, as one might expect that parents of children who experienced considerable stress were also stressed themselves. As discussed previously, stressed adults tend to eat unhealthy foods, and parents strongly influence their children's eating behaviors as they are both models and supporters of health behaviors for their children (Epstein, Valoski, Wing, & McCurley, 1990).

In addition, when *youth* have been examined in studies connecting stress and unhealthy diet, measures of stress have focused on generalized stress patterns and coping styles. For example, Cartwright and colleagues (2003) asked youth: "How often have you felt you couldn't control important things in your life?" In contrast, the current study asked about specific, concrete stressful events: "Is one of your parents now out of a job because of the hurricane?" Thus, it is possible that past studies linking stressors and diet have found significant findings because of the populations used (i.e., adults) or because they asked about generalized stress patterns, rather than specific stressors and stress levels.

Similar to concerns about the conceptualization and measurement of stressors, the measurement of unhealthy diet may have impacted the findings. Future research should conduct validation studies examining the validity of this measure of unhealthy diet and alternative measures of unhealthy diet for use with children after disasters. This would provide valuable information about how to capture the most nuanced or accurate picture of children's unhealthy diet after disasters. For example, it may be useful to collect parent reports of unhealthy diet, as parents may be the best informants of children's diet (Corder et al., 2008).

In addition, this study may have obtained null findings because it was conducted eight months post-disaster. It is possible that the use of "comfort foods" may have increased initially, immediately after Hurricane Ike. However, by eight months post-disaster, unhealthy food levels may have reduced to a more average level. Future research must address this issue through multiple measurements of stress and dietary behaviors at multiple timepoints post-disaster.

Null findings for a link between stressors and unhealthy diet may have also been obtained because the population in the current study was composed of predominantly low-income, ethnically diverse children. Levels of unhealthy eating may have already been high pre-disaster and thus may not have changed after the disaster. However, without information about children's pre-disaster eating behaviors in the current study, this question remains unanswered. Future studies should collect information about children's pre-disaster eating behaviors to address questions about changes in eating behaviors.

An alternative explanation for the current study's null findings is that the link between stress and unhealthy diet may be moderated by other variables that were not measured in the current study. For example, people may have different physiological responses to stress that link stress with unhealthy diet. Epel and colleagues (1998) found that when stressed, only high cortisol reactors consumed more calories. Low cortisol reactors consumed similar amounts of calories during stressful conditions and during control conditions. In addition, different types of children may have different dietary reactions to stress. Roemmich and colleagues (2002) found that when stressed, only children who are "dietary restrainers" increased their snacking activity. Collecting information on physiological reactions and dietary styles in future research may be necessary in order to be better able to understand whether certain children may be more susceptible to stress reactions involving dietary behaviors.

Covariates and unhealthy diet. In addition to the main findings, African American children reported higher levels of unhealthy diet than White children. This is in keeping with past literature showing that African American youth eat more unhealthy foods that White youth (Mackey & La Greca, 2007; Nicklas et al., 2003). Interventions for unhealthy diet post-disaster should attempt to recruit African American children, as these initial results provide evidence that African American children may be at higher risk for engaging in unhealthy diet behaviors after exposure to disasters.

Testing Hypothesis 2: Stressors and sedentary activity. Overall, one of the most persuasive findings from the current study is that, consistent with hypotheses, stressors are positively related to children's sedentary activity levels post-disaster. These results are consistent with the literature linking stressors and sedentary activity (Ng &

Jeffrey, 2003). Findings indicate that children with higher levels of exposure stressors following a disaster and with higher levels of recovery stressors may be more at risk for engaging in sedentary activity.

The current study also examined indirect relationships from exposure stressors to sedentary activity. Specifically, results showed that both actual life threat and perceived life threat are indirectly related to sedentary activity through recovery stressors, also consistent with hypotheses.

Findings related to indirect effects of exposure stressors to sedentary activity indicate that both objective stressors (i.e., actual life threat) and the perception of stressors (i.e., perceived life threat) are related to sedentary activity. It may be that children who had more actual life stressors were also more likely to live in an area or attend a school that was heavily impacted by Hurricane Ike. There may have also been more damage to their homes and neighborhoods, limiting the number of safe outdoor play spaces (Associated Press, 2008). This issue particularly affects elementary-aged children because their primary physical activity involves play (Farley et al., 2007; Sallis et al., 1993). In addition, disasters may destroy toys (e.g., bikes, scooters) and limit the time and resources available for children to play. Thus, children may have engaged in more sedentary behavior because they had fewer opportunities to engage in more active pursuits. Anecdotally, during testing, the researchers had the opportunity to spend time in the areas surrounding the schools where testing took place, eight months post-disaster.

The neighborhoods were still in disarray, with large piles of trash on residential streets, homes in the various stages of repair (and some in only the very initial stages of repair), and broken streetlights across the entire city.

In addition, children with higher levels of perceived life threat may also be children who had more exposure to the storm and who therefore may be more vulnerable to stress reactions. Future research should focus on identifying objective exposure stressors or the impact of these stressors on homes and neighborhoods, and should also focus on identifying the perception of life threat in order to better understand which children may be at risk for engaging in higher levels of sedentary activity.

In order to address some of these issues, schools and parks may want to consider rebuilding gyms and playgrounds quickly after disasters. For children in Galveston, some schools were so overcrowded that their gym classes took place in the cafeteria for an entire academic year following Hurricane Ike (S. Howell, personal communication, September 15, 2009). Although playgrounds and gyms may seem to be an afterthought in the stressful recovery period following a disaster, rebuilding and opening play spaces may help children return to normal roles and routines more quickly following a disaster, a practice recommended by the American Psychological Association (2010). Nevertheless, these changes may be difficult to implement if homes and schools are still in disrepair after disasters.

Sedentary activity should continue to be studied in future research, as sedentary behavior may have long term health consequences. Sedentary activity is related to higher adult morbidity and mortality (Must & Tybor, 2005; Utter et al., 2003). The current study findings have important clinical implications for understanding how children react to disasters. Parents, schools, and pediatricians should carefully consider and ask about children's sedentary activity post-disasters, as findings indicate that children who are exposed to more stressors may be at risk for engaging in more sedentary activity post-disaster.

Covariates and sedentary activity. Overall, boys reported higher levels of sedentary activity. This finding is consistent with past research showing that among elementary school children, boys engage in more sedentary activity than girls (Berkey et al., 2000). In addition, African American and Hispanic children engaged in more sedentary activity than White children, also consistent with past research among children (Anderson et al., 1998; CDC, 2004) and adolescents (Dowda et al., 2004). These findings imply that boys, African American children, and Hispanic children, may be especially at risk for engaging in sedentary activity after a disaster. Thus, interventions for sedentary activity should recruit boys, African American children, and Hispanic children. Interventionists should also consider ways to tailor exercise interventions for use with these populations.

In addition to direct relationships between covariates and sedentary activity, there were significant indirect effects from African American ethnicity, Hispanic ethnicity, and gender to sedentary activity through recovery stressors. Interestingly, the indirect effect from gender to sedentary activity was positive, indicating that *girls* are at risk for engaging in more sedentary activity when recovery stressors are taken into account. These findings imply that levels of recovery stressors may be a mechanism linking minority status and gender with sedentary activity. Thus, schools and parents should be made aware that monitoring levels of recovery stressors is important, as it may provide additional clues about which children are at risk for engaging in higher levels of sedentary activity.

Testing Hypothesis 3a: Linking stressors and PTS Symptoms. Consistent with study hypotheses, there was an indirect relationship from disaster exposure stressors to PTS symptoms through recovery stressors. This finding is in keeping with the literature on children after natural disasters. For example, La Greca and colleagues (in press) reported similar relationships between exposure stressors, recovery stressors, and PTS symptoms among children following Hurricane Charley. The current study's findings indicate that children who experience both high levels of disaster exposure stressors and high levels of recovery stressors are most at risk for developing PTS symptoms eight months post-disaster.

However, contrary to study hypotheses, there was not a direct relationship between perceived and actual life threat and children's PTS symptoms. Thus, findings suggest that recovery stressors are a potential full mediator of the relationship between exposure stressors and PTS symptoms in the current sample. Past research has shown that exposure stressors uniquely predict PTS symptoms after disasters (La Greca et al., in press; La Greca et al., 1996; Yelland et al., 2010). It may be that perceived and actual life threat were not significantly directly related to PTS symptoms in the current study because so many of the children in this study evacuated the island. Thus, they were not in imminent danger, and did not perceive themselves to be in imminent danger, as shown by the lower levels of children who endorsed perceived life threat relative to other disaster studies (e.g., La Greca et al., 1996, 1998; Yelland et al., 2010). Studies showing direct relationships between exposure stressors and PTS symptoms have been conducted among populations of children where fewer percentages of children evacuated (e.g., La Greca et al., in press), and rates of perceived life threat were much higher.

In addition, past studies showing a direct relationship between exposure stressors and PTS symptoms were conducted with samples of children exhibiting higher levels of PTS symptomatology, as measured by their reports of children meeting criteria for symptom clusters on the *Reaction Index* measure (e.g., La Greca et al., 1996; La Greca et al., in press). Thus, again, the sample of children examined in the current study may differ from children examined in other natural disaster studies.

Covariates and PTS symptoms. With regards to ethnicity and gender, the current study's results showed that ethnicity and gender were significantly and indirectly related to PTS symptoms, consistent with hypotheses. Direct relationships from ethnicity to PTS symptoms were not significant, contrary to hypotheses.

These findings imply that higher levels of recovery stressors may be the mechanism linking minority status and female gender to PTS symptoms. Thus, this research is in keeping with hypotheses from other researchers, which have noted although higher levels of PTS symptoms have been reported by girls and by ethnic minority children, this may be accounted for by the fact that these groups also experience higher levels of recovery stressors (e.g., Shannon et al., 1994; Silverman & La Greca, 2002). Findings from the current study support this idea and may help explain the mixed findings in the larger literature on disasters, where some studies have shown that children of ethnic minorities (La Greca et al., 1998; see Norris et al., 2002 for a review) and girls (e.g., Weems et al., 2007) show more PTS symptoms, and other studies have reported no ethnic or gender differences several months post-disaster (Jones et al., 2001; La Greca et al., 1996; Pina et al., 2008).

These findings have important implications. Future research should account for levels of recovery stressors when examining relationships between minority status, female gender, and PTS symptoms, as these findings implicate recovery stressors as a potential mediator of this relationship. Clinical implications of these findings suggest that in designing interventions for decreasing PTS symptoms, researchers should be careful to include girls and children of African American or Hispanic ethnicity, as these groups are at risk for reporting higher levels of PTS symptoms. Further, findings suggest that reducing the number of recovery stressors that children experience would be a fruitful area to target in future interventions.

Testing Hypothesis 3b: Physical activity moderates the relationship between recovery stressors and PTS symptoms. The subsample used in moderation analyses (i.e., the sample with information for all variables) was a sample with fewer disaster and other life stressors, fewer minority children, and less sedentary activity than the sample with missing data. Thus, the analyses of this subpopulation must be interpreted with caution.

For the sample with all data, physical activity did not attenuate the relationship between recovery stressors and PTS symptoms, contrary to hypotheses. These results are also in contrast to findings showing that physical activity attenuates the relationship between stress and anxiety (see Salmon, 2001 for a review).

First, null findings may have been obtained because the current study did not take an active intervention approach for physical activity. Past research that has shown that physical activity attenuates the relationship between stress and PTS symptoms has been conducted with active intervention designs (e.g., Diaz & Motta, 2008; Manger & Motta, 2005; Motl et al., 2004). For example, Manger and Motta (2005) conducted an active intervention which required participants to complete a 10 minute warm up, 30 minutes of walking or jogging at moderate intensity for 2 to 3 times a week for 10 weeks. Future studies should examine interventions that compare physical activity interventions to control groups.

A second explanation for these null findings is that power was limited in our LMS approach for these analyses. The LMS approach was a strength of the current study, as it allowed analyses to be conducted that incorporated a latent variable for recovery stressors and also took advantage of the full range of information available related to physical activity. However, this approach decreased power for these analyses. The LMS approach required that all children have information for all variables studied, thus reducing the sample size. Although this limited power, the significance value for the interaction effect was not close to significance, indicating that increasing power in this case would not likely affect study findings. Future studies should obtain full information for all participants on all measures and try to recruit larger samples to address limitations of an LMS approach.

Third, null findings may have been obtained due to problems with the measurement of physical activity. This study is the first to measure physical activity after a disaster, and this represents a strength of the study. However, it is possible that children may have struggled with the "language" of physical activity. This point is discussed in further detail below. Future research should consider alternative measurements of physical activity in order to replicate these findings.

Future studies should continue to consider whether physical activity may attenuate PTS symptoms after disasters. Physical activity interventions remain a promising avenue for interventions as these types of interventions could be implemented at low cost and with little training. Such interventions have the potential to help reduce health care costs associated with disasters.

Covariates and physical activity. In the current study, weight was positively related to physical activity. These findings are in contrast to the larger literature on weight and physical activity, which has consistently shown a negative relationship between weight and physical activity (e.g., Eisenmann et al., 2002; Patrick et al., 2004; Steinbeck, 2001). Findings may indicate a lack of validity in the physical activity measure. Future research should consider test the validity of this measure for use with children post-disasters and also test the validity of alternative measures of physical activity. No other covariates were significantly related to physical activity.

Follow up analysis: Testing sedentary activity as a moderator of the relationship between recovery stressors and PTS symptoms. Given the possible problems related to the measurement of physical activity, sedentary activity was also tested as a possible mediator of the relationship between recovery stressors and PTS symptoms. However, sedentary activity did not moderate this relationship.

There are several possible explanations for these null findings. First, it may be that sedentary activity does not moderate the relationship between stressors and PTS symptoms. This relationship has not been studied in past research. Second, although it has been reported that physical activity attenuates PTS symptoms, it does not necessarily follow that sedentary activity might show these same properties, as sedentary and physical activity are not necessarily two ends of a continuum. Third, again, although the LMS approach for testing moderation with a latent variable is a strength of this study, it also limited power. Future studies should make efforts to increase power (e.g., obtain full information on all variables, or obtain larger samples).

Follow-up Analysis: PTS symptoms mediate the relationship between recovery stressors and sedentary activity. Disaster exposure and recovery stressors were indirectly related to sedentary activity through PTS symptoms. These results are consistent with PTS symptoms as a mediator of this relationship, and in keeping with the larger literature linking PTS symptoms with negative health behaviors in adults (Brewerton, 2007; Ciechanowski, Walker, Russo, Newman, & Katon, 2004; Lang et al., 2003). For example, Lang and colleagues (2003) reported that PTSD mediated the relationship between sexual trauma and substance use, risky sexual behaviors, and preventative health behaviors. The current study is notable in that it is the first, to our knowledge, to find these associations among children. Findings from the current study suggest that children with PTS symptoms should be monitored as they may exhibit higher levels of sedentary activity. Further, additional health risk behaviors should be considered as potential avenues for future research, as children with higher levels of PTS symptoms may also be more likely to engage in other health-risk behaviors (e.g., smoking, drinking).

Summary of main analyses. Thus, findings of this study, conducted eight months post-disaster, have numerous implications. First, researchers should consider and continue to measure health behaviors of children following disasters. This may be especially important to consider among children who are exhibiting higher levels of PTS symptoms, as these children are also tend to exhibit higher levels of sedentary activity. Second, these findings suggest that PTS symptoms may be a mechanism driving the relationship between recovery stressors and sedentary activity. These findings should be replicated and extended in future research.

Feasibility of Collecting Height, Weight, and Health Behavior Information

This study also provided important information about the feasibility of collecting height and weight data and health behavior data among older elementary school-aged children. This information has implications for researchers who work with elementary school children in general. In addition, this information is especially important for designing research studies that take place after a disaster. After a disaster, the recovery period is often chaotic, and schools, families, and children are often distressed. Given that researchers are working with an already distressed population, researchers should strive to minimize the additional burden research places upon schools (La Greca, 2006).

After a disaster: Measuring height and weight. Children in the current study were able to accurately and reliably report their weight. In contrast, children were consistent, but not accurate, reporters of their height. These results present helpful information for researchers, as little research exists on whether self-reported height and weight data is valid among older elementary school-aged children, ages 8 to 10 years. Among even older youth, research on the validity of self-reported height and weight has been mixed. Some studies have shown that young adolescents are valid reporters of both height and weight (Goodman, Hinden, & Khandelwal, 2000). However, adolescent boys from higher SES backgrounds may over-report their height (Wang & Beydoun, 2007). Studies have also shown that obese adolescents underreport their weight (Sherry, Jefferds, & Grummer-Strawn, 2007), as do adolescent girls (Himes, Hannan, Wall, & Neumark-Sztainer, 2005). However, as no known researchers have attempted to test the validity of self-reported height and weight data for elementary school aged children, ages 8 to 10 years, the current study fills a crucial gap in our knowledge about the feasibility of collecting children's height and weight information.

These findings have important implications for future research. Though in need of replication, current findings indicate that when studying older elementary school-aged children, ages 8 to 10 years, investigators may ask children for self-reported weight, but children's heights should be directly measured. These findings have the potential to reduce the burden of collecting biometric information in school settings, as obtaining measurements of actual weight require that research personnel individually measure each child in a private space away from areas where main study measures are completed. In addition, findings imply that children are unable to accurately self-report their heights. Questions about height may be removed from questionnaires, and children's heights should be measured biometrically. Of importance, height may be easily measured and does not appear to be sensitive information for children, in contrast to the apparent sensitivity of weight information. One way to accomplish this height measurement would be to measure children who have completed questionnaires before they return to their classrooms. Further, it is of note that children were consistent reporters of their height, although they were inaccurate. Thus, it may be possible to train children to be able to more accurately report their height.

After a disaster: Measuring diet and activity. Measures of unhealthy diet and sedentary activity exhibited good stability across time. However, the measure of physical activity was not stable over time, and other options for measuring physical activity may need to be explored. Past research on self-reported diet and activity measures have shown that children are able to validly self-report their diet, although younger children may struggle when asked about the more abstract concept of "average" intake (Field et al., 1999). Self-reported measures of sedentary activity levels have also been used with elementary school aged children (Myers et al., 1996). Findings regarding the validity of self-reported measures of physical activity among elementary school-aged children have been mixed, with some studies showing that self-report is valid (Sallis, Buono, Roby, Micale, & Nelson, 1993), and others showing that self-reported physical activity is not valid among elementary school-aged children (Pratt, Macera, Blanton, 1999; Treuth et al., 2004).

Findings related to the more questionable reliability of physical activity might be partially explained by children struggling with the levels of language comprehension and abstract reasoning required for the physical activity measure. The language of the physical activity measure was abstract (e.g., "an activity that made your heart beat fast and made you breathe hard") and may have been difficult for 3rd and 4th graders to understand. However, research assistants were on hand to explain the measures to any children who had difficulty, and all children appeared to comprehend the measure. In contrast, the language of measures of unhealthy diet and sedentary required low reading comprehension and referred to concrete situations such as times drinking soda, eating fast food, playing video games, and so on.

The findings have important implications for future research. Unhealthy diet and sedentary activity appear to be good measures of health behaviors and future studies should continue to explore the feasibility of using these measures with children post-disasters or in other research assessing children's health behaviors. However, future research should examine alternative physical activity measures that might rely less heavily on abstract reasoning and reading comprehension or that might train children to increase their comprehension of the measure. For example, "habit books" were used with children in the Bogalusa Heart Rate study, and children and their families were trained to count and mark time spent in physical activities (Myers et al., 1996). Alternative physical activity measures might include non self-report measures such as heart rate telemetry, accelerometers, or pedometers (Rowlands, Eston, & Ingledew, 1997).

Limitations and Future Directions

Although this study had several strengths, including recruiting children from all elementary schools in a geographic area heavily impacted by a large-scale natural disaster, this study also had several limitations. First, we did not have information about children's prior functioning. Children's prior health behaviors are likely to be related to their current health behaviors (Pugliese & Tinsley, 2007); without pre-disaster data, it is not possible to know if current levels are similar to or different from the children's pre-disaster behaviors. In future studies, it would be useful to obtain information about health behaviors prior to disasters. However, as has been noted by past disaster researchers, children's functioning prior to a disaster is very difficult to obtain, as the key feature of natural disasters is that they often strike suddenly and without notice (e.g., La Greca et al., 1998).

In the current study, attempts were made to ask children about how their diet and activity levels had changed from before the disaster to after the disaster. However, children struggled with this question and had great difficulty answering it. Thus, this measure was dropped from the study protocol due to the amount of time it took children to answer the question and their difficulty answering these questions. In addition, questions about healthy diet were examined, but children's reports showed little validity when correlations between healthy diet and covariates were examined. Thus, although attempts were made to collect additional information related to health behaviors, results exemplified some of the difficulties of collecting this type of information post-disaster and in children ages 8 to 10 years.

Second, the cross-sectional nature of the current study precluded an examination of the reciprocal influences of health behaviors and PTS symptoms. Although this study was a necessary starting point to begin to understand children's health behaviors after disasters, there are possible alternate causal paths. For example, stress could affect health behaviors, but it may also be that health behaviors affect stress. It is possible that children who were not leading a healthy lifestyle before the disaster could have experienced more stress during or after the hurricane. Future studies should consider longitudinal designs to further elucidate the causal pathways between stressors, PTS symptoms, and health behaviors. In the current study, the cross-sectional design prevented investigators from being able to test recovery stressors as a mediator, as causality could not be established. Longitudinal designs with multiple post-disaster measures over time would allow researchers to test recovery stressors as a mediator, and it would also allow investigators to examine changes in diet and activity over time and to be able to examine how these changes may relate to children's functioning.

A third limitation of the current study is that measures were based exclusively on child report, with the exception of measured height and weight data for 53 children at Time 2. This aspect of the current study's design was implemented because it offered several advantages: 1) youth are considered to be the best informants for PTS symptoms (Yelland et al., 2010), 2) utilizing child measures exclusively reduced the burden of this research protocol on schools, and 3) it allowed study investigators to examine the feasibility of using health behavior measures with children post-disasters. Results from the current study show promise for using these measures in future disaster studies. Nevertheless, utilizing children report exclusively introduces the possibility that shared method variance may be influencing findings. Future studies should obtain measures from multiple informants. This is especially important as parents may be better informants of children's eating or physical activity (Corder, Ekelund, Steele, Wareham, & Brage, 2008).

Fourth, the current study sample was drawn from an ethnically diverse, primarily low-income area. Although this ethnic diversity presents a strength of the current study, findings may not generalize to other ethnicities or to populations from higher income areas. Future studies are needed to replicate these findings in different settings with additional populations. In addition, the current study did not collect information related to socio-economic status for each child. Future studies should collect information about socioeconomic status, as past research has shown that low socioeconomic status is related to both unhealthy diet and sedentary activity (Wang & Tussing, 2004).

Finally, self-reported weight was used in the current study as a predictor variable. Future studies should utilize BMI percentile scores as a predictor variable, because BMI percentile scores are ratio scores calculated from height and weight that are normed and account for age and gender (CDC, 2010). However, in the current study it was not possible to calculate BMI percentile scores, as height data, which was self-reported, was not valid.

Although future studies should attempt to address these limitations, study design choices in the current study were made in order to minimize the burden that research would place on the schools, families, and children involved in the current study. Minimizing the burden of research is a crucial consideration for disaster studies that take place during the period of recovery after a disaster. Recovery periods post-disaster are often characterized by chaotic environments, school closures, and numerous other stressors (La Greca, 2006). The Galveston Independent School District was no exception, as the school district closed for one month following Hurricane Ike, and two elementary schools were closed indefinitely. Children from these schools were forced to attend consolidated schools in other locations (Galveston Independent School District, 2009). Given these considerations, researchers should avoid placing additional stressors upon already stressed populations. This may be accomplished by streamlining the teacher and parent burden of study designs, and limiting the amount of time researchers spend in schools.

In conclusion, the current study presents a crucial first step toward understanding the association between stressors, PTS symptoms, and health behaviors post-disasters. Findings highlight the feasibility of collecting weight and health behavior data after large-scale natural disasters. In addition, higher levels of recovery stressors are related to higher levels of sedentary activity among children post-disasters. Recovery stressors are a potential mediator of the relationship between disaster exposure stressors and sedentary activity. Findings of the current study have important implications for the assessment of health behaviors after disasters and point to possible interventions for children. Findings also paint a more comprehensive picture of children's functioning following disasters. Future studies may extend these findings by collecting information about children's health behaviors prior to disasters and by collecting information about how health behaviors change over time. Results from the current study are promising and suggest that more information is needed on children's health behaviors after natural disasters.

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TABLES

Table 1: *Means and Standard Deviations of Study Variables.*

Variables (with possible scores)	Boys (n = 96)	Girls (n = 108)	Total (n = 204)
Demographics			
Age T1	9.24 (.84)	9.22 (.74)	9.23 (.79)
Self-reported Weight T1*	73.82 (22.20)	82.12 (26.78)	78.43 (25.12)
Self-reported Weight (no outliers) T1*	77.50 (17.80)	84.59 (24.52)	81.48 (22.04)
Self-reported Weight T2†	84.74 (25.03)	99.48 (30.23)	92.81 (28.74)
Actual Weight T2**	85.56 (17.88)	106.08 (33.02)	97.17 (29.14)
Exposure Stressors			
Perceived Life Threat T1 (0 – 1)	.31 (.47)	.30 (.46)	.31 (.46)
Actual Life Threat T1 (0 – 6)	.73 (.88)	.72 (.86)	.72 (.86)
Recovery Stressors			
Initial Loss/Disruption T1 (0 – 10)**	3.07 (2.06)	3.87 (2.07)	3.49 (2.10)
Ongoing Loss/Disruption T1 (0 – 6)	1.41 (1.33)	1.76 (1.98)	1.60 (1.70)
Life Events T1 (0 – 14)†	1.38 (1.33)	1.75 (1.82)	1.57 (1.62)
Continuous Outcomes			
Unhealthy Diet T1 (0 – 20)	6.61(4.72)	6.16 (4.70)	6.37 (4.71)
Physical Activity T1 (0 – 21)	8.90 (4.27)	8.18 (3.55)	8.52 (3.91)
Sedentary Activity T1 (0 – 18)***	7.04 (4.87)	4.92 (4.12)	5.91 (4.60)
PTS symptoms T1 (0 – 68)*	20.65 (13.88)	25.05 (14.43)	22.97 (14.31)

Note: T1 = Time 1; T2 = Time 2. Significant differences denoted between boys and girls.
$^{\dagger}p \leq .10$. $^{*}p \leq .05$. $^{**}p \leq .01$. $^{***}p \leq .001$.

Table 2: *PTS Symptom Clusters (Based on the Reaction Index-Revised) Among All Children in the Current Study (N = 204).*

	8 months post-disaster
PTSD symptom clusters	
A. Reexperiencing T1	
n (and %) that met criteria	89 (44%)
M (and *SD*)	.92 (1.32)
B. Avoidance – psychic numbing	
n (and %) that met criteria	36 (18%)
M (and *SD*)	1.16 (1.35)
C. Hyperarousal	
n (and %) that met criteria	67 (33%)
M (and *SD*)	1.22 (1.27)
All three symptom clusters	
n (and %) that met criteria	24 (12%)

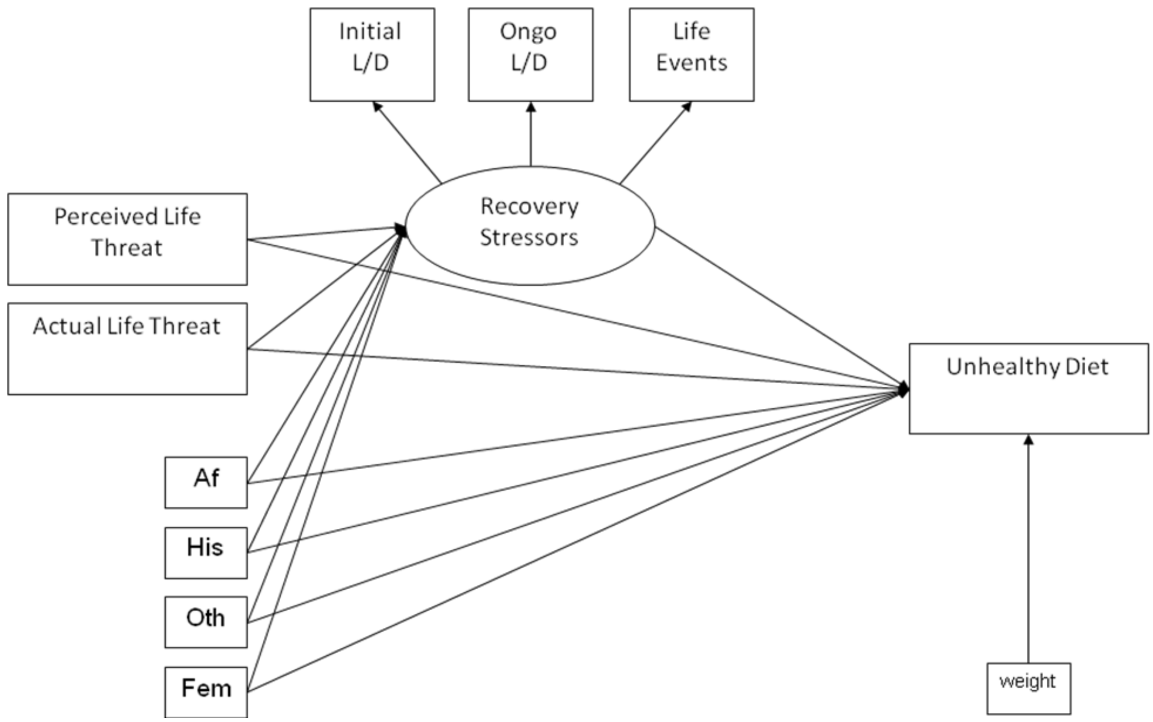
Table 3: *Correlations Among Study Variables.*

	1	2	3	4	5	6	7	8	9	10	11	12
1. Age	--											
2. Female	-.01	--										
3. Weight (Outliers Removed)	.31	.16*	--									
4. Perceived Life Threat	.15	-.01	.21	--								
5. Actual Life Threat	-.03	-.01	.10	.21**	--							
6. Initial Loss/Disruption	.10	.19**	.09	.16*	.35***	--						
7. Ongoing Loss/Disruption	.00	.10	.05	.17*	.29***	.48***	--					
8. Major Life Events	-.05	.12	.13	.25***	.37***	.41***	.16*	--				
9. PTS symptoms	-.02	.15*	.05	.22**	.29***	.46***	.21**	.47***	--			
10. Unhealthy Diet	.01	-.05	-.05	.04	.11	.11	.00	.15*	.22**	--		
11. Physical Activity	.20	-.09	.13	.06	-.03	-.01	.02	.05	.04	.15*	--	
12. Sedentary Activity	.06	-.23**	.13	.13	.15*	.19**	.10	.21**	.32***	.33***	.11	--

*p<.05, **p<.01, ***p<.001

FIGURES

Figure 1: *Hypothesis 1, Hypothesized model for stressors and unhealthy diet.* All exogenous variables were assumed to be correlated.



Key for all figures:

L/D = Loss/Disruption
Ongo = Ongoing
Fem = Female
Af = African American
His = Hispanic
Oth = Other

Figure 2: *Hypothesis 1, Final model for stressors and unhealthy diet.* Significant paths and loadings ($p < .05$) are denoted by bold lines. Unstandardized path coefficients are listed, followed by standardized path coefficients in parentheses. All exogenous variables were assumed to be correlated and covariates are described in the results section in order to reduce clutter.

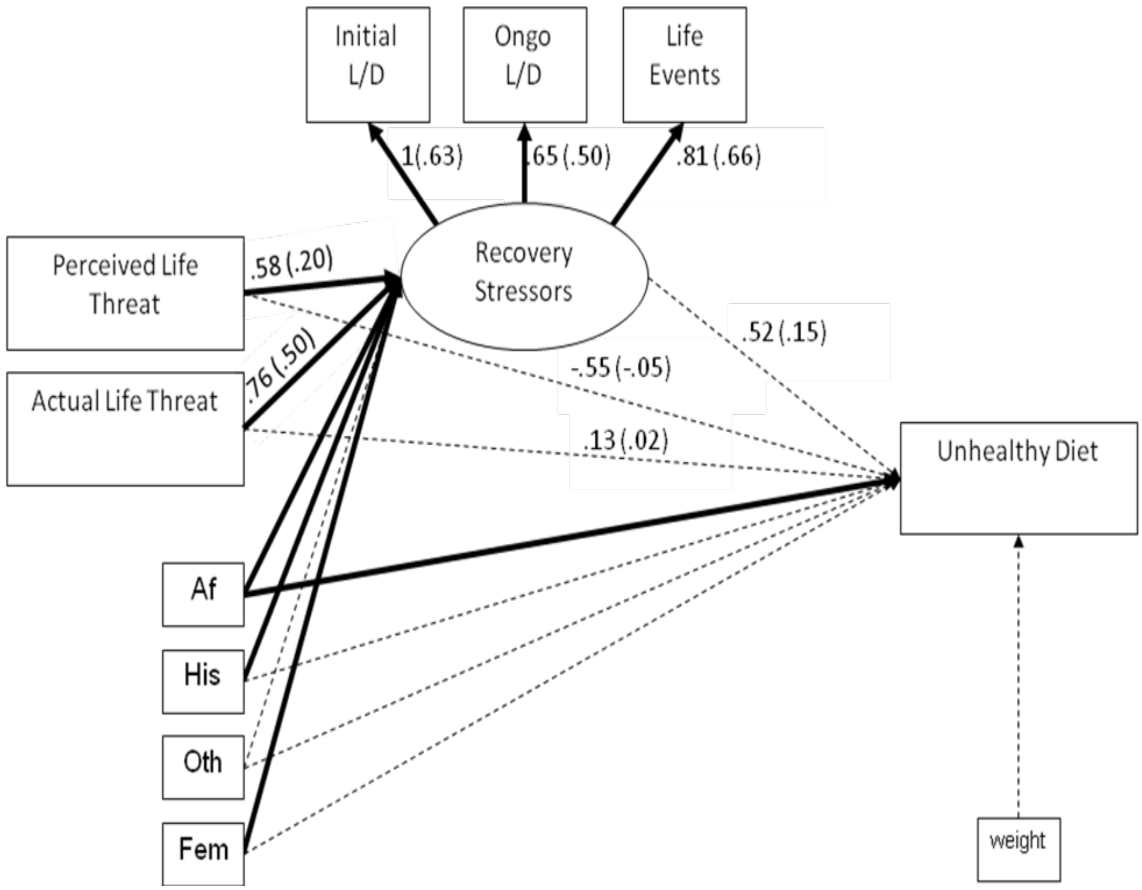


Figure 3: *Hypothesis 2, Hypothesized model for stressors and sedentary activity.* All exogenous variables were assumed to be correlated.

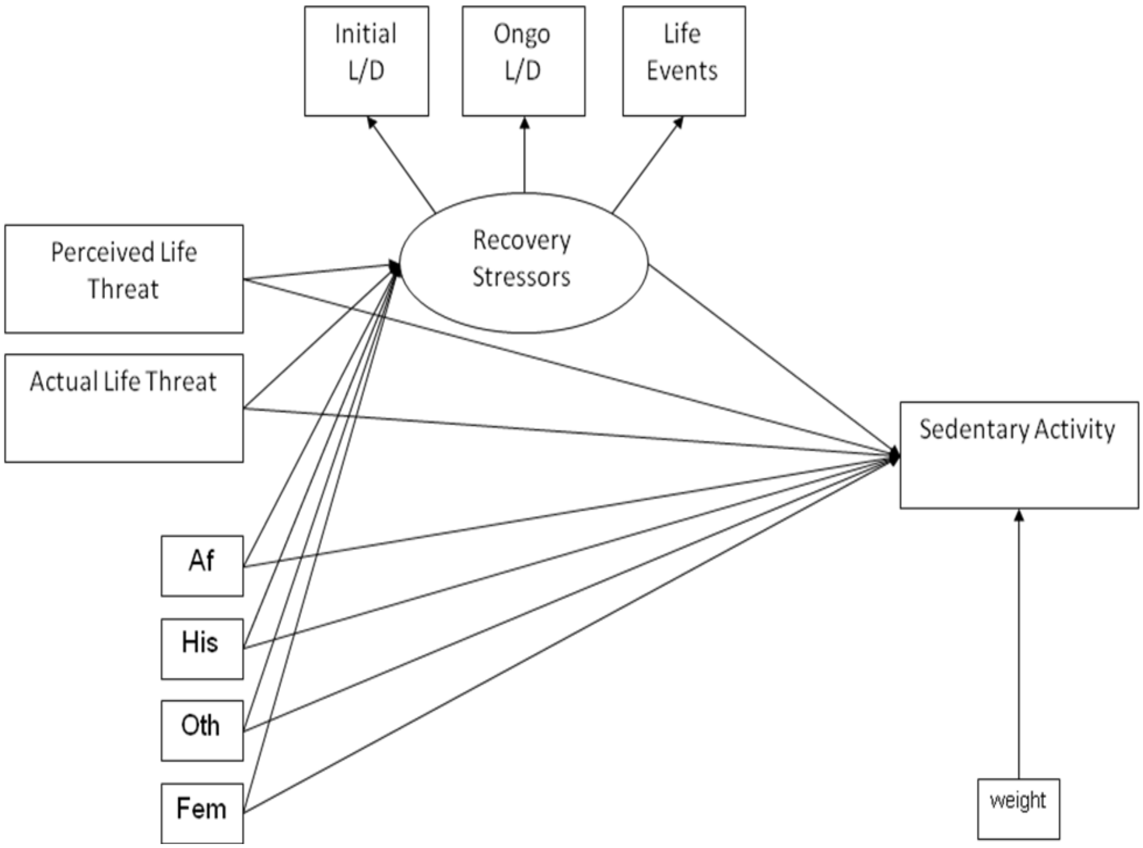


Figure 4: *Hypothesis 2, Final Model for stressors and sedentary activity.* Significant paths and loadings ($p < .05$) are denoted by bold lines. Unstandardized path coefficients are listed, followed by standardized path coefficients in parentheses. All exogenous variables were assumed to be correlated and covariates are described in the results section in order to reduce clutter.

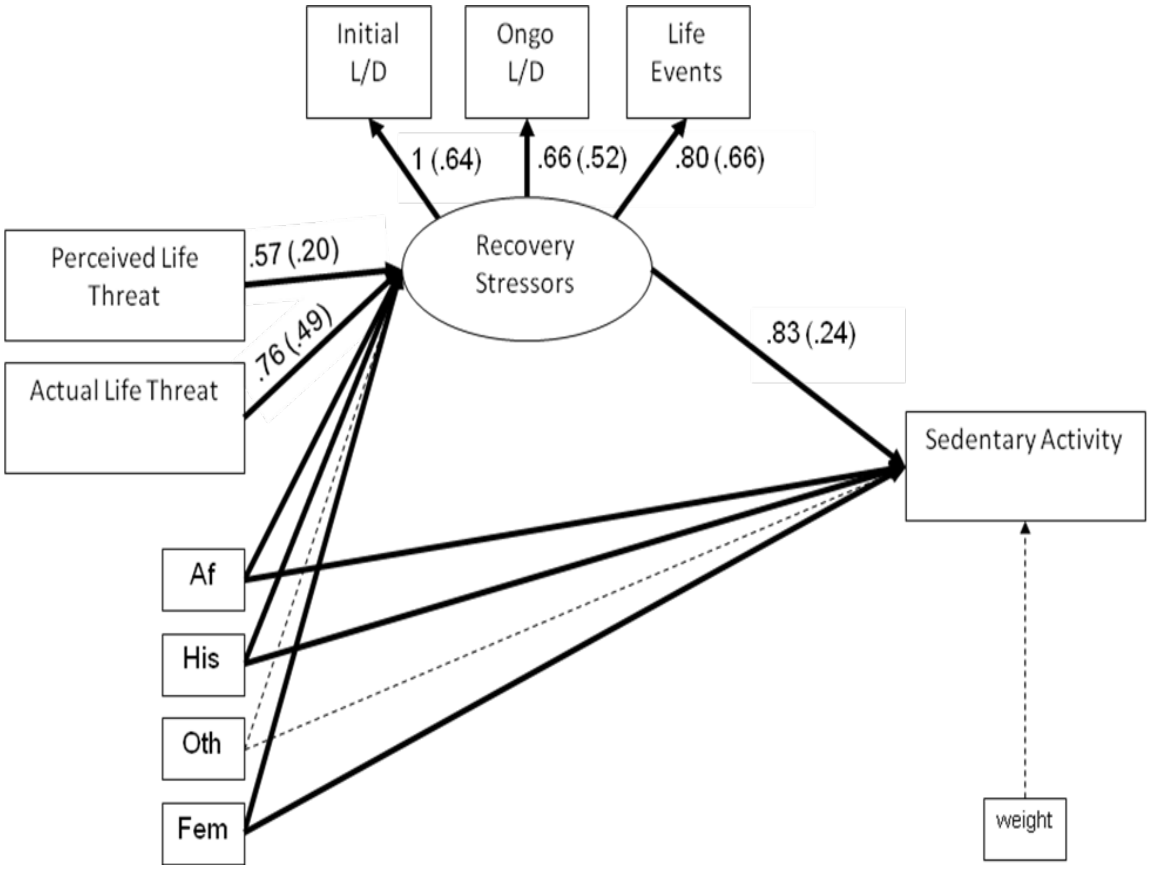


Figure 5: *Hypothesis 3a, Hypothesized model for stressors and PTS symptoms.* All exogenous variables were assumed to be correlated.

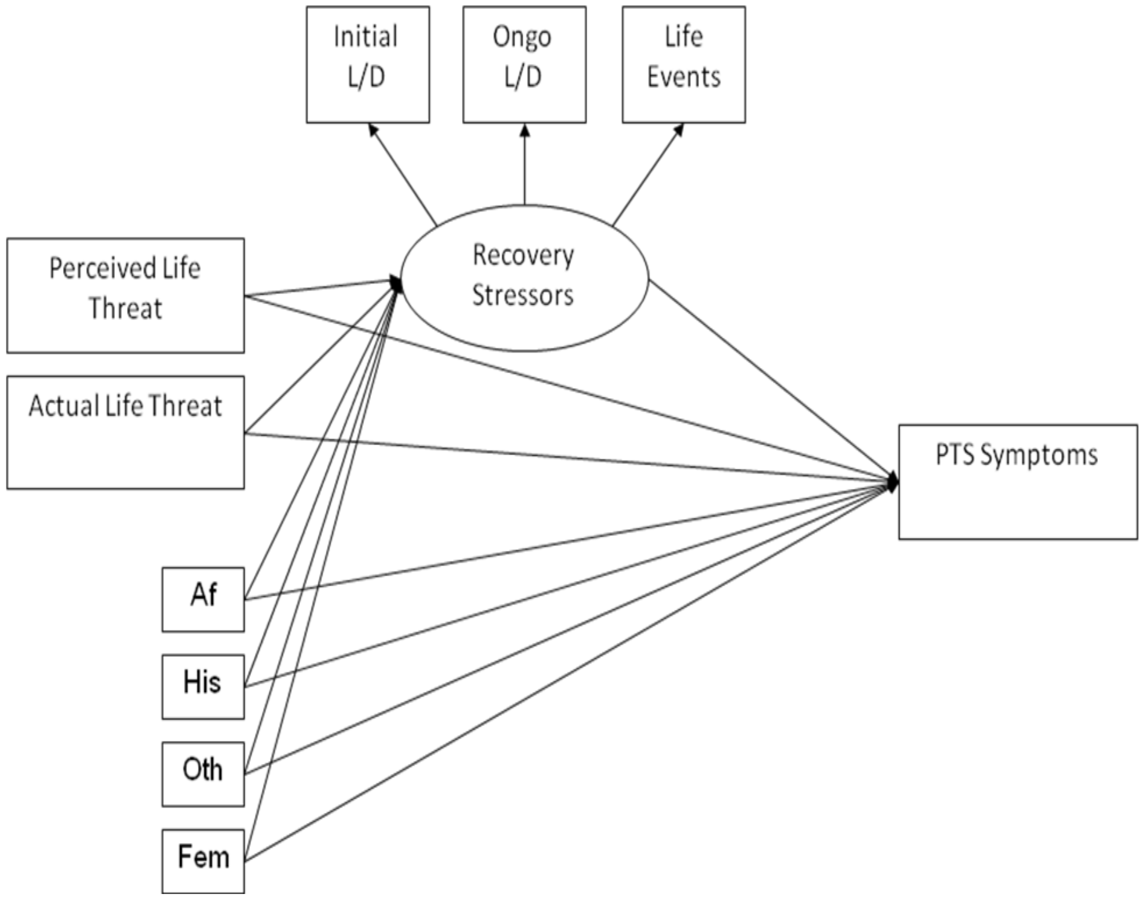


Figure 6: *Hypothesis 3a, Final model for stressors and PTS symptoms.* Significant paths and loadings ($p < .05$) are denoted by bold lines. Unstandardized path coefficients are listed, followed by standardized path coefficients in parentheses. All exogenous variables were assumed to be correlated and covariates are described in the results section in order to reduce clutter.

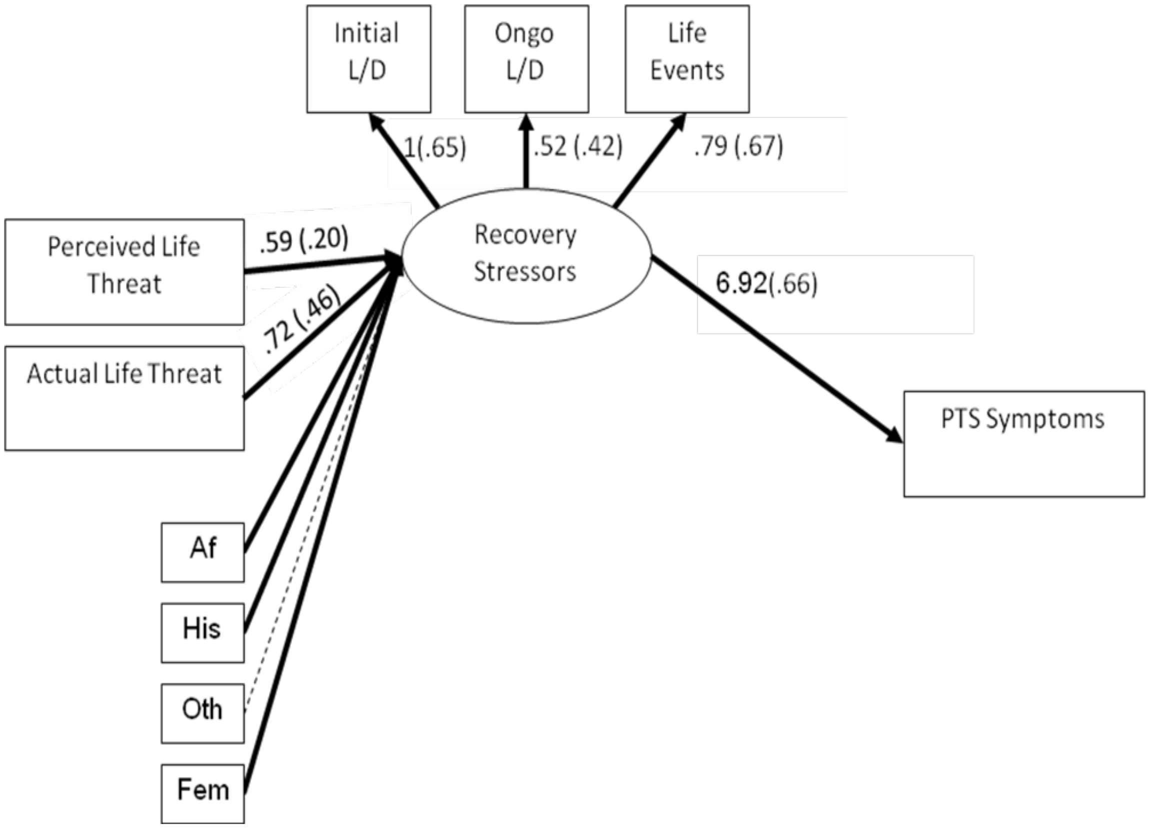


Figure 7: Hypothesis 3b: Physical activity as a moderator of the relationship between stressors and PTS symptoms: Physical Activity. Significant paths and loadings ($p < .05$) are denoted by bold lines. All values are unstandardized; standardized coefficients are not available for latent moderated structural equation models. All exogenous variables were assumed to be correlated and covariates are described in the results section in order to reduce clutter.

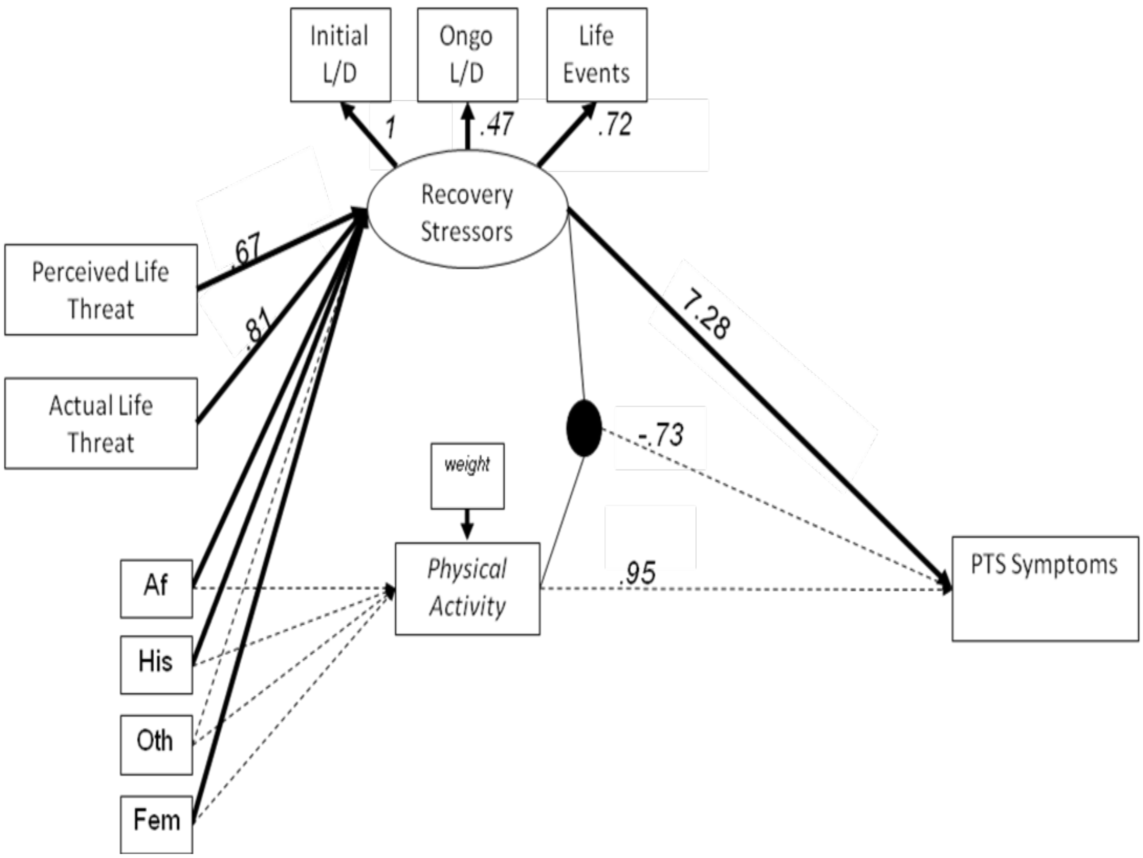
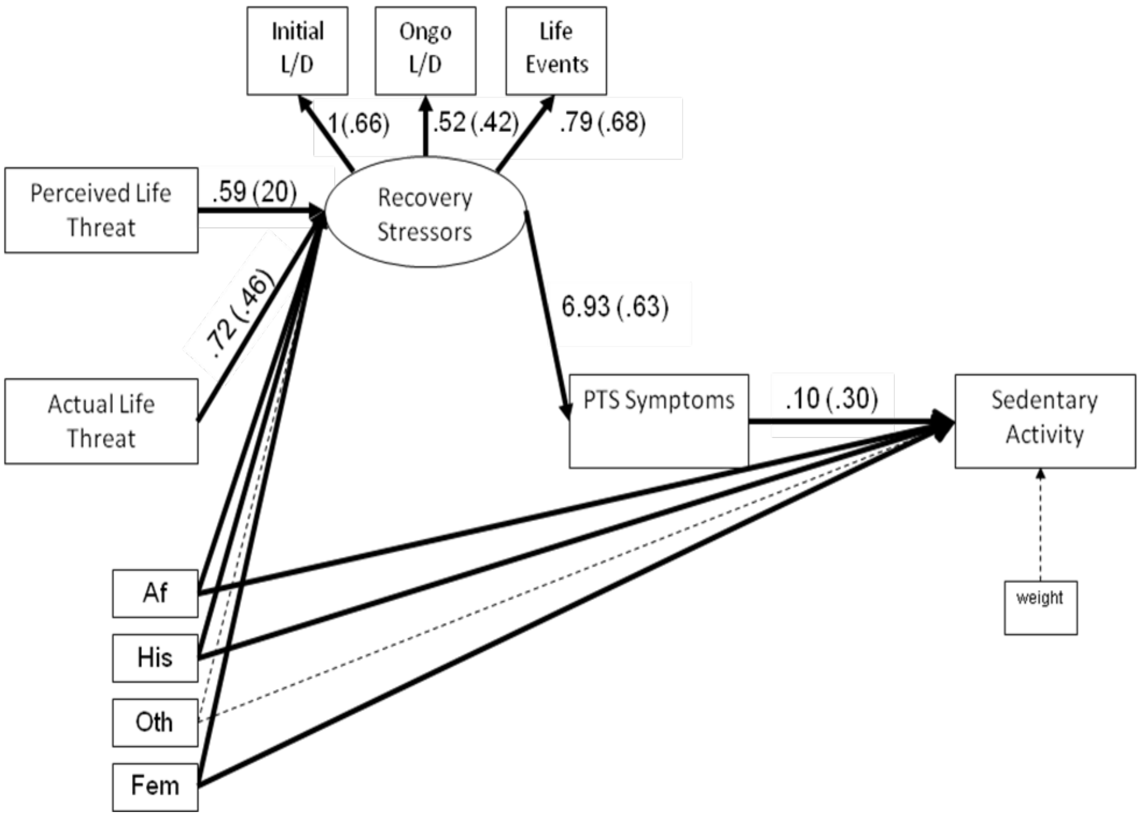


Figure 8: *Follow-up Analyses: PTS symptoms and Sedentary Activity.* Significant paths and loadings ($p < .05$) are denoted by bold lines. Unstandardized path coefficients are listed, followed by standardized path coefficients in parentheses. All exogenous variables were assumed to be correlated and covariates are described in the results section in order to reduce clutter.



APPENDICES:
STUDY MEASURES

APPENDIX A:
Child Demographics

Are you a boy or girl?		BOY		GIRL					
Grade :	2	3	4						
School:	L.A.Morgan		Oppe		Parker		Rosenberg		
Scott									
Is this the same school you were in last year? ☐Yes ☐No									
Teacher: ______________________________									
Birthdate:	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct
	Nov	Dec							
		Day: _______		**Year**:	1999	2000	2001	2002	
	Other________								
Age: _______									

Who <u>currently</u> lives with you at home?

_____ Mother _____Brother/Sister (Age: _______)

_____Father _____Brother/Sister (Age: _______)

_____Stepmother _____Brother/Sister (Age: _______)

_____Stepfather

_____Other (Specify: ______________________)

Who did you live with at home <u>before the hurricane</u>?

_____ Mother _____Brother/Sister (Age: _______)

_____Father _____Brother/Sister (Age: _______)

_____Stepmother _____Brother/Sister (Age: _______)

_____Stepfather

_____Other (Specify: ______________________)

Were you born in the United States?

☐Yes ☐No → I was born in ___________________

What is/are your ethnicity (race)?

☐ White (Not Hispanic)
☐ Hispanic (Cuban, Colombian, Nicaraguan, Mexican, other)
☐ African-American or Black (Not Hispanic)
☐ Caribbean-American (Haitian, Jamaican, other)
☐ Asian
☐ Mixed Ethnicity / Other (Please describe)

____

What was the first language you learned to speak?	☐ English	☐ Spanish	☐ Other: ____________
What language do you use the most now?	☐ English	☐ Spanish	☐ Other: ____________
What language do your parents speak at home?	☐ English	☐ Spanish	☐ Other: ____________

What is your current:
Weight (in pounds)__________________
Height: ______feet ____ inches

APPENDIX B: HURTE-R

What Happened To You ***During*** the Hurricane?

1. **Where were you during the Hurricane?**

(you can check more than one) ✓

______ in my home	______ in a bathroom
______ in a friend's or relative's home	______ in a hallway
______ in a shelter	______ in a car
______ out of town	______ other
______ in a closet	(describe)____________________

**Please circle one answer for each question.*

2.	**Did windows or doors break in the place you stayed during the Hurricane?**	Yes	No
3.	**Did you get hurt during the Hurricane?**	Yes	No
4.	**At any time during the Hurricane, did you think you might die?**	Yes	No
5.	**Did you see anyone get hurt badly during the Hurricane?**	Yes	No
6.	**Did you have to go outside during the Hurricane because the building you were in was badly damaged?**	Yes	No
7.	**Did a pet you liked get hurt or die during the Hurricane?**	Yes	No
8.	**Did you get hit by anything falling or flying during the Hurricane?**	Yes	No
9.	**Was your mother or father with you during the Hurricane?**	Yes	No
10.	**Did you think someone might die during the Hurricane?**	Yes	No
11.	**Did you think you might be hurt badly during the Hurricane?**	Yes	No
12.	**Did you think someone might be hurt badly during the Hurricane?**	Yes	No
13.	**Overall, how scared or upset were you *during* the Hurricane?** Not at all A little A Lot A Whole Lot		

HURTE- *After*

What Happened to you* after *the Hurricane?

Instructions: *Think about how many of the things listed were present and/or happened in the first month or two after the Hurricane.*

1.	Was your home damaged badly or destroyed by the Hurricane?	Yes	No
2.	Did you have to go to a new school because of the Hurricane?	Yes	No
3.	Did you move to a new place because of the Hurricane?	Yes	No
4.	Did one of your parents lose his or her job because of the Hurricane?	Yes	No
5.	Has it been hard to see your friends since the Hurricane because they moved or you moved?	Yes	No
6.	Did you or your family have trouble getting enough food and water after the Hurricane?	Yes	No
7.	Were your clothes or toys ruined by the Hurricane?	Yes	No
8.	Did your pet run away or have to be given away because of the Hurricane?	Yes	No
9.	Has anyone stolen anything from your home since the Hurricane?	Yes	No
10.	Did you have to live away from your parents for a week or more because of the Hurricane?	Yes	No
11.	Overall, how upset about things have you been since the Hurricane? *Not at all* *A little* *A lot* *A whole lot*		

What Has Happened To You Since The Hurricane?

Since the Hurricane: How are things now? Please circle your answers.

1.	Has almost all the damage to your house from the Hurricane now been fixed?	Yes		No	
2.	Are you now living in the house you lived in before the Hurricane?	Yes		No	
3.	Are you living in a house that still has damage because of the Hurricane?	Yes		No	
4.	Do you have to travel a lot longer to get to your school now than you did before the Hurricane?	Yes		No	
5.	Is one of your parents now out of a job because of the Hurricane?	Yes		No	
6.	How many times have you moved since the Hurricane? **None Once Twice Three or More**				
7.	How much are you bothered by:				
	a. The way things look in your neighborhood	Not at all	A little	A lot	A whole lot
	b. Problems spending time with friends	Not at all	A little	A lot	A whole lot
	c. Family members not getting along	Not at all	A little	A lot	A whole lot
	d. The way things look at home	Not at all	A little	A lot	A whole lot

APPENDIX C: The Life Events Scale

Instructions: Please circle "yes" if these events have happened to you *since the Hurricane*.

	Life Event	**Happened since the Hurricane**	
1.	The death of a parent	Yes	No
2.	The death of a brother or sister	Yes	No
3.	Divorce of your parents	Yes	No
4.	Marital separation of your parents	Yes	No
5.	The death of a grandparent	Yes	No
6.	Hospitalization of a parent	Yes	No
7.	Birth of a brother or sister	Yes	No
8.	Hospitalization of a brother or sister	Yes	No
9.	Loss of a job by your father or mother	Yes	No
10.	Change in job by your father or mother	Yes	No
11.	Death of a pet	Yes	No
12.	Being hospitalized for illness or injury	Yes	No
13.	Death of a close friend	Yes	No
14.	New stepmother or stepfather	Yes	No

APPENDIX D: Reaction Index

The following is a list of things that kids sometimes do after a hurricane. Please THINK about Hurricane Ike and then READ the list carefully. CIRCLE ONE of the numbers (0, 1, 2) that tells how often something has happened to you in the past month. Use the Rating Sheet to help you decide how often the problem has happened in the past month.

PLEASE BE SURE TO ANSWER ALL QUESTIONS.

PLEASE THINK ABOUT THE PAST MONTH:	None of the time	Some of the time	Most of the time
1. I watch out for danger or things that I am afraid of.	0	1	2
2. When something reminds me of what happened, I get very upset, afraid or sad.	0	1	2
3. I have upsetting thoughts, pictures, or sounds of what happened come into my mind when I do not want them to.	0	1	2
4. I feel grouchy, angry or mad.	0	1	2
5. I have dreams about the hurricane or other bad dreams.	0	1	2
6. I feel like I am back at the time when the bad thing happened, living through it again.	0	1	2
7. I feel like staying by myself and not being with my friends.	0	1	2
8. I feel alone inside and not close to other people.	0	1	2
9. I try not to talk about, think about, or have feelings about the hurricane.	0	1	2
10. I have trouble feeling happiness or love.	0	1	2
11. I have trouble feeling sadness or anger.	0	1	2
12. I feel jumpy or startle easily, like when I hear a loud noise or when something surprises me.	0	1	2
13. I have trouble going to sleep or I wake up often during the night.	0	1	2
14. I think that some part of the hurricane is my fault.	0	1	2
15. I have trouble remembering important parts of the hurricane.	0	1	2
16. I have trouble concentrating or paying attention.	0	1	2

17. I try to stay away from people, places, or things that make me remember the hurricane.	0	1	2
18. When something reminds me of the hurricane, I have strong feelings in my body, like my heart beats fast, my head aches, or my stomach aches.	0	1	2
19. I think that I will not live a long life.	0	1	2
20. I am afraid that a hurricane will happen again.	0	1	2

APPENDIX E: Food Frequency and Activity Questionnaire

	During the **past 7 days**, how many times did you:	I did not have any in the past 7 days	1 to 3 times in the past 7 days	4 to 7 times in the past 7 days	2 times per day	3 times per day	4 or more times per day
	1. Eat whole grains (like whole wheat bread, brown rice, whole wheat cereal).	☐	☐	☐	☐	☐	☐
	2. Eat dark green vegetables (like spinach, broccoli).	☐	☐	☐	☐	☐	☐
	3. Eat beans or peas.						
	4. Eat carrots.	☐	☐	☐	☐	☐	☐
	5. Eat fruit (do not count fruit juice).	☐	☐	☐	☐	☐	☐
	6. Have a glass or bottle of low-fat or fat-free milk.	☐	☐	☐	☐	☐	☐
	7. Have a can or bottle of non-diet sodas or sports drinks (like Coke, Sprite, Gatorade).	☐	☐	☐	☐	☐	☐
	8. Eat "fast food?" (like pizza, fries, McDonalds).	☐	☐	☐	☐	☐	☐
	9. Eat "sweets?" (like chocolate, candy, cake, ice cream, cookies).	☐	☐	☐	☐	☐	☐
	10. Eat chips (like potato chips, corn chips).	☐	☐	☐	☐	☐	☐
	11. Take vitamins (like Flintstones, One-A-Day).	☐	☐	☐	☐	☐	☐
	12. Eat breakfast.	☐	☐	☐			

13. Think about how often you eat items 1 through 12 now compared to how often you ate them before the hurricane.
    In the grey boxes next to each number:
    Draw a + next to each food item you eat more often now.
    Draw a – next to each food item you eat less often now.
    Draw a **O** next to each food item you eat about the same amount now as compared to before the hurricane.
14. How does the type of food you eat now compare to the types of food you ate before the hurricane?
    ☐Less healthy ☐Same ☐More healthy

	1. On how many of the past 7 days did you exercise or take part in physical activity that made your heart beat fast and made you breathe hard for at least 20 minutes? (For examples: basketball, soccer, running or jogging, fast dancing, swimming laps, tennis, fast bicycling, or similar aerobic activities) ☐0 days ☐ 1day ☐2 days ☐3 days ☐4 days ☐5 days ☐ 6 days ☐7 days
	2. On how many of the past 7 days did you do any exercise that did not make your heart beat fast and did not make you breathe hard for at least 30 minutes? (For example: fast walking, slow bicycling, skating, pushing a lawn mower, or mopping floors) ☐0 days ☐ 1day ☐2 days ☐3 days ☐4 days ☐5 days ☐ 6 days ☐7 days

	3. Last week, on how many days did you go to physical education (PE) or gym classes? ☐0 days ☐ 1day ☐2 days ☐3 days ☐4 days ☐5 days ☐ 6 days ☐7 days
	4. Yesterday, how many hours did you watch TV or video movies away from school? ☐I didn't watch TV yesterday ☐1 hour ☐2 hours ☐3 hours ☐4 hours ☐5 hours ☐ 6 or more hours
	5. How many hours per day do you usually spend on the computer away from school? ☐I don't use the computer ☐1 hour ☐2 hours ☐3 hours ☐4 hours ☐5 hours ☐6 or more hours
	6. How many hours per day do you usually spend playing video games (like Nintendo, PlayStation, GameBoy)? ☐I don't play video games ☐ 1 hour ☐2 hours ☐3 hours ☐4 hours ☐5 hours ☐6 or more hours

7. Think about how often you do items 1 through 6 <u>now</u> compared to how often you did these activities <u>before the hurricane</u>.
   In the grey boxes next to each number:
   Draw a + next to each activity you do <u>more often now</u>.
   Draw a – next to each activity you do <u>less often now</u>.
   Draw a **O** next to each activity you do <u>about the same amount now</u> as compared to before the hurricane.
8. Compared to other students in your grade who are as tall as you, do you think you weigh:
   ☐ Too little ☐The right amount ☐Too much