

DISSERTATION

RISK AND RESILIENCE: THE ROLE OF PHYSICAL ACTIVITY AND RELATED
FACTORS IN ADULT PSYCHOLOGICAL FUNCTIONING
AFTER EXPOSURE TO CHILDHOOD MALTREATMENT

Submitted by

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ABSTRACT

RISK AND RESILIENCE: THE ROLE OF PHYSICAL ACTIVITY AND RELATED FACTORS IN ADULT PSYCHOLOGICAL FUNCTIONING AFTER EXPOSURE TO CHILDHOOD MALTREATMENT

Across decades of research, exposure to severe childhood maltreatment has repeatedly been identified as one of the most potentially-damaging life events suffered by a considerable number of children worldwide. Yet while many of those exposed to such events experience chronic and debilitating symptoms of their early traumas, others actually demonstrate notable resilience to these experiences – often transitioning into adulthood with remarkably few scars to mark their early trials. As a result of this phenomenon, recent research has increasingly focused on identifying the traits facilitating such resilience amongst those who have it, as well as those factors contributing to increased risk amongst those who do not. In the present study, participant gender, engagement in physical activity, and the intensity of such activity were evaluated as potential factors influencing adult psychological functioning in college students exposed to childhood abuse and neglect. In particular, the focus of this investigation was on how these factors might interact in moderating the relationship between childhood maltreatment and later psychological health. Among a sample of 584 undergraduate college students, the results of these multiple regression analyses indicated that engagement in hard (e.g., aerobic) physical activity uniquely moderated the relationship between childhood abuse and psychological functioning among both male and female participants. Among women, increases in physical activity were associated with greater sensitivity to the negative influence of childhood abuse. In contrast, male participants actually demonstrated greater resilience to such abuse at higher levels of activity.

DEDICATION

I dedicate this dissertation to my wife, whose warmth has given me more than 10 years of summer. To my mother, who fought the echoes of her own past in an effort to protect me from the same. And finally, to my committee and especially my advisor Dr. Lee A. Rosén. Thank you all for your unerring support, patience, and belief. Your passion and expertise have been essential to the completion of this project, and it has been a true pleasure learning from each of you.

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CHAPTER I

Introduction

In recent years, many researchers and health practitioners have identified childhood trauma as one of the most concerning phenomena in the United States and worldwide (e.g., Fitzpatrick & Boldizar, 1993; Terr, 1991). In 2011 alone, Child Protective Services substantiated more than 640,000 cases of child maltreatment in the United States, while prevalence estimates from the U.S. Department of Health and Human Services (2012) suggest that the true incidence of such events may be more than ten times greater. Among a sample of more than 17,000 U.S. children surveyed from 1995 to 1997, the Centers for Disease Control and Prevention (1997) found that more than 64% had suffered at least one trauma related to abuse, neglect, or significant household dysfunction (i.e., household substance abuse, parental separation, violence against the mother, household mental illness, or an incarcerated household member).

Despite worldwide efforts to reduce the prevalence and impact of such events, an alarming number of children and adolescents continue to experience severe physical and/or psychological trauma every year. In 2009, approximately five U.S. children died every day as a direct result of severe abuse and/or neglect, more than any previously recorded year (U.S. Department of Health and Human Services, 2010). In fact, nationwide prevalence estimates indicate that early exposure to traumatic experience may be the norm rather than the exception. According to the American Psychological Association (2008), more than two thirds of Americans will have experienced a traumatic event (one that threatens injury, death, or the physical integrity of self/others) by the age of 16. Among a nationally-representative sample of children and adolescents (age 0-17.2), the National survey of Children's Exposure to Violence (2008) found that 60.2% of responders had experienced or witnessed violence, neglect, or

maltreatment within the past year. Nearly half (46.3%) experienced physical assault, 10.2% suffered child maltreatment, 6.1% were sexually victimized, and 25.3% had witnessed domestic or community violence (Finkelhor, Turner, Ormond, & Hamby, 2009).

According to Van der Kolk (1987), a psychological trauma is an experience or event that overwhelms both biological and psychological coping mechanisms. By this definition, the breadth of experience that might be deemed “traumatic” is incredibly diverse, while the outcomes associated with these experiences are often equally varied. In recent decades, trauma researchers and mental health professionals have identified a broad variety of psychological, emotional, behavioral, and biological changes associated with traumatic experience – likely affecting millions of victims each year (e.g., Atlantis et al., 2004; Quirk and Beer, 2006; Vasterling et al., 2001; Breslau, Davis, Peterson, & Shultz, 2000). Yet despite a growing worldwide concern regarding the impact of psychological trauma and a continued search for effective interventions, existing treatment approaches appear to be far from perfect (McNally, Bryant, & Ehlers, 2003; Litz et al., 2006; Rose & Bisson, 1998).

Fortunately, significant variance in studies of post-trauma functioning suggest that chronic pathology is not always inevitable. In fact, recent data indicates that many of those exposed to early-life traumas do not go on to develop PTSD or suffer other significant deficits in adult functioning (Collishaw et al., 2007; MacMillan et al., 2001; McGloin & Widom, 2001; Mullen et al., 1996; Walsh, Dawson, & Mattingly, 2010). Masten, Best, and Garmzey (1990) defined the remarkable fortitude of these individuals as *resilience*, or “the process of, capacity for, or outcome of successful adaptation despite challenging or threatening circumstances (p. 426). And although this phenomena has only recently been studied as it applies to victims of childhood maltreatment, existing data suggests some considerable reason for hope. In a study

conducted by Walsh, Dawson, and Mattingly (2010), approximately 3% to 18% of children were found to be functioning well despite their exposure to maltreatment. By adolescence, these rates increased to between 11% and 48%. Collishaw et al. (2007) found similar results among adult survivors of childhood maltreatment, reporting that 48% of their study sample was “resilient.”

Together, these well-established differences in the outcomes of trauma survivors suggest that both risk and resilience may be complex and multifaceted. If many of those exposed to even severe maltreatment and trauma go on to live successful, happy lives, then traumatic experience – while terrible – is not necessarily irreparable. In light of this, two important questions must be addressed: First, what are the specific factors that facilitate either risk or resilience among those exposed to maltreatment and trauma? Second, how can we develop more effective interventions and/or facilitate greater resilience for those individuals at greatest risk of trauma-related pathology?

The Impact of Psychological Trauma

In recent decades, the immediate negative consequences of traumatic experience have been well-documented. In particular, Terr (1991) describes four specific traits associated with most cases of trauma in childhood or adolescence: “visualized or otherwise repeatedly perceived memories” (Terr, 1991, p. 12), “repetitive behaviors” (Terr, 1991, p. 12), “trauma-specific fears” (Terr, 1991, p. 13), and “changed attitudes about people, life, and the future” (Terr, 1991, p. 13). In addition, many individuals exposed to trauma also demonstrate increased risk of a variety of psychological ailments. Often, these include PTSD, anxiety, depression, anger/hostility, sexually inappropriate behavior, self-destructive behavior, feelings of isolation, poor self-esteem, difficulty establishing trust, substance abuse/dependence, sexual maladjustment, relationship problems, substance abuse, and problems with academic performance (Brown & Finkelhor,

1986; Kilpatrick et al., 2000). Finally, exposure to childhood trauma has also been identified as a significant contributor to increased mortality in adulthood and adolescence (Felitti et al., 1998).

Because both traumatic experiences and the individuals who suffer them are often incredibly diverse, researchers have also identified a variety of unique contextual factors contributing either to risk or resilience in the face of psychological trauma. Frequently-identified protective factors include social support, intelligence, emotional regulation skills, self-esteem, self-efficacy, and openness to experience (Moroz, 2005), prosocial adults (Mohr, 2015), and overall social/emotional resources (Shirley, Park, Nolen, & Rosén, 2014). In contrast, increased risk is associated with deficits in these areas, as well as with specific characteristics of the traumatic experience. In particular, individual risk of post-trauma pathology seems to be strongly associated with the victim's age at initial traumatic experience (e.g., Brewin et al., 2000; McCutcheon et al. 2010), overall severity of traumatic experience (e.g., Brewin, Andrews, & Valentine, 2000; Maercker, Beauducel, & Shutzwohl, 2000), and the specific type(s) of traumatic exposure (e.g., Terr, 1991).

In particular, victim age during the experience of a traumatic event has been identified as a powerful predictor of post-trauma pathology. In a meta-analysis conducted by Brewin et al. (2000), age at time of traumatic experience was inversely associated with increased symptom pathology, and children in particular seemed to demonstrate disproportionate risk of long-term trauma-related difficulties. In a study conducted by McCutcheon et al. (2010) child victims of physical abuse, sexual assault, and neglect demonstrated significantly greater risk of trauma-related pathology than subjects exposed to similar traumas in adolescence or adulthood.

In general, early-age psychological trauma has been associated both with increased severity of symptoms, as well as a greater likelihood of developing long-term pathology (Armstrong & Holaday, 1993).

In addition to these observed differences in pathology based on age of traumatic experience/maltreatment, available evidence also suggests that the severity, duration, and variety of trauma exposure are also strongly associated with both short-term and long-term outcomes (e.g., Brewin, Andrews, & Valentine, 2000; Maercker, Beauducel, & Shutzwohl, 2000; Spauwen, Krabbendam, Lieb, Wittchen, & van Os, 2006). Trauma severity has been repeatedly been demonstrated as one of the primary risk factors for pathology, predicting a variety of outcomes ranging from psychoses (Spauwen et al., 2006) to dissociation (Maercker et al., 2000) and traditional symptoms of PTSD (Brewin et al., 2000). In addition, repeated exposure to multiple different traumas has been identified as a particularly influential risk factor for subsequent long-term pathology (e.g., Clemmons, Walsh, DiLillo, & Moore, 2007; Green et al., 2000).

Finally, differences between diverse categories of traumatic experience have also been indicated as significant contributors both to the severity and type of symptoms suffered by victims. In particular, research evaluating the outcomes of childhood maltreatment has tended to focus on two particular categories of such trauma: abuse and neglect. Whereas childhood abuse is usually defined as a resulting from traumatic, physically or emotionally-aggressive dynamics between parent and child, the term neglect refers to a pathological lack of parent/child interaction (Gauthier, 1996). Of these, neglect is generally the more broadly-defined and is the most common form of maltreatment (U.S. Department of Health and Human Services, 2010), encompassing physical neglect (e.g., failure to meet basic needs), educational neglect, medical

neglect, and emotional neglect. In 2012, out 679,810 substantiated cases of childhood maltreatment, 78.3% of the victims were neglected, 18.3% experienced physical abuse, 9.3% were sexually abused, and 10.6% were exposed to “other” abuse (e.g., emotional abuse, USDHHS, 2012).

Recently, these identified differences in both the process and prevalence of child abuse vs. neglect have led researchers to search more specifically for trauma-related outcomes that might be uniquely associated with each (e.g., Loos and Alexander, 1997; Prino and Peyrol, 1994). While maltreated children in general are at increased risk of symptoms ranging from cognitive delays (Koenen et al., 2003) to personality disorders (Collishaw et al., 2007) and suicidal ideation (Chandy et al., 1996), there do appear to be some potential differences in outcome based on the specific type of maltreatment experienced. In a study by Loos and Alexander (1997), analysis of a large undergraduate student sample revealed associations between adult reports of anger-related difficulties and childhood exposure to physical or verbal abuse. In contrast, emotional neglect was associated far more strongly with symptoms of loneliness and social isolation. Similar results were found by Prino and Peyrol (1994), who noted positive associations between physical abuse and aggression as well as childhood neglect and withdrawal/isolation among children aged five to eight.

In general, given the particularly high risk associated with early-onset traumatic experience, child and adolescent victims of trauma have frequently been identified as populations in particular need of additional research and intervention. Recently, such research has begun to focus not only on the development of effective treatment protocols for trauma survivors, but also the effective identification of factors related to vulnerability and resilience amongst those at-risk for trauma-related pathology. In particular, given the unique needs of at-

risk youth and their tendency to resist therapeutic intervention (Karver et al., 2006), a growing emphasis has been placed on identifying methods for facilitating increased resilience as well as designing interventions that are non-threatening, attractive to young populations, and easily accessible. With these objectives in mind, a number of researchers have suggested the utilization of physical activity-based interventions to facilitate the resilience and/or recovery of children, adolescents, and young adults with a variety of presenting concerns (Brown et al., 2012a).

Physical Exercise and Health

Due to a sizable body of evidence indicating the benefits of physical exercise for both physical and psychological health, researchers and health practitioners have long recommended deliberate physical activity as an essential component of optimal human functioning (e.g., Atlantis et al., 2004). In studies examining the role of exercise on overall human functioning, consistent positive associations have been noted between exercise and general mood (e.g., Folkins, 1976; Lichtman & Poser, 1983), psychological well-being (Hassmén, Koivula, & Uutela, 2002), and multiple measures of cognitive functioning (Asoh, Takeuchi, and Tsuji, 1986; Cotman & Berchtold, 2002; Kramer et al., 1999; Lauren et al., 2001; Lichtman, 1983; Maniam & Morris, 2010, Schindler, 2010). In addition, exercise has been identified as a significant protective factor against symptoms of depression (e.g., Doyne et al., 1983; Greist et al., 1979; Kavanagh, Shepard, Tuck, & Qureshi, 1977) and anxiety (e.g., Bahrke & Morgan, 1978; Driscoll, 1976; Morgan, 1979;), as well as contributing significantly to effective stress regulation (Long, 1984; Mastorakos et al., 2005; Sothmann et al., 1996), self-esteem (Calfas & Taylor, 1994; Gruber, 1986; McDonald & Hogdon, 1991; Spece, Poon, & Dyck, 1997), self-competence (Gauvin & Brawley, 1993; Sonstroem & Morgan, 1989), self-concept (Spence, Poon, & Dyck, 1997), and resilience to substance abuse/dependence (Medina et al., 2011)

Although direct research of physical exercise as it relates to post-trauma symptomology is still relatively scarce, decades of study have demonstrated that strenuous physical activity can be a powerful intervention for many facets of psychological health and well-being. In particular, the effects of exercise on depression and anxiety are well-documented and robust. In recent decades, five meta-analytic reviews (Calfas & Taylor, 1994; Craft, 1997; Kugler et al., 1994; McDonald & Hodgdon, 1991; North, McCullagh, & Tran, 1990) have found consistent and significant reductions in depression following both acute and chronic exercise. Similarly, six meta-analyses related to exercise and anxiety (Calfas & Taylor, 1994; Kugler, Seelback, & Kruskemper, 1994; Landers & Petruzzello, 1994; Long & van Stavel, 1995; McDonald & Hodgdon, 1991; Petruzzello, Landers, Hatfield, Kubitz, & Salazar, 1991) found significant reductions in anxiety across all studies reviewed.

A number of studies have also explored the effects of exercise on measures of global physical and psychological functioning, with results suggesting that exercise may be a uniquely comprehensive contributor to general human well-being. In a randomized controlled trial conducted by Atlantis et al., (2004), a 24-week exercise training program was found to result in significant improvements of general mental health, stress, vitality, and depression. In addition, participants also demonstrated measurable improvements in general physical functioning, pain, and physical health. In a review of four large samples in the United States and Canada, Stephens (1988) noted similar results. Individual exercise habits were positively correlated with general well-being and mood, as well as being negatively associated with anxiety and depression. According to Stephens (1988), these results were consistent across age, gender, physical health, and socioeconomic status.

Although participation in physical exercise appears to be almost universally-beneficial, there are a number of specific factors which seem to influence the relative strength of exercise-related benefits. In particular, the intensity of exercise (Brown et al., 2012b) and one's motivation for pursuing it (Ackard, Brehm, & Steffen, 2010; Mond & Calogero, 2009) have repeatedly been associated with differential outcomes resulting from exercise participation. In addition, given existing cultural trends surrounding physical exercise, fitness, and body image, there may also be some measurable differences in both the cause and effect of exercise participation across genders (Eglil, Bland, Melton, & Czech, 2011; Tigemann & Williamson, 2000).

Exercise, Intensity, and Motivation

In a number of recent studies, greater exercise intensity has been positively associated with corresponding benefits across multiple psychological domains (e.g., Brown et al., 2012b; Cox et al., 2011). In Brown et al. (2012b), increases in exercise intensity were significantly associated with improvements in subsequent neuropsychological testing performance. Other researchers have noted similar results when examining the relationship between exercise and anxiety, as well as depression and general physical health (Cox et al., 2011). And although even low and moderate-intensity exercise have consistently demonstrated positive benefits within these same domains, many researchers agree that high (but not excessively so) intensities of exercise are likely to result in the greatest relative benefits for participants (Jacks et al., 2002).

However, while there is a generally positive association between exercise intensity and corresponding benefits, a number of researchers have identified negative outcomes associated with exercise when pursued either to excess or for potentially problematic reasons. Excessive and/or compulsive exercise has been linked to increases in anxiety and obsessive-compulsive

symptoms, as well as perfectionism and narcissistic traits (Iannos & Tiggemann, 1997; Shroff et al., 2006; Spano, 2001). Additionally, a variety of studies have noted correlations between extreme exercise participation and disordered body image or eating habits (e.g., Gulker, Laskis, & Kuba, 2010; Shroff et al., 2006). Although a high level of physical activity can certainly be healthy in many individuals, emotional and/or compulsive attachment to exercise appears to mediate the consequences for those at particular risk of negative exercise outcomes (Mond & Calogero, 2009; Ackard, Brehm, & Steffen, 2010).

In some populations, significant gender differences in both motives for (Eglil et al., 2011) and the benefits of physical exercise (e.g., Tiggemann & Williamson, 2000), may help to clarify the apparent risks associated with extreme forms of exercise participation. In Eglil et al. (2011), the authors identified significant differences across gender in terms of motivation for exercise among college students. Although men were typically motivated to engage in exercise by intrinsic factors (i.e., strength, competition), women exercised more frequently as a result of extrinsic factors (i.e. weight management, appearance). Additionally, these differences in exercise motivation may also contribute to observed discrepancies in the outcomes of exercise participation. In a study conducted by Tiggemann and Williamson (2000), young (i.e., high-school and college-aged) female participants demonstrated significantly negative associations between body satisfaction/self-esteem and exercise quantity, while positive associations were demonstrated for older women and men in general. Consistent with the results of Eglil et al. (2011), women in this study were also more likely than men to exercise for purposes of weight control, tone, and mood enhancement.

Physical Exercise and Trauma

Although the psychological and physical benefits of exercise have been well-documented, comparatively little research has explored the possibility of either of these factors as an intervention targeted specifically at individuals suffering from symptoms of trauma exposure. However, a number of recent studies have identified physical exercise as a valuable treatment measure for sufferers of post-traumatic stress disorder (PTSD) and related symptoms of trauma. For example, in Newman and Motta (2007), the authors noted positive changes in the anxiety, depression, and PTSD symptoms of adolescents after an eight-week aerobic exercise program. In fact, many of the participants no longer qualified for a diagnosis of PTSD after the program was completed (Newman & Motta, 2007). Diaz and Motta (2008) later replicated this finding, and noted a similarly powerful reduction in PTSD symptoms after participation in regular aerobic exercise. More recently, Smith and Rotunda (2011) provided further evidence for the trauma-symptom attenuating effects of physical exercise in a randomized and controlled clinical study. Among a sample of rape survivors exhibiting PTSD-related symptoms, the authors found that a combined intervention of cognitive-behavioral therapy and physical exercise led to significantly greater symptom improvement than CBT alone.

However, while these analyses have provided promising evidence for physical exercise as a promising form of intervention for sufferers of trauma-related symptoms, the exact causes of these effects remain unclear. Specifically, it is difficult to clarify whether the observed associations between trauma symptoms and exercise simply reflect the general health benefits of these factors – or whether the physiological and psychological processes associated with these predictors might be uniquely effective in moderating the impact of traumatic experience.

Nolen (2013)

Given the strong empirical evidence for similarities between the psychological domains (e.g., stress regulation, self-concept) impacted by psychological trauma and those that are uniquely benefited via physical activity/exercise, I recently completed a study (Nolen, 2013) designed to further evaluate the relationships between these variables and assess for the presence of potential interaction/moderation effects. In this study, quantity of physical activity did not moderate the impact of either child maltreatment, number of traumatic events, or trauma severity on college adjustment, anxiety, or depression. However, physical activity did interact uniquely with both childhood maltreatment and number of traumatic experiences as they related to psychological flourishing, a broad measure of psychological well-being. For outcomes related to childhood maltreatment, the positive impact of physical activity on flourishing was gradually attenuated at increasing levels of maltreatment – eventually reaching non-significance at roughly two standard deviations above the maltreatment mean. Similar results were found in the interaction between number of traumatic events and physical exercise as related to flourishing, except that the benefits of exercise became non-significant at roughly one standard deviation above the norm. In other words, physical activity was generally beneficial across all measures of psychological functioning, but was gradually less-so for individuals with especially-traumatic histories.

Because previous researchers have noted reduced benefits of intervention among individuals of particularly high pathology or trauma exposure (e.g. Soloman and Heide, 1999; Terr, 1991), it may be that my results (Nolen, 2013) are simply representative of a similar effect related to the benefits of physical activity. However, there are a number of alternative explanations proposed by my research or indicated in previous studies that might contribute to an

improved understanding of the relationship between physical activity or exercise and the outcomes of psychological trauma. In particular, unique interactions between gender, activity, and motivation for activity may significantly influence the outcomes associated with exercise in the context of psychological trauma. Additionally, a more detailed understanding of trauma itself – in terms of the various outcomes associated with different *types* of trauma – may help to further clarify the implications of previous research as well as my own analysis in Nolen (2013).

Present Study

The present study was designed to expand upon my previous results (Nolen, 2013) by more specifically examining the relationships between physical activity, gender, and exposure to childhood maltreatment as they relate to each other and to adult psychological functioning. Rather than combining participants' reported exercise activities into a single "physical activity" variable (as was done in Nolen, 2013), the results of this measure were by purpose/intentionality (e.g., leisure/recreational vs. work-related activity), as well as being divided into "moderate-intensity" and "hard-intensity" forms of physical activity/exercise,. Additionally, participants' reported experiences of childhood maltreatment were further differentiated into "abuse" and "neglect" variables and analyzed discretely in order to assess for differences in adult outcome based on type of childhood maltreatment. Finally, gender was included as an additional variable of interest, in order to assess for potential differences in the trajectory of post-maltreatment and physical-activity associated functioning in women as opposed to men – and vice versa.

In the present study, these additional predictors were assessed in order to better understand the individual factors that contribute to risk, resilience, and adult psychological functioning after early traumatic experience, as well as to identify those candidates who might be most or least likely to benefit from exercise-related interventions or preventative strategies.

Given the exploratory nature of these analyses, the following research questions and hypotheses were proposed.

Research Question 1: Does participant gender influence the benefits associated with physical exercise following exposure to childhood maltreatment?

Hypothesis: Based on previously-identified gender differences in motivations for exercise (Eglil et al., 2011), as well as females' disproportionate exposure to sexual abuses (Kearney-Cooke & Ackard, 2000) and the impact of such abuses on body image (e.g., Wenniger & Helman, 1998), women exposed to maltreatment will demonstrate fewer benefits associated with physical activity than their male counterparts.

Research Question 2: Will type of childhood maltreatment experience (e.g., abuse vs. neglect) influence the presence, direction, or strength of corresponding activity-based moderation effects?

Research Question 3: Does intensity of physical activity influence the presence, direction, or strength of its moderation effect on the relationship between maltreatment and psychological functioning?

Hypothesis: Given previous research identifying aerobic-intensity physical activity/exercise as essential to many of the associated benefits (e.g., Brown et al., 2012b; Cox et al., 2011), it is hypothesized that any observed moderation effects of exercise on childhood maltreatment will occur at "hard" intensity physical activity.

CHAPTER II

Method

Participants

The present study was designed to expand upon analysis of a pre-existing dataset I originally collected for Nolen, 2013. Participants were recruited from an available pool of undergraduate students enrolled in introductory psychology courses at a large university in the Western U.S. Recruitment was conducted via an online departmental research system, soliciting voluntary participation in an anonymous online survey. The recruitment notice informed students about the inclusion of survey questions regarding trauma and general psychological functioning, but did not exclude any potential participants on the basis of trauma history.

A total of 605 undergraduate students participated in the survey (Nolen, 2013), with 21 of these cases eventually removed due to aberrant data, incomplete responses, or identification as outliers. The resulting sample of 584 cases served as the data of interest for the proposed study. This dataset included 182 males (31.2%), 400 females (68.5%), and two students who did not specify a gender (0.3%). A total of 482 participants identified as Caucasian/White (81.8%), 55 (9.3%) as Latino or Hispanic, 16 (2.7%) as Asian American, nine (2.2%) as “Other,” eight (1.3%) as African American/Black, eight (1.3%) as Middle Eastern American, five (0.8%) as Hawaiian/Pacific Island, and one (0.2%) as American Indian/Native American. Three hundred and eight (52.8%) students reported some religious affiliation, 273 (46.7%) reported no such affiliation, and an additional three participants did not indicate religious beliefs or lack thereof. The mean age of students in this sample was 18.86 years ($SD=1.35$).

Measures

Demographic Information.

Participant demographic information was acquired via a brief demographic survey administered at the beginning of study participation. This form asked participants to disclose a variety of demographic characteristics including age, year in school, gender, ethnicity, religious affiliation, and socioeconomic status. See Appendix A.

Childhood Abuse and Neglect

Childhood abuse and neglect were assessed via the Childhood Maltreatment Questionnaires – Abuse (CMQ-A) and Childhood Maltreatment Questionnaires – Neglect (CMQ-N) developed by Shirley, Park, Nolen, and Rosén (2010a). The Childhood Maltreatment Questionnaires - Abuse (Shirley, Park, Nolen, & Rosén, 2010a) asks respondents to indicate the frequency of abuse-related events experienced during childhood. These items are measured on a five-point Likert-type scale, with responses ranging from “never” to “very often.” The CMQ-A consists of 19 items and 4 subscales: Emotional Abuse, Physical Abuse, Sexual Abuse and Love. Confirmatory factor analysis of the CMQ-A demonstrated excellent fit, with a TLI of 0.96, CFI of 0.96, and a RMSEA of 0.06. The CMQ-A also demonstrated excellent reliability, with an overall Cronbach’s alpha of 0.90 and subscale alphas ranging from 0.80 to 0.93 (Shirley et al., 2010a). In the dataset utilized for this study, the CMQ-A demonstrated an overall Cronbach’s alpha of 0.86 (Nolen, 2013). See Appendix B.

In the Childhood Maltreatment Questionnaires – Neglect (Shirley et al., 2010a), participants are asked to indicate the frequency of neglect-related events experienced during childhood. These items are measured on a five-point Likert-type scale, with responses ranging from “never” to “very often.” The CMQ-N consists of 16 items and 4 subscales: Emotional

Neglect, Physical Neglect, Lack of Supervision, and Love. Confirmatory factor analysis revealed a TLI of 0.91, CFI of 0.93, and a RMSEA of 0.08. Reliability analysis of the CMQ-N found an overall Cronbach's alpha of 0.86, with subscale alphas ranging from 0.80 to 0.91 (Shirley et al., 2010a). Nolen (2013) demonstrated an overall Cronbach's alpha of 0.86 for the CMQ-N. See Appendix C.

Physical Activity Habits

Participants' physical activity habits were investigated using the Seven-Day Physical Activity Recall Scale (PAR). The PAR is a 10-item questionnaire designed to assess both work-related and recreational physical activity (Dishman & Steinhardt, 1988). Respondents are asked to estimate the number of hours they slept and spent in moderate, hard, and very hard physical activity during the past week. Test-retest reliability scores for the PAR were found to be .58 and .42 at three and seven weeks, respectively (Dishman & Steinhardt, 1988). High correlations ($r = .82$) were found between the self-administered PAR and daily diaries of physical activity. Additionally, measures of discriminant validity indicate that PAR results are consistent with measured cardiopulmonary fitness (Dishman & Steinhardt, 1988). A correlation of $r = .83$ was found between self-administered and interview versions of the PAR (Dishman & Steinhardt, 1988).

In Nolen (2013), physical activity was measured using a self-report version of the PAR questionnaire and divided into discrete categories of work-related and recreational activity. In the present study, work-related activity was ignored and recreational activity identified as the primary domain of interest in order to focus on deliberate rather than necessary forms of activity as much as was possible. In addition, leisure activity was further divided into varying "intensities" (e.g., level of effort required) including moderate physical activity (PARM), hard

physical activity (PARH), and very hard physical activity (PARV). However, due to a low number of participants reporting PARV, this variable was omitted from analysis. Reliability analysis for participants in the sample from Nolen (2013) revealed a Cronbach's alpha of 0.55. See Appendix D.

Psychological Functioning

Current psychological functioning was assessed using the College Adjustment Questionnaire (CAQ; Shirley, Park, Nolen, & Rosén, 2010b), which was designed to assess the overall psychological functioning and well-being of college students. The CAQ consists of a total of 14 items and is divided into three subscales: Academic Adjustment, Social Adjustment, and Emotional Adjustment, as well as a total composite score measure of general psychological well-being. Respondents are asked to indicate the accuracy of various statements regarding their college experiences "at this point in time." These items are measured on a five-point Likert-type scale, which ranges from "not true" to "completely true." Reported subscale reliabilities have previously been identified as strong, with alphas of .89, .84, and .78, respectively (Shirley, Park, & Rosén, 2013).

The Academic Adjustment scale of the CAQ focuses on questions related to an individual's ability to meet educational demands, and respondents are asked to rate questions pertaining to their achievement and motivation for learning. The Social Adjustment Scale focuses on the social aspect of college, including factors related to interpersonal relationships and overall relational satisfaction. The Emotional Adjustment Scale focuses on the emotional and psychological experience of the student, and asks that respondents rate questions pertaining to how successful they have been at coping with the unique stresses of undergraduate life. The CAQ total score has been found to have an overall Cronbach's alpha of 0.83 and a split-half

reliability of 0.88 (Shirley et al., 2010b), as well as an overall Cronbach's alpha of 0.87 in Nolen (2013). In comparison with the Student Adaptation to College Questionnaire, the convergent validity of the CAQ was demonstrated by a Pearson product-moment correlation coefficient of $r=.67$ (Shirley et al., 2010b).

For the present study, the CAQ total score was employed as an overall measure of psychological functioning in order to represent participants' multidimensional well-being following early exposure to trauma. This composite score from the CAQ has been used similarly in a number of previous studies (e.g., Mohr, 2015; Nolen, 2013; Sheline, 2013; Sheline, 2015; Shirley et al, 2010b), and is believed to be a valid and reliable measure for this purpose. See Appendix E.

Procedure

Data collection for my previous study (Nolen, 2013) was approved by the Institutional Review Board in October 2012, with data collection taking place in November 2012. Participants were recruited via an online departmental listing, which included a general description of the study's purpose as well as details regarding anonymity and compensation (provided as required course credit). Interested volunteers were then directed to an electronic informed consent document (see Appendix F), providing information regarding the possible risks and benefits of participation as well as a reminder of the study's voluntary nature.

Following completion of informed consent procedures, participants were granted immediate access to an online survey consisting of a demographic questionnaire as well as the CMQ, PAR, and CAQ. The demographic questionnaire was presented first, followed by a randomized sequence of all remaining study measures. This process was utilized in order to

protect against the influence of any priming effects that might result from a more standardized presentation format.

In order to address the possibility of participants' negative reactions to sensitive survey topics such as trauma history and present psychological functioning, an extensive debriefing document was provided following survey completion. This document included a message of appreciation to participants, relevant psychoeducation, and contact information for readily-available counseling and emergency services (see Appendix G).. All students who fully participated in this study received credit toward required elements of their introductory psychology course as compensation.

CHAPTER III

Results

Many of the primary statistical analyses conducted in this study were performed via multiple linear regression, which necessitates the preliminary testing and validation of specific assumptions regarding sample data. Prior to conducting final analysis, the assumption of normality was first evaluated by constructing each of the primary variables of interest as an individual distribution. These distributions were then evaluated both visually (i.e., in scatterplot form) and statistically for problematic levels of skewness and/or kurtosis. Variables identified as extremely non-normal (i.e. with a skewness or kurtosis greater than one and more than two standard errors from zero) were uniquely transformed via square root transformations. These transformations were chosen based on their ability to minimize skewness/kurtosis in individual variables (as opposed to other potential transformations, e.g., logarithmic), as well as their ability to maximize the linearity of relationships between variables and the amount of variance accounted for by each model. Such transformations are frequently recommended for the analysis of skewed statistical data (e.g., Cohen, Cohen, West & Aiken, 2003; Howell, 2007; Tabachnik & Fidel, 2007). In the present study, CMQA, CQMN, PARM, and PARH were square-root transformed, while the original values of CAQ were maintained due to the relatively normal distribution of this variable.

In addition to the assumption of normality, effective multiple linear regression analysis also necessitates exploration of the assumptions of linearity and homogeneity of variance (homoscedasticity). In order to verify these assumptions, individual scatter plots were generated based on predicted values for all possible pairs of dependent and independent variables. Linearity

and homoscedasticity were verified via visual inspection of the resulting scatter plots, revealing no apparent violations of these assumptions across transformed variables.

Locating Outliers

A variety of visual and statistical analyses were also conducted in order to assess for the possibility of outliers which might significantly alter the relationships between examined variables. First, individual cases were visually scanned for apparent signs of invalid data. A total of 7 cases were initially removed due to the presence of multiple responses inconsistent with the goals of survey questionnaires (e.g., reporting “drinking” or “sleeping” as a source of physical activity). In addition, further visual exploration identified another four case cases demonstrating significant missing data, characterized by the omission of at least one entire survey measure. Finally, visual examination of the remaining data was also accomplished via the generation of a series of box-plot graphs, resulting in the elimination of five cases reporting physical activity greater than two standard deviations above the mean and well beyond realistic possibility given the reporting period of one week.

Finally, these visual scanning procedures were supplemented using statistical analysis of studentized residuals and Cook’s Distance values, which provide a statistical representation of each case’s residual error and resulting influence on the overall model (Belsley et al., 1980; Cook, 1982). Cases were identified as potentially problematic when resulting in a Cook’s Distance value greater than $4/n$ (.006) (Bolen & Jackman, 1990) or a studentized residual exceeding ± 2 (Belsley et al., 1980). These cases were then further visually examined in order to assess whether they represented valid data or instances of unrealistic/faulty survey response. A total of eight additional cases were removed during this final step, resulting in a total sample of 584 participants to be included in further analysis.

Missing Data

In pursuit of maximum statistical accuracy and maintenance of acquired data, the process of multiple imputation (MI; Rubin, 1987) was utilized in order to facilitate analysis of cases with limited missing values. According to Rubin (1987), this method avoids the shortcomings of case deletion methods, including the loss of power resulting from a reduced sample size. In the process of MI, the original dataset is scanned and examined by statistical computing software, which then identifies scoring patterns and relationships between survey responses. Identified patterns are then used to generate multiple additional datasets, each retaining the original values of the primary dataset, but with missing values replaced by unique imputations drawn from a distribution of likely values (Ruben, 1987). A total of five new datasets were generated for the purposes of the present study, each complete with unique imputed values. Results of this imputation process were then pooled, with the resulting data (a total of 3504 datapoints) utilized in all statistical analyses. Although two respondents failed to report gender (GEN), this variable was not included in multiple imputation due to its categorical nature.

Preliminary Analyses

An initial set of correlation analyses were conducted in order to evaluate the strength and directionality of the relationships between measures of childhood maltreatment (CMQA, CMQN), physical activity (PARM, PARH), gender, (GEN), and psychological functioning (CAQ). In this analysis, childhood abuse (CMQA) was moderately and positively associated with childhood neglect (CMQN). CMQA was also weakly and negatively correlated with CAQ ($r=-.31, p<.001$), as was CMQN ($r=-.28, p<.001$). While PARM demonstrated no significant associations with CAQ ($r=.06, p=.16$), PARH was weakly and positively associated with this outcome ($r=.20, p<.001$). Finally, participant gender (GEN) was significantly associated only

with PARH ($r=.11, p=.01$), indicating that men in the sample participated in significantly more hard physical activity (on average) than did women. These results along with the pooled means and standard deviations of examined variables can also be found in Table 1.

Generally similar results were also found during additional correlational analysis of the same variables among both male and female subsets of the study sample. However, a number of distinct relationships were noted. Among men, CMQN was weakly and positively associated with PARM ($r=.11, p<.001$), while no such association was present among women ($r=-.03, p=.50$). In contrast, PARH was weakly negatively associated with CMQN ($r=-.11, p=.02$), and weakly positively associated with PARM ($r=.22, p<.001$), while neither of these effects were observed among men ($r=-.10, p=.17; r=.14, p=.06$; respectively). See Table 2 for correlations, means, and standard deviations of variables among the male portion of the sample, and Table 3 for the results of these analyses within the female sample.

In addition, specific maltreatment questions and subscales were individually assessed in order to evaluate the prevalence of various traumatic experiences among the sample group as well as to identify any apparent differences across genders. In the study sample, 45 out of 183 men (24.59%) reported experiencing physical abuse, as compared to 81 out of 401 (20.20%) of women. Sexual abuse was endorsed by 13 men (7.1%) and 70 women (17.46%), while emotional abuse was reported by 66 men (36.10%) and 171 women (42.64%) in the sample. In terms of childhood neglect, 57 men (31.15%) and 97 women (24.19%) reported physical neglect. Emotional neglect was endorsed by 57 men (31.15%) and 152 women (37.91%), and lack of supervision was reported by a total of 95 men (51.19%) and 154 women (38.4%).

Finally, additional descriptive analysis of participants' reported forms of physical activity was included in order to assess for potential differences in activity type and/or function between

intensity/variable levels (PARM, PARH). In the “moderate” category, participants most common forms of activity were walking ($n=517$), stretching ($n=179$), and biking ($n=142$). In the “hard” category, physical activity primarily took the forms of lifting weights ($n=210$), jogging ($n=142$), no activity/no response ($n=118$), running ($n=100$), and biking/cycling ($n=66$). In contrast to the “moderate” category, “hard” physical activity also began to include a number of traditional sports (e.g., football, basketball, soccer, volleyball) among participant responses.

Moderation Analyses

This study also included a series of multiple regression analyses in order to assess the possible influence of subject gender, intensity of physical activity (PARM, PARH), and type of childhood maltreatment (CMQA, CMQN) on the hypothesized moderation effect of physical activity on the relationship between childhood maltreatment and adult psychological functioning (CAQ). For this type of moderated multiple regression, Aiken and West (1991) suggests that each included variable first be centered at its respective mean. During moderation analysis, this process is crucial for limiting multicollinearity and facilitating maximum interpretability of results (Barron & Kenny, 1986). For the purposes of this study, each variable of interest was individually centered by subtracting respective variable means from all included cases. Pairs of these centered variables were then multiplied together to generate additional interaction variables (e.g., PARMxCMQA), and included in subsequent multiple linear regression models in order to assess for significant moderation effects.

Moderate Physical Activity – Male

In the first of these models, PARM was evaluated as a potential moderator of the presumed relationship between CMQA and CAQ among men (see Table 4). This analysis revealed a significant relationship between CMQA and CAQ ($b=-1.76, p<.001$), neither PARM

($b=-.69$, $p=.29$) nor the interaction between CMQA and PARM ($b=-.42$, $p=.31$), was identified as a significant predictor of CAQ when controlling for the effects of all other included variables. Overall, a total of approximately 11% of the variance of CAQ was accounted for by this model ($R^2=.11$).

Multiple linear regression analysis was also conducted to explore the relationship between CMQN, PARM, and CAQ scores among men (see Table 4). Similar to the first model, results of this analysis identified a significant relationship between CMQN and CAQ ($b=-1.96$, $p<.001$), though neither PARM ($b=-.43$, $p=.52$) nor the interaction CMQN and PARM ($b=-.31$, $p=.42$), variables was identified as a significant predictor of CAQ. In this model, roughly 12% of the variance in CAQ was accounted for by the predictors ($R^2=.12$).

Moderate Physical Activity – Female

A similar pair of multiple linear regression models was also conducted to assess the relationships between these variables (CMQA, CMQN, PARM, CAQ) among women. In the first of these models, PARM was assessed as a potential moderator of the presumed relationship between CMQA and CAQ among women (see Table 4). In this model, significant associations were found both between CMQA and CAQ ($b=-1.82$, $p<.001$), and PARM/CAQ ($b=1.26$, $p=.01$). However, no significant moderation effect was discovered based on the multiplicative interaction between these two variables ($b=.10$, $p=.73$). Overall, this model accounted for a total of 10% of the variance in CAQ among women ($R^2=.10$).

In the second female model, the relationships between CMQN, PARM, and CAQ were also explored via multiple linear regression. In this analysis, both CMQN ($b=-1.59$, $p<.001$), and PARM ($b=1.29$, $p=.01$), significantly predicted CAQ, while their interaction did not ($b=.09$,

$p=.75$). In this model, roughly 9% of the variance in CAQ was accounted for by the predictors ($R^2=.12$). See Table 4 for the results of this analysis.

Hard Physical Activity – Male

An additional set of multiple linear regression models was also conducted in order to evaluate the possible impact of PARH on post-maltreatment functioning. In the first of these, PARH was evaluated as a potential moderator of the relationship between CMQA and CAQ among men (see Table 5). This analysis revealed a significant relationship between CMQA and CAQ ($b=-2.04, p<.001$), as well as between PARH and CAQ ($b=1.20, p=.02$). In addition, the interaction between CMQA and PARH was independently and significantly associated with CAQ ($b=.72, p=.04$). In this model, simple slope analysis revealed no significant association between CMQA and CAQ at either one standard deviation above the mean of PARH (9.9 hours; $b=.24, p=.05$) or at the mean (3.49 hours; $b=-.69, p<.001$), though CMQA was significantly and negatively associated with CAQ at one standard deviation below the PARH mean (zero hours; $b=-1.62, p=.38$). Using the procedures outlined by Preacher, Curran, and Bauer (2006) to probe a significant interaction, it was determined that CMQA ceased to be associated with CAQ at PARH values of 1.26 and higher. Following reverse-transformation back to the original measure of PARH, this value corresponds to a total weekly PARH value of 1.59 hours/week. In short, men who participated in greater than 1.59 hours of weekly hard leisure physical activity appeared to be protected from the ill-effects of childhood abuse on college adjustment. See Figure 1 for a graph of this effect. Overall, this model accounted for a total of 11% of the variance in CAQ among men ($R^2=.11$).

In contrast, the multiple linear regression model conducted to explore the relationship between CMQN, PARH, and CAQ identified a significant relationship only between CMQN and

CAQ ($b=-2.08, p<.001$), while both PARM ($b=.88, p=.01$) and the PARM/CMQN interaction term ($b=.35, p=.31$) demonstrated non-significant effects. In this model, roughly 13% of the variance in CAQ was accounted for by the predictors ($R^2=.13$). See Table 5 for the full results of this analysis.

Hard Physical Activity – Female

These regression models were again replicated within the female portion of the sample. In the first of these, CMQA, PARH, and the CMQA/PARH interaction term were regressed on CAQ (see Table 5). In this model, significant associations were found between CMQA and CAQ ($b=-1.83, p<.001$), and PARH/CAQ ($b=1.89, p<.001$), as well as for the CMQA/PARH interaction term ($b=-.49, p=.03$). In this model, simple slope analysis of the CMQA/CAQ model revealed PARH as a significant moderator at all three levels of analysis: one standard deviation above the mean (7.43 hours; $b=-3.18, p<.001$), at the mean (2.52 hours; $b=-2.62, p<.001$), and below the mean (0.22 hours; $b=-2.05, p<.001$). In addition, further probing of this interaction revealed a significant relationship between CMQA and CAQ for all values of PARH greater than zero (see Figure 2). In other words, CMQA was significantly and negatively associated with CAQ at all levels of physical activity, though this association grew stronger at increasing levels of PARH. Overall, this model accounted for a total of 15% of the variance in CAQ among women ($R^2=.15$).

In the second female model, the relationships between CMQN, PARH, and CAQ were also explored via multiple linear regression. In this analysis, both CMQN ($b=-1.54, p<.001$), and PARM ($b=1.53, p<.001$), significantly predicted CAQ, while their interaction did not ($b=-.23, p=.34$). This model accounted for a total of 10% of the variance in CAQ among women ($R^2=.10$). See Table 5 for the results of this analysis.

CHAPTER IV

Discussion

Previous research has consistently highlighted the value of physical exercise as it relates to general physical and psychological health. In particular, existing data is especially robust in its indication of this activity as powerful interventions for depression (i.e., Doyne et al., 1983; Greist et al., 1979; Kavanagh, Shepard, Tuck, & Oureshl, 1997) and anxiety (i.e., Bahrke & Morgan, 1978; Driscoll, 1976; Morgan, 1979;) as well as self-esteem (Calfas & Taylor, 1994; Gruber, 1986; McDonald & Hogdon, 1991; Spece, Poon, & Dyck, 1997), stress regulation (Long, 1984), energy levels (Sateia, Doghramji, Hauri, & Morin, 2000), PTSD symptoms (Schindler, 2010), and general mood (i.e., Folkins, 1976; Lichtman, 1983). However, while these studies have thoroughly established the mental health benefits of physical activity in a general sense, relatively little is known about how such activity might uniquely contribute to either resilience or recovery among specific at-risk populations.

Individuals exposed to early childhood maltreatment represent one population of particular interest. Although many of these individuals appear to demonstrate significant resilience in the face of such events, early psychological trauma has nevertheless been repeatedly identified as a crucial area for additional study and improved intervention. Toward this purpose, it is important not only to identify promising treatment protocols for those suffering the effects of such traumas, but also to better understand the factors contributing to notable resilience (or lack thereof) when confronted with traumatic adversity. For these reasons, my previous study (Nolen, 2013) endeavored to assess the specific potential of physical activity as a moderator of the negative impacts of psychological trauma. However, while the results of that study did indicate some intriguing relationships between trauma, physical activity, and psychological functioning,

it was clear that these interactions would benefit from further exploration in order to better understand their effects. With this in mind, the goal of the present study was to evaluate the relationships between childhood maltreatment, physical activity, and adult psychological functioning in far greater detail and with additional consideration of the various additional factors (gender, type of maltreatment, intensity of physical activity) that might

In the present study, results of initial correlational analysis were largely consistent with relationships identified in previous research. Among participating students, moderate-intensity physical activity was not significantly associated with psychological functioning, though hard physical activity demonstrated a positive relationship with this outcome. In addition, both childhood abuse and neglect were associated (negatively) as expected with college adjustment. Each of these results are consistent with existing data, which has identified greater benefits associated with higher-intensity physical activity (e.g., Brown et al., 2012b; Cox et al., 2011), as well as measurable deficits in adult psychological well-being resulting from early traumatic experience (e.g., Browne & Finkelhor, 1986; Cohen et al., 2009).

Multiple regression analyses of the presents study's primary research questions also revealed a number of significant results. In conducting these analyses, the primary goal of this study was to investigate the potential impact of physical activity on adult psychological outcomes following exposure to early childhood maltreatment. In addition, further attention was paid to how the inclusion of gender, intensity of physical activity, and type of maltreatment (i.e., abuse, neglect) might influence this relationship. In short, results of this study indicated that each of these factors did uniquely affect the interactive relationships between maltreatment, physical activity, and psychological functioning. While models including moderate physical activity and/or childhood neglect demonstrated no significant moderation effects between maltreatment

and physical activity, hard physical activity did significantly interact with childhood abuse in predicting adult psychological outcomes – though it demonstrated no such interaction with neglect. In addition, these moderation effects were uniquely expressed across genders. Whereas women demonstrated a stronger negative association between childhood abuse and psychological health at increasing levels of hard physical activity, such activity actually contributed to an apparent protective effect among male participants. In other words, hard physical activity was associated with increased vulnerability to negative abuse outcomes in female participants, while contributing to greater resilience among male participants. In contrast, while childhood neglect was independently and negatively associated with psychological functioning, its effects were not moderated in any way by participants’ physical activity habits.

Research Question 1: Gender

The relationship between gender, physical activity, and psychological outcomes following childhood maltreatment was investigated via comparison of multiple linear regression analyses run on both male and female portions of the study sample. In this analysis, hard-intensity physical activity was identified as significantly interacting with the effect of child abuse on college adjustment/psychological functioning among women, resulting in greater sensitivity to the impact of abuse at higher levels of physical activity. In contrast, men actually demonstrated *an increase* in activity-associated functioning benefits at higher levels of abuse.

Although the true cause of this disparity is impossible to determine based on this study alone, this phenomenon is likely best explained by unidentified differences in participants’ chosen type of physical activity, their reasons for engaging in physical activity, or disparities in the traumatic events suffered (and their consequences) among women as opposed to men. In particular, motives for engaging in exercise/physical activity have previously been identified as

critical to the outcomes associated with such activity (e.g., Tiggemann and Williamson, 2000). Whereas activity pursued for self-improvement or recreation may contribute greatly to general psychological well-being, activity motivated by compulsion, anxiety, low self-esteem and poor body image may even be associated with negative outcomes. And because college-aged women have been identified as particularly at-risk for engaging in physical activity based on these motives (Eglil et al., 2011) they may be more likely than men to demonstrate negative associations between quantity of such activity and psychological outcomes. In particular, if women who are exposed to especially high levels of childhood maltreatment are more likely (due to differences in societal gender roles, cultural values, or a variety of other factors) to partake in physical activity as a result of low self-esteem, poor body image, or attempts to alleviate anxiety, then this might partly explain the gender-differentiated moderation effects of the present study.

Alternatively, it may be that cultural values surrounding the practice of physical activity itself might account for some of disparity between male and female outcomes. Although no previous research could be found directly assessing this possibility, it may be that physical activity or exercise – and those who engage in it – might be viewed differently and/or experience disparate benefits based on the gender of the participant. Particularly in an environment such as a large U.S. college institution, where popular sports participation has historically been both highly emphasized and male-dominated, it might not be surprising to find significant differences in the social status, self-worth, etc. associated with these activities amongst men as opposed to women and vice versa. In the future, studies seeking to better understand the impacts of physical activity and exercise among participants of both genders may benefit from additional consideration of the potential cultural factors involved.

Another possible explanation for the observed gender differences in these models is that they simply reflect differential exposure to unique categories of trauma, each of which might contribute to subsequent differences in trauma-related pathology. Although this question was not a subject of the present paper's data analysis, some tentative inferences might be drawn from apparent differences in reported maltreatment experiences within the study sample. Of particular interest, women in the sample reported far greater exposure to sexual and emotional forms of abuse than did their male counterparts. Whereas 17.46% of women disclosed some form of sexual abuse, only 7.10% of men indicated the same. In addition, roughly 42.64% of women reported emotional abuse, as opposed to 36.10% of men. Within these subscales, items demonstrating a particular gender disparity included: "I was touched in a sexual way by a person older than me" (men 3.8%, women 13.2%), "I was sexually molested by a person older than me" (men 1.1%, women 10.2%), "I was sexually abused as a child (men 1.6%, women 6.7%), and "I was emotionally maltreated by a parent/guardian (men 16.4%, women 24.4%). Given the pattern of women more frequently-reporting sexual and emotional forms of abuse than men, and the documented associations between these abuses and negative body image (e.g., Kearney-Cooke & Ackard, 2000; Wenniger & Helman, 1998) – which itself has been associated with maladaptive exercise patterns (e.g., Gulker, Laskis, & Kuba, 2010; Shroff et al., 2006), these disparities might partially explain the observed gender differences in post-trauma activity/health patterns in the present study.

Research Question 2: Category of Maltreatment

Notably, while childhood abuse was identified as interacting uniquely with hard physical activity in predicting outcomes among both men and women, childhood neglect did not contribute to any interaction/moderation effects in any of the analyzed models. This effect may

have a number of implications, one of which is also relevant to the gender/sexual abuse theory outlined above. In short, if we presume that the gendered differences in physical activity/abuse interactions reflect (in part) disparate exposure to sexual and emotional abuses and their subsequent effects on body image/self-esteem, then childhood neglect – which includes neither of these traumas – might be less likely to engender harmful exercise patterns among those exposed.

However, this explanation does not fully account for the fact that hard physical activity appeared to protect against the effects of abuse amongst men, but not against the corresponding effects of neglect on that same group. In part, this outcome may simply reflect the findings of previous research (e.g., Gauthier, 1996), which has identified childhood neglect as generally contributing to greater pathology and being more resistant to intervention/protective factors than childhood abuse. Alternatively, it may be that childhood abuse – characterized by disciplinary, aggressive parenting styles rather than the lack of parent/child interaction associated with neglect – somehow pushes men toward or prepares them for successful participation in later athletics.

Research Question 3: Intensity of Physical Activity

In comparing the differences between moderate and hard physical activity as they relate to childhood maltreatment and psychological functioning, a number of obvious differences were noted. In particular, moderate physical activity was neither independently predictive of psychological functioning, nor did it interact significantly with maltreatment variables in any of the tested models. In contrast, hard physical activity significantly predicted psychological functioning in all but the male childhood neglect model, and interacted significantly with childhood abuse in predicting the adult functioning among both women and men. As stated previously, these interactions resulted in a vulnerability effect within the female sample, and an

apparent resilience effect among the male sample.

As to why these differences might occur, a better understanding can likely be reached via further consideration of the specific types of physical activity encompassed at each PAR intensity. For example, it might be that hard physical activity represents the threshold of activity with both the greatest potential for benefit (e.g., social/recreational sports, healthy aerobic activity), as well as the highest likelihood of misuse (e.g., compulsive aerobic/cardio activity). In contrast, the lack of association between moderate physical activity and psychological functioning in the present study suggests that the activities encompassed within this variable are simply too minimal or mundane to exert any measurable effect on adult well-being.

Indeed, some general themes are apparent across activity intensities that may help to interpret the different outcomes associated with each of these categories. In particular, while “moderate” activity is largely comprised of nonaerobic, and low-exertion endeavors (e.g., walking, stretching), “hard” activity appears to be far more frequently aerobic (e.g., jogging, running, biking), and higher-exertion, as well as more frequently including traditional social/team-oriented activities (e.g., college sports). In addition, while much of the reported moderate activity (e.g., walking to class) appeared to be “necessary” or functional activity, hard physical activity – at least at face value – seemed to consist of more deliberate, intentional types – and thus potentially more likely to represent either compulsive or healthy/recreational activity. Consistent with this theory, “hard” activity encompassed not only the activities perhaps most likely to be misused (e.g., aerobic/cardio activities commonly associated with weight loss) but also the majority of social/recreational sports activity (e.g., football, basketball, track and field) that might potentially be of greatest benefit.

Limitations and Directions for Future Research

There are a number of limitations to the present study that should be considered both during the interpretation of these results and in the designing of any future research to further explore similar hypotheses. First, and perhaps most obviously, it should be noted that the sample included in this study was comprised entirely of undergraduate students who are likely to be in some ways more privileged or higher-functioning than the general population. In part, this was supported by the observed skew in many of the primary variable distributions, with negative predictors (e.g., CMQA, CMQN) demonstrating negative skew, and CAQ demonstrating mildly positive skew. In addition, the fact that all included subjects were – at the time of the survey – current participants in higher graduation suggests that they may have been somewhat inherently resilient in the face of previous trauma. If true, future studies may benefit from sampling from more diverse populations in order to assess individuals across the full spectrum of risk and resilience. In light of this, further research is recommended prior to generalizing the results of this analysis to more varied demographic populations.

In addition, there are a number of possible improvements that might be made upon this study's methods of assessing physical activity. Unfortunately, while the Physical Activity Recall is considered a valid measure of both short and long-term exercise habits (Dishman & Steinhardt, 1988), bulk measurement of total exercise participation does little to control for the presumably disparate effects of different exercise types (e.g., sports, jogging, etc.) – even when divided by intensity. This becomes especially problematic when considering the possibility of compulsive exercise, overtraining, or negative coping, each of which might contribute to significantly different outcomes than more adaptive forms of physical activity. Aside from discriminating the intensity of physical activity, the PAR survey utilized in this study was unable

to provide any further delineation of subject's intentionality or motive for engaging in activity. As a result, any subsequent interpretations of how these factors might contribute to the impact of exercise on post-trauma functioning can only be speculative in nature.

In future studies, it may be helpful to determine whether any reported physical activity is either deliberate (e.g., playing sports) or necessary (e.g., walking between classes), and what other motives might be associated with this activity (e.g., recreation, self-improvement, anxiety, poor body image). While the present study's results do indicate some significant differences in the associations between physical activity and mental health at different levels of trauma, the underlying reasons for this disparity are impossible to further discriminate. With a greater understanding of how these intentions and motives might contribute to participants' engagement in physical activity, it is expected that the associations between such activity, traumatic histories, sleep, and psychological functioning might become far more clearly interpretable.

In building upon the results of the present study, it may also be worthwhile to explore more fully the specifics of participants' trauma exposures (e.g., types of traumas suffered), as well as to better understand the psychological traits associated with different types of traumatic experience. In the present study, childhood maltreatment was only broadly divided into categories of abuse and neglect. However, previous research (e.g., Loos and Alexander, 1997; Prino and Pevrol, 1994) has suggested a variety of specific outcomes associated with more specific types of trauma, including sexual abuse, verbal abuse, physical abuse, etc. As a result, future examination of the relationships between traumatic experience, exercise participation, and psychological functioning is likely to benefit from a more detailed analysis of initial trauma exposure. For example, if sexual and/or verbal abuses are more likely to result in body image issues than physical abuse, they may be more commonly associated with maladaptive forms of

physical activity and subsequently unlikely to benefit from exercise or activity-based interventions. On the opposite side of the spectrum, it might be discovered that some forms of trauma contribute to increased participation in healthy recreational activity, perhaps as a way to escape an abusive home, to establish a positive support group, or to appease a harsh and demanding parent.

Finally, it must be acknowledged that another major limitation of the present study is its logistical reliance on retrospective self-report measures rather than a truly experimental approach incorporating activity-based intervention(s) along with a traditional control group to more directly measure the effect of physical activity on mental health among trauma-exposed populations. As a result, any conclusions drawn herein regarding the relationship between physical activity and risk/resilience are purely speculative in terms of the direction of that relationship. Does physical activity facilitate resilience among men exposed to child abuse, or is it simply that resilient men are more likely to engage in such activity than their peers? Among women, does high activity contribute to increased risk, or are the observed effects of this study more a reflection of high-risk women driven to exercise by their abusive pasts? In the future, the answers to these questions will be essential for effectively designing activity-based interventions for populations at-risk of or previously exposed to childhood abuse and trauma.

Overall, it was the goal of the present study to spark further inquiry into the possibilities of exercise or activity-based interventions for individuals exposed to or at-risk of trauma. And in many ways, the results of this analysis suggest that physical activity might have some interesting potential for this purpose, particularly among male populations. However, this study's lack of a true experimental structure means that any conclusions drawn from this data are limited to the correlational. For while the overall conclusions of this paper do suggest that physical activity

may benefit the majority of those exposed to childhood trauma and maltreatment, the real-world verification of this hypothesis remains a task for future exploration.

Conclusion

This study was designed to evaluate the presumed influence of physical activity on participant resilience and/or vulnerability and/or resilience to the impact of early childhood maltreatment, with a particular focus on how these effects might be influenced by gender, intensity of physical activity, and category of traumatic experience. Overall, the results of this analysis did indicate that each of these factors uniquely influenced the associations between childhood maltreatment, physical activity, and adult psychological functioning. Most significantly, the resulting moderation effects were uniquely expressed across genders. Whereas women exposed to childhood abuse appeared to demonstrate greater vulnerability to the influence of abuse at increasing levels of hard physical activity, similar activity actually contributed to increased resilience among male subjects. These results have a number of important implications associated with the future development of activity and exercise-based interventions for at-risk populations. In particular, health professionals should be encouraged to consider the specifics of an individual's trauma history, their attitudes toward exercise, their gender, and other factors associated with risk/resilience before implementing or recommending any activity-based interventions. For while physical exercise is generally presumed as a major contributor to health and well-being, this study suggests that this may not always be the case – particularly among individuals with significant histories of childhood trauma.

TABLES

Table 1.

Variable Means, Standard Deviations, and Intercorrelations – Full Sample

Variable	<i>M</i>	<i>SD</i>	1	2	3	4	5	6
1. CMQA	5.03	7.13	1					
2. CMQN	5.19	7.07	.66**	1				
3. PARM	7.2	5.19	.02	.04	1			
4. PARH	4.24	4.67	-.03	-	.18**	1		
5. GEN				1.1**			1	
6. CAQ	52.3	9.46	-.06	.02	.05	.11*		1
	6		.31**	.28**	.06	.19**	-.03	

*Indicates significance at <.05

**Indicates significance at <.01

Table 2.

Variable Means, Standard Deviations, and Intercorrelations Among Men

Variable	<i>M</i>	<i>SD</i>	1	2	3	4	5
1.	4.39	6.31	1				
CMQA							
2.	5.15	6.88	.68**	1			
CMQN							
3. PARM	7.66	5.94	.14	.20**	1		
4. PARH	5.13	5.23	-.03	-.10	.14	1	
5. CAQ	52.8	9.38	-	-	-.12	.16*	1
	3		.31**	.33**			

*Indicates significance at <.05

**Indicates significance at <.01

Table 3.

Variable Means, Standard Deviations, and Intercorrelations Among Women

Variable	<i>M</i>	<i>SD</i>	1	2	3	4	5
1.	5.31	7.47	1				
CMQA							
2.	5.22	7.15	.66**	1			
CMQN							
3. PARM	6.99	4.81	-.04	-.03	1		
4. PARH	3.84	4.33	-.15	-.11*	.20**	1	
5. CAQ	52.1	9.50	-	-.27*	-	.21**	1
	4		.30**		.14**		

*Indicates significance at <.05

**Indicates significance at <.01

Table 4.

Results of multiple regression analysis exploring moderate leisure physical activity as a potential moderator of the relationship between childhood maltreatment and college adjustment.

	<i>B</i>	<i>SE (B)</i>	<i>t</i>	<i>p</i>
Gender = Male				
Childhood Abuse	-1.76	.47	-3.78	<.001
Moderate Leisure Physical Activity	-.69	.66	-1.05	.29
Childhood Abuse x Activity	-.42	.41	-1.02	.31
Constant	57.31			
Gender = Male				
Childhood Neglect	-1.96	.46	-4.2	<.001
Moderate Leisure Physical Activity	-.43	.66	-.54	.52
Childhood Neglect x Activity	-.31	.39	-.81	.42
Constant	57.40			
Gender = Female				
Childhood Abuse	-1.82	.29	-6.31	<.001
Moderate Leisure Physical Activity	1.26	.49	2.59	.01
Childhood Abuse x Activity	.10	.29	.34	.73
Constant	52.11			
Gender = Female				
Childhood Neglect	-1.59	.29	-5.42	<.001
Moderate Leisure Physical Activity	1.29	.49	2.66	.01
Childhood Neglect x Activity	.09	.28	.32	.75
Constant	27.53			

Note: $R^2 = .11$ in male abuse model, $.12$ in male neglect model, $.10$ in female abuse model, and $.09$ in female neglect model

Table 5.

Results of multiple regression analysis exploring hard leisure physical activity as a potential moderator of the relationship between childhood maltreatment and college adjustment.

	<i>B</i>	<i>SE (B)</i>	<i>t</i>	<i>p</i>
Gender = Male				
Childhood Abuse	-2.04	.45	-4.59	<.001
Hard Leisure Physical Activity	1.20	.51	2.34	.02
Childhood Abuse x Activity	.72	.35	2.05	.04
Constant	52.20			
Gender = Male				
Childhood Neglect	-2.08	.45	-4.64	<.001
Hard Leisure Physical Activity	.88	.51	1.71	.09
Childhood Neglect x Activity	.35	.34	1.00	.31
Constant	54.85			
Gender = Female				
Childhood Abuse	-1.83	.28	-6.50	<.001
Hard Leisure Physical Activity	1.89	.40	4.76	<.001
Childhood Abuse x Activity	-.49	.22	-2.23	.03
Constant	52.20			
Gender = Female				
Childhood Neglect	-1.54	.30	-5.21	<.001
Hard Leisure Physical Activity	1.53	.40	3.83	<.001
Childhood Neglect x Activity	-.23	.24	.96	.34
Constant	52.25			

Note: $R^2 = .13$ in male abuse model, .13 in male neglect model, .15 in female abuse model, and .10 in female neglect model

FIGURES

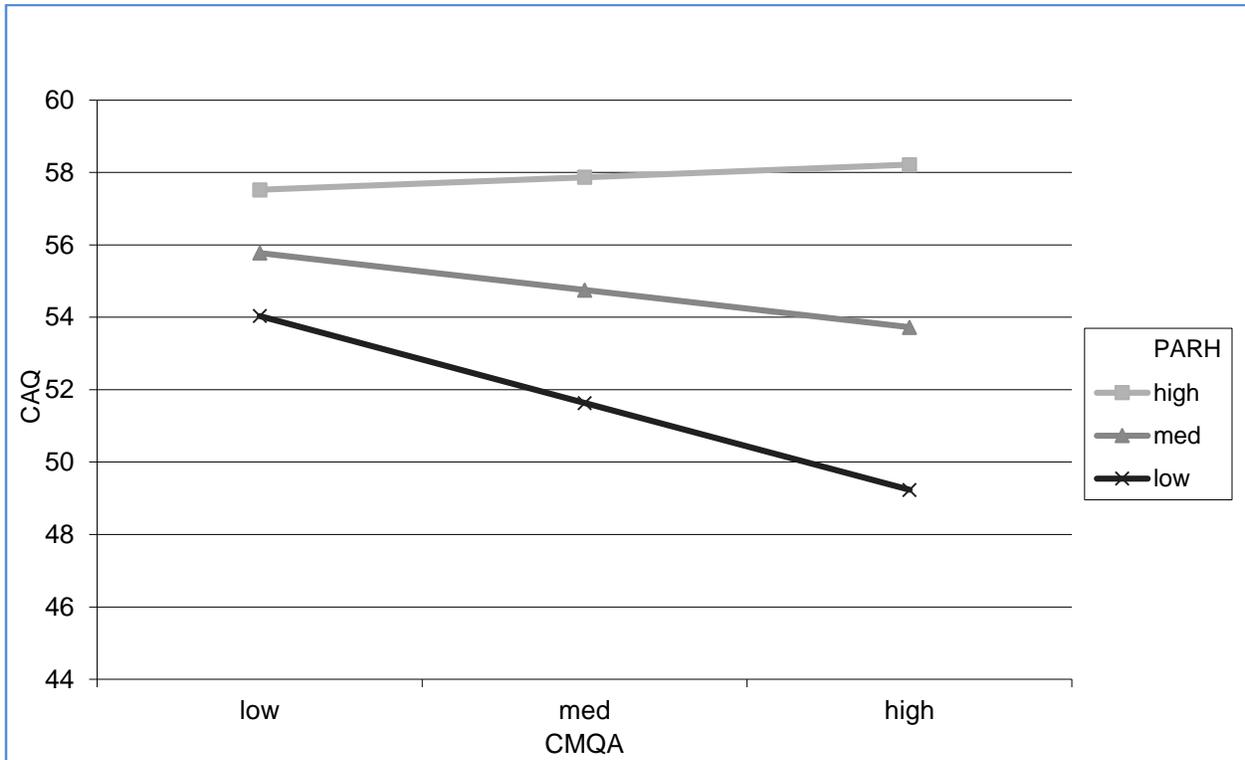


Figure 1. The Differential Effect of Childhood Abuse on College Adjustment by Hard-Intensity Physical Activity (Among Men).

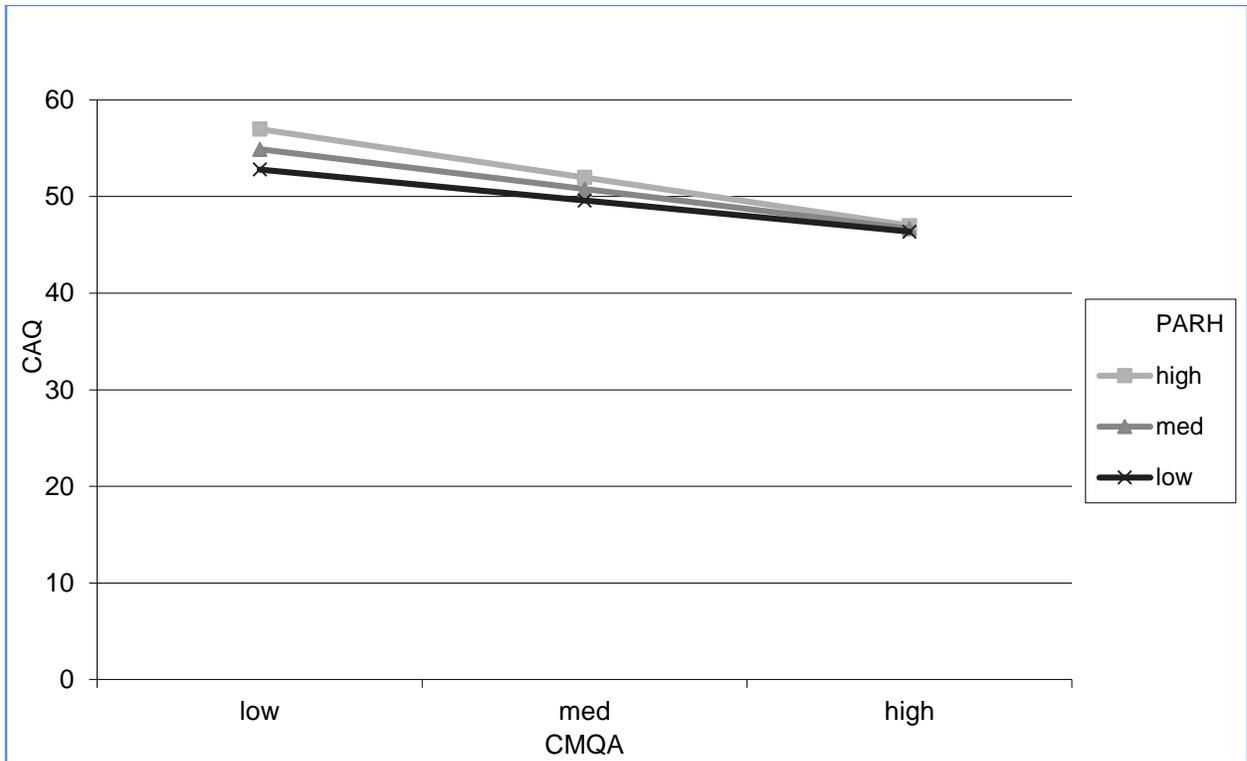


Figure 2. The Differential Effect of Childhood Abuse on College Adjustment by Hard-Intensity Physical Activity (Among Women).

REFERENCES

- Ackard, D. M., Brehm, B. J., & Steffen, J. J. (2010). Exercise and eating disorders in college-aged women: Profiling excessive exercisers. *Eating Disorders: The Journal of Treatment & Prevention, 10*, 31-47.
- Armsworth, M. W., & Holaday, M. (2001). The effects of psychological trauma on children and adolescents. *Journal of Counseling & Development, 72*, 49-56.
- Asoh, T., Takeuchi, Y., Tsuji, H. (1986). Effect of voluntary exercise on resistance to trauma in rats. *Circulatory Shock, 20*, 259-267.
- Atlantis, E., Chow, C. M., Kirby, A., & Singh, M. F. (2004). An effective exercise-based intervention for improving mental health and quality of life measures: A randomized controlled trial. *Preventative Medicine, 39*, 424-434.
- Bahrke, M. S., & Morgan, W. P. (1978). Anxiety reduction following exercise and meditation. *Cognitive Therapy and Research, 2*, 323-333.
- Breslau, N., Davis, G. C., Peterson, E. L., & Schultz, L. R. (2000). A second look at comorbidity in victims of trauma: The posttraumatic stress disorder-major depression connection. *Biological Psychiatry, 48*, 902-909.
- Brewin, C. R., Andrews, B., & Valentine, B. A. (2000). Meta-analysis of risk factors for posttraumatic stress disorder in trauma-exposed adults. *Journal of Counseling and Clinical Psychology, 68*, 748-766.
- Brown, B. M., Peiffer, J. J., Sohrabi, H. R., Mondai, A., Gupta, V. B., Rainey-Smith, S. R., Taddei, K., Burnham, S., Ellis, K. A., Szoeki, C., Masters, C. L., Ames, D., Rowe, C. C., Martins, R. N., & the AIBL research group (2012). Intense physical activity is associated with cognitive performance in the elderly. *Transl Psychiatry, 2012*, 1-6.

- Brown, H. E., Pearson, N., Braithwaite, R. E., Brown, W. J., & Biddle, S. J. H. (2012). Physical activity interventions and depression in children and adolescents. *Sports Med*, *43*, 195-206.
- Browne, A. & Finkelhor, D. (1986). Impact of child sexual abuse: A review of the research. *Psychological Bulletin*, *99*, 66-77.
- Calfas, K.J., & Taylor, W.C. (1994). Effects of physical activity on psychological variables in adolescents. *Pediatric Exercise Science*, *6*, 406–423.
- Centers for Disease Control (1997). *Adverse Childhood Experiences Study*. Available from: <http://www.cdc.gov/violenceprevention/acestudy/>
- Centers for Disease Control (2008). The effectiveness of interventions to reduce psychological harm from traumatic events among children and adolescents: A systematic review. *American Journal of Preventative Medicine*, *35*, 287-313.
- Chandy, J.M., Blum, R.W., & Resnick, M.D. (1996). Gender-specific outcomes for sexually abused adolescents. *Child Abuse & Neglect*, *20*, 1219-1231.
- Clemmons, J.C., Walsh, K., DiLillo, D., and Messman-Moore, T.L. (2007). Unique and combined contributions of multiple child abuse types and abuse severity to adult trauma symptomatology. *Child Maltreatment*, *12*, 172-181.
- Collishaw, S., Pickles, A., Messer, J., Rutter, M., Shearer, C., & Maughan, B. (2007). Resilience to adult psychopathology following childhood maltreatment: Evidence from a community sample. *Child Abuse and Neglect*, *31*, 322-327.
- Cotman, C. W., & Berchtold, N. C. (2002). Exercise: a behavioral intervention to enhance brain health and plasticity. *Trends in neurosciences*, *6*, 295-301.

- Craft, L.L. (1997). *The effect of exercise on clinical depression and depression resulting from mental illness: A meta-analysis*. Unpublished master's thesis, Arizona State University, Tempe.
- Diaz, A. B., & Motta, R. W. (2008). The effects of an aerobic exercise program on posttraumatic stress disorder symptom severity in adolescents. *International Journal of Emergency Mental Health, 10*, 49-59.
- Doyne, E. J., Chambless, D. L., & Beutler, L. E. (1983). Aerobic exercise as a treatment for depression in women. *Behavior Therapy, 14*, 434-440.
- Driscoll, R. (1976). Anxiety reduction using physical exertion and positive images. *The Psychological Record, 26*, 87-94.
- Egli, T., Bland, H. W., Melton, B. F., & Czech, D. R. (2011). Influence of age, sex, and race on college students' exercise motivation of physical activity. *Journal of American College Health, 59*, 399-406.
- Felitti, V. J., Anda, R. F., Nordenberg, D., Williamson, D. F., Spitz, A. M., & Edwards V. (1998). Relationship of childhood abuse and household dysfunction to many of the leading causes of death in adults. The Adverse Childhood Experiences (ACE) Study. *American Journal of Preventative Medicine, 14*, 245-258.
- Finkelhor, D., Turner, H., Ormond, R., & Hamby. S. (2009). Violence, abuse, and crime exposure in a national sample of children and youth. *Pediatrics, 124*, 1411-1423.
- Fitzpatrick, K. M., & Boldizar, J. P. (1993). The prevalence and consequences of exposure to violence among African-American youth. *Journal of the American Academy of Child and Adolescent Psychiatry, 32*, 424-430.

- Folkins, C. H. (1976). Effects of physical training on mood. *Journal of Clinical Psychology, 32*, 385-388.
- Gauthier, L. (1996). Recall of childhood neglect and physical abuse as differential predictors of current psychological functioning. *Child Abuse & Neglect, 20*, 549-559.
- Gauvin, L. & Brawley, L. R. (1993). Alternative psychological models and methodologies for the study of exercise and affect. In P. Seraganian (Ed.), *Exercise Psychology: The influence of physical exercise on psychological processes* (pp. 146-171). New York: John Wiley & Sons, Inc.
- Green, B., Goodman, L. A., Krupnick, J. L., Corcoran, C. B., Petty, R. M., Stockton, P., & Stern, N. M. (2000). Outcomes of single versus multiple trauma exposure in a screening sample. *Journal of Traumatic Stress, 13*, 271-286.
- Greist, J. H., Klein, M. H., Eischens, R. R., Faris, J., Gurman, A. S., & Morgan, W. P. (1979). Running as treatment for depression. *Comprehensive Psychiatry, 20*, 41-54.
- Gruber, J. J. (1986). Physical activity and self-esteem development in children. In G.A. Stull & H.M. Eckert (Eds.), *Effects of physical activity and self-esteem development in children*. Champaign, IL: Human Kinetics Publishers.
- Gulker, M. G., Laskis, T. A., & Kuba, S. A. (2001). Do excessive exercisers have a higher rate of obsessive-compulsive symptomatology? *Psychology, Health & Medicine, 6*, 387-398.
- Hassmén, P., Koivula, N., & Uutela, A. (2002). Physical exercise and psychological well-being: A population study in Finland. *Preventive Medicine, 30*, 17-25.
- Helm, C., & Nemeroff, C. B. (2001). The role of childhood trauma in the neurobiology of mood and anxiety disorders: Preclinical and clinical studies. *Biological Psychiatry, 49*, 1023-1039.

- Howell, D. C. (2007). *Statistical methods for psychology (6th ed.)*. Belmont, CA: Thomson Wadsworth.
- Iannos, M., & Tiggemann, M. (1997). Personality of the excessive exerciser. *Personality and Individual Differences, 22*, 775-778.
- Jacks, D. E., Sowash, J., Anning, J., McGloughlin, T., & Andres, F. (2002). Effect of exercise at three exercise intensities on salivary cortisol. *Journal of Strength & Conditioning Research, 16*, 286-289.
- Karver, M. S., Handelsman, J. B., Fields, S., & Bickman, L. (2006). Meta-analysis of therapeutic relationship variables in youth and family therapy: The evidence for different relationship variables in the child and adolescent treatment outcome literature. *Clinical Psychology Review, 26*, 50-65.
- Kavanagh, T., Shepard, R. J., Tuck, J.A., Qureshi, S. (1977). Depression following myocardial infarction: The effects of distance running. *Ann N Y Acad Sci., 301*, 1029-1038.
- Kilpatrick, D., et al. (2000). Risk factors for adolescent substance abuse and dependence: Data from a national sample. *Journal of Consulting and Clinical Psychology, 68*, 19-30.
- Kearney-Cooke, A. & Ackard, D. M. (2000). The effects of sexual abuse on body image, self-image, and sexual activity of women. *The Journal of Gender-Specific Medicine, 3*, 54-60.
- Koenen, K.C., Moffitt, T.E., Caspi, A., Taylor, A., & Purcell, S. (2003). Domestic violence is associated with environmental suppression of IQ in young children. *Development and Psychopathology, 15*, 297-311.

- Kramer, A.F., Hahn, S., Cohen, N.J., Banich, M.T., McAuley, E., Harrison, C.R., Chason, J., Vakil, E., Bardell, L., Boileau, R.A., & Colombe, A. (1999). Aging, fitness, and neurocognitive function. *Nature*, *400*, 418-419.
- Kugler, J., Seelback, H., & Krüskemper, G.M. (1994). Effects of rehabilitation exercise programmes on anxiety and depression in coronary patients: A meta-analysis. *British Journal of Clinical Psychology*, *33*, 401–410.
- Landers, D.M., & Petruzzello, S.J. (1994). Physical activity, fitness, and anxiety. In C. Bouchard, R.J. Shephard, & T. Stevens (Eds.), *Physical activity, fitness, and health*. Champaign, IL: Human Kinetics Publishers.
- Lichtman, S., & Poser, E. G. (1983). The effects of exercise on mood and cognitive functioning. *Journal of Psychosomatic Resilience*, *27*, 43-52.
- Litz, B. T., Gray, M. J., Bryant, R. A., & Adler, A. B. (2006). Early intervention for trauma; Current status and future directions. *Clinical Psychology: Science and Practice*, *9*, 112-134.
- Long, B.C., & van Stavel, R. (1995). Effects of exercise training on anxiety: A meta-analysis. *Journal of Applied Sport Psychology*, *7*, 167–189.
- Maniam, J., & Morris, M. J. (2010). Voluntary exercise and palatable high-fat diet both improve behavioural profile and stress responses in male rats exposed to early life stress: Role of hippocampus. *Psychoneuroendocrinology*, *35*, 1553-1564.
- Mastorakos, G., Pavlatou, M., Diamanti-Kandarakis, E., & Chrousos, G. P. (2005). Exercise and the stress system. *Hormones*, *4*, 73-89.
- MacMillan, H.L., Fleming, J.E., Steiner, D.L., Lin, E., Boyle, M.H., Jamieson, E., et al. (2001). Childhood abuse and lifetime psychopathology in a community sample.

- American Journal of Psychiatry*, 158(11), 1878-1883.
- McCutcheon, V. V., Sartor, C. E., Pommer, N. E., Bucholz, K. K., Nelson, E. C., Madden, P. A. F., & Heath, A. C. (2010). Age at trauma exposure and PTSD risk in young adult women. *Journal of Traumatic Stress*, 23, 811-814.
- McDonald, D.G., & Hodgdon, J.A. (1991). *The psychological effects of aerobic fitness training: Research and theory*. New York: Springer-Verlag.
- McGloin, J.M. & Widom, C.S. (2001). Resilience among abused and neglected children grown up. *Development and Psychopathology*, 13, 1021-1038.
- McNally, R. J., Bryant, R. A., & Ehlers, A. (2003). Does early psychological intervention promote recovery from posttraumatic stress? *Psychological Science in the Public Interest*, 4, 45-79.
- Medina, J. L., Vujanovic, A., A., Smits, J. A., Irons, J. G., Zvolensky, M. J., & Bonn-Miller, M. O. (2011). Exercise and coping-oriented alcohol use among a trauma-exposed sample. *Addictive Behaviors*, 36, 274-277.
- Maercker, A., Beauducel, A., & Schutzwohl, M. (2000). Trauma severity and initial reactions as precipitating factors for posttraumatic stress symptoms and chronic dissociation in former political prisoners. *Journal of Traumatic Stress*, 13, 651-660.
- Masten, A.S., Best, K.M. & Garmezy, N. (1990). Resilience and development: Contributions from the study of children who overcome adversity. *Development and Psychopathology*, 2, 425-444.
- Mohr, D., Vedantham, K., Neylan, T., Metzler, T. J., Best, S., & Marmar, C. R. (2003). The mediating effects of sleep in the relationship between traumatic stress and health symptoms in urban police officers. *Psychosomatic Medicine*, 65, 485-489.

- Mond, J. M. & Calogero, R. M. (2009). Excessive exercise in eating disorder patients and in healthy women. *Australian and New Zealand Journal of Psychiatry*, *43*, 227-234.
- Morgan, W. P. (1979). Negative addiction in runners. *The Physician and Sportmedicine*, *7*, 57-71.
- Mullen, P. E., Martin, J., L., Anderson, J. C., Romans, S. E., & Herbison, G. P. (1996). The long-term impact of the physical, emotional, and sexual abuse of children: A community study. *Child Abuse and Neglect*, *20*, 7-21.
- Newman, C. L., & Motta, R. W. (2007). The effects of aerobic exercise on childhood PTSD, anxiety, and depression. *International Journal of Emergency Mental Health*, *9*, 133-158.
- North, T.C., McCullagh, P., & Tran, Z.V. (1990). Effect of exercise on depression. *Exercise and Sport Science Reviews*, *18*, 379-415.
- Petruzzello, S.J., Landers, D.M., Hatfield, B.D., Kubitz, K.A., & Salazar, W. (1991). A meta-analysis on the anxiety-reducing effects of acute and chronic exercise. *Sports Medicine*, *11*, 143-182.
- Prino, C. T. & Peyrot, M. (1994). The effect of child physical abuse and neglect on aggressive, withdrawn, and prosocial behavior. *Child Abuse & Neglect*, *18*, 871-884.
- Preacher, K. J., Curran, P. J., & Bauer, D. J. (2006). Computational tools for probing interaction effects in multiple linear regression, multilevel modeling, and latent curve analysis. *Journal of Educational and Behavioral Statistics*, *31*, 437-448.
- Quirk, G. J., & Beer, J. S. (2006). Prefrontal involvement in the regulation of emotion: convergence of rat and human studies. *Curr Opin Neurobiol*, *16*, 723-727.
- Rose, S., & Bisson, J. (1998). Brief early psychological interventions following trauma: A systemic review of the literature. *Journal of Traumatic Stress*, *11*, 697-710.

- Rubin, D.B. (1987). *Multiple Imputation for Nonresponse in Surveys*. J. Wiley & Sons, New York.
- Sateia, M. J., Doghramji, K., Hauri, P. J., & Morin, C. M. (2000). *Sleep*, 23, 243-308.
- Schindler, R. T. (2010). *Relations among exercise patterns, life satisfaction, and PTSD related symptoms*. Unpublished doctoral dissertation, Yeshiva University, New York.
- Shirley, L. A., Park, S. S., & Rosen, L. A. (2013). *Measuring resilience to childhood maltreatment in college students*. Unpublished manuscript, Colorado State University, Fort Collins, CO.
- Shirley, L. & Rosén, L. A. (2010a). *The childhood maltreatment questionnaire: A measure of abuse and neglect*. Unpublished master's thesis, Colorado State University, Fort Collins.
- Shirley, L. & Rosén, L. A. (2010b). *The college adjustment questionnaire: A measure of student's academic, social, and emotional adjustment to the college environment*. Unpublished master's thesis, Colorado State University, Fort Collins.
- Shroff, H. M., Reba, L., Thornton, L. M., Tozzi, F., Klump, K. L., Berrettini, W. H., Brandt, H., Crafwofr, S., Crow, S., Fichter, M. M., Goldman, D., Halmi, K. A., Johnson, C., Kaplan, A. S., Keel, P., LaVia, M., Mitchell, J., Rotondo, A., Strober, M., Treasure, J., Woodside, D. B., Kaye, W. H., & Bulik, C. M. (2006). Features associated with excessive exercise in women with eating disorders. *International Journal of Eating Disorders*, 39, 454-461.
- Singh, N. A., Clements, K. M., & Fiatarone, M. A. (1997). A randomized controlled trial of the effect of exercise on sleep. *Sleep, Sleep Deprivation, and Daytime Activities*, 20, 95-101.

- Soloman, E. P., & Heide, K. M. (1999). Type III trauma: toward a more effective conceptualization of psychological trauma. *Int J Offender Ther Comp Criminol*, 43, 202-210.
- Sonstroem, R. J., & Morgan, W. P. (1989). Exercise and self-esteem: Rational and model. *Medicine & Science in Sports and Exercise*, 21, 329-337.
- Sothmann, M. S., Buckworth, J., CLaytor, R. P., Cox, R. H., White-Whelkley, J. E., & Dishman, R. K. (1996). Exercise training and the cross-stressor adaptation hypothesis. *Exercise and Sport Sciences Reviews*, 24, 267-288.
- Spano, L. (2001). The relationship between exercise and anxiety, obsessive-compulsiveness, and narcissism. *Personality and Individual Differences*, 30, 87-93.
- Spauwen, J., Krabbendam, L., Lieb, R., Wittchen, H., & van Os, J. (2006). Impact of psychological trauma on the development of psychotic symptoms: relationship with psychosis proneness. *The British Journal of Psychiatry*, 188, 527-533.
- Spence, J. C., Poon, P., & Dyck, P. (1997). The effect of physical-activity participation on self-concept: A meta-analysis (Abstract). *Journal of Sport and Exercise Psychology*, 19, S109.
- Stephens, T. (1988). Physical activity and mental health in the United States and Canada: Evidence from four population surveys. *Preventive Medicine*, 17, 35-47.
- Tabachnick, B. G., & Fidell, L. S. (2007). *Using multivariate statistics (5th ed.)*. Boston: Allyn and Bacon.
- Terr, L. C. (1991). Childhood traumas: An outline and overview. *American Journal of Psychiatry*, 148, 10-20.

- Tiggemann, M. & Williamson, S. (2000). The effect of exercise on body satisfaction and self-esteem as a function of gender and age. *Sex Roles, 43*, 119-127.
- U.S. Department of Health and Human Services, Administration for Children and Families, Administration on Children, Youth and Families, Children's Bureau. (2010). *Child Maltreatment 2009*. Available from http://www.acf.hhs.gov/programs/cb/stats_research/index.htm#can.
- U.S. Department of Health and Human Services, Administration for Children and Families, Administration on Children, Youth and Families, Children's Bureau. (2012). *Child Maltreatment 2011*. Available from <http://www.acf.hhs.gov>
- Van der Kolk, B. A. (1987). *Psychological Trauma*. Washington, DC: American Psychiatric Press.
- Wenniger, K. & Heiman, J. R. (1998). Relating body image to psychological and sexual functioning in child sexual abuse survivors. *Journal of Traumatic Stress, 11*, 543-62.

APPENDIX A

Demographic Questionnaire:

1. What is your age? ___ years old
2. What is your gender? (please choose one)
 Male
 Female
 Transgender
 I prefer not to answer
3. What race/ethnicity do you identify with the most? (please choose one)
 African American/Black
 Alaska Native
 American Indian/Native American
 Asian American
 Caucasian/White
 Hawaiian/Pacific Islander
 Latino or Hispanic
 Middle Eastern American
 Other (Please specify: _____)
4. What is your current employment status? (please choose one)
 Employed full-time
 Employed part-time
 Unemployed
5. Please indicate the highest level of education achieved by your father:
 Some high school
 High school graduate or GED recipient
 Some college
 College graduate
 Graduate degree (e.g., M.S., M.A.)
 Doctoral degree (e.g., Ph.D., M.D.)
6. Please indicate the highest level of education achieved by your mother:
 Some high school
 High school graduate or GED recipient
 Some college
 College graduate
 Graduate degree (e.g., M.S., M.A.)
 Doctoral degree (e.g., Ph.D., M.D.)
7. Are you religiously affiliated?
 No
 Yes

APPENDIX B

Childhood Maltreatment Questionnaires - Abuse (CMQ-A)

Listed below are statements that describe experiences with maltreatment that people may have had when they were growing up. Some of the experiences can be very common and others not as common. **Please indicate how often each of the following occurred while you were a child.** So that you can describe your experiences in an honest manner, your responses will be kept in absolute confidence. Please read each statement carefully, and then circle the number that best describes your experience.

Response Options

- 1: Never
- 2: Rarely
- 3: Sometimes
- 4: Often
- 5: Very Often

When I was a child:	Never				Very Often
1. I was hit hard enough by a parent/guardian to have to receive medical care.	1	2	3	4	5
2. I was touched in a sexual way by a person older than me.	1	2	3	4	5
3. I felt cared for by my parents/guardians.	1	2	3	4	5
4. One of my caregivers said degrading things to me.	1	2	3	4	5
5. I was physically hurt by a parent/guardian.	1	2	3	4	5
6. I felt safe with all of my caregivers.	1	2	3	4	5
7. I was emotionally maltreated by a parent/guardian.	1	2	3	4	5

8. I was hit hard enough by a parent/guardian to leave marks on my skin.	1	2	3	4	5
9. I was sexually molested by a person older than me.	1	2	3	4	5
10. I could trust that none of my caregivers would intentionally hurt me.	1	2	3	4	5
11. I was sexually abused as a child.	1	2	3	4	5
12. A caregiver said things that indicated they cared very little for my wellbeing.	1	2	3	4	5
13. One of my caregivers physically abused me.	1	2	3	4	5
14. A person older than me made me show them my genitals for their sexual gratification.	1	2	3	4	5
15. I felt supported by all of my caregivers.	1	2	3	4	5
16. A parent/guardian emotionally abused me.	1	2	3	4	5
17. I experienced non-accidental physical injury from a parent/guardian.	1	2	3	4	5
18. I was coerced into unwanted sexual behavior.	1	2	3	4	5
19. All of my caregivers were “there for me” when I was growing up.	1	2	3	4	5

APPENDIX C

Childhood Maltreatment Questionnaires – Neglect (CMQ-N)

Listed below are statements that describe experiences with maltreatment that people may have had when they were growing up. Some of the experiences can be very common and others not as common. **Please indicate how often each of the following occurred while you were a child.** So that you can describe your experiences in an honest manner, your responses will be kept in absolute confidence. Please read each statement carefully, and then circle the number that best describes your experience.

Response Options

- 1: Never
- 2: Rarely
- 3: Sometimes
- 4: Often
- 5: Very Often

When I was a child:	Never		Very Often		
1. I was left alone and unsupervised for significant periods of time as a young child.	1	2	3	4	5
2. One of my caregivers did not bathe me, even when I was clearly dirty.	1	2	3	4	5
3. One of my caregivers failed to provide adequate emotional care for me.	1	2	3	4	5
4. I felt cared for by my parents/guardians.	1	2	3	4	5
5. My physical care was neglected by a parent/guardian.	1	2	3	4	5

6. A parent/guardian refused or failed to provide the affection I needed.	1	2	3	4	5
7. I felt safe with all of my caregivers.	1	2	3	4	5
8. My emotional needs were not met by a parent/guardian.	1	2	3	4	5
9. I had to fend for myself because there was no one around to supervise me.	1	2	3	4	5
10. I went hungry because a parent/guardian did not feed me.	1	2	3	4	5
11. I felt supported by all of my caregivers.	1	2	3	4	5
12. A parent/guardian left me by myself even though there should have been someone watching me.	1	2	3	4	5
13. All of my caregivers were “there for me” when I was growing up.	1	2	3	4	5
14. I was emotionally neglected by a parent/guardian.	1	2	3	4	5
15. A caregiver did not dress me appropriately for the weather.	1	2	3	4	5
16. I could trust that none of my caregivers would intentionally hurt me.	1	2	3	4	5

APPENDIX D

Seven-Day Physical Activity Recall Questionnaire

This questionnaire is called the Seven-Day Physical Activity Recall. The information from it will be used to estimate the number of calories you burn up through physical activity. For questions regarding the number of hours you spend engaging in various activities, **please round to the nearest half-hour.**

1. On average, how many hours did you sleep each night during the last five weekday nights, Sunday through Thursday? _____

2. On average, how many hours did you sleep each night last Friday and Saturday nights? _____

Now you will be asked questions about your physical activity during the past seven days; that is, the last five weekdays and last weekend, Saturday and Sunday, even if this was not a typical week for you.

3. What moderate physical activities (i.e., walking, stretching, gardening, playing golf, etc.) did you do during the last five weekdays? Please list below:

How many hours did you spend during the last five weekdays doing these moderate activities or others like them? _____

4. What moderate activities did you do last Saturday and Sunday? Please list below:

How many hours did you spend last Saturday and Sunday doing these moderate activities? _____

5. Now let's look at hard activities. What *hard* physical activities (i.e., light jogging, yoga, lifting weights, etc.) did you do during the last five weekdays? Please list below:

How many hours did you spend during the last five weekdays doing these hard activities or others like them? _____

6. What hard activities did you do last Saturday and Sunday? Please list below:

How many hours did you spend last Saturday and Sunday doing these activities? _____

7. Now let's look at very hard activities. What *very hard* activities (i.e., strenuous running, competitive sports, vigorous bike-riding, etc.) did you do during the last five weekdays? Please list below:

How many hours did you spend during the last five weekdays doing these very hard activities or others like them? _____

8. What very hard activities did you do last Saturday and Sunday? Please list below:

How many hours did you spend last Saturday and Sunday doing these very hard activities? _____

9. Were you gainfully employed, that is, did you earn money for doing work during the last seven days?

___ Yes

___ No

If no, proceed to question 10

If yes, how many days?

How many hours per day? _____

How many of these hours per day were spent doing moderate activities? _____

How many of these hours per day were spent doing hard activities? _____

How many of these hours per day were spent doing very hard activities? _____

10. Compared to your physical activity over the past three months, was last week's physical activity more, less, or about the same?

More

Less

About the same

11. Compared to your physical activity during *high school*, was last week's physical activity more, less, or about the same?

More

Less

About the same

12. Compared to your physical activity during *middle school and/or junior high school*, was last week's physical activity more, less, or about the same?

More

Less

About the same

13. Compared to your physical activity during *elementary school*, was last week's physical activity more, less, or about the same?

More

Less

About the same

APPENDIX E

College Adjustment Questionnaire (CAQ)

Listed below are some statements that describe how college students might be feeling about their experience with college. **Please use the rating scale below to indicate how accurately each statement describes you *at this point in time*.** Please read each statement carefully, and then circle the number that corresponds to how accurately the statement describes you.

Response Options

- 1: Very Inaccurate
- 2: Moderately Inaccurate
- 3: Neither Inaccurate nor Accurate
- 4: Moderately Accurate
- 5: Very Accurate

Right now:	Very Inaccurate				Very Accurate
<i>(Academic Adjustment)</i>					
1. I am succeeding academically	1	2	3	4	5
5. I am doing well in my classes	1	2	3	4	5
7. I am happy with the grades I am earning in my classes	1	2	3	4	5
10. I am meeting my academic goals	1	2	3	4	5
13. I have performed poorly in my classes since starting college	1	2	3	4	5
<i>(Social Adjustment)</i>					
2. I don't have as much of a social life as I would like	1	2	3	4	5
4. I am happy with my social life at college	1	2	3	4	5
9. I have had a hard time making friends since coming to college	1	2	3	4	5
11. I am as socially engaged as I would like to be	1	2	3	4	5
14. I am satisfied with my social relationships	1	2	3	4	5
<i>(Emotional Adjustment)</i>					
3. I feel that I am doing well emotionally since coming to college	1	2	3	4	5
6. I am happy with how things have been going in college	1	2	3	4	5
8. I feel that I am emotionally falling apart in college	1	2	3	4	5
12. I have felt the need to seek emotional counseling since coming to college	1	2	3	4	5

APPENDIX F

Informed Consent

Thank you for agreeing to participate in my study. This form is designed to explain the purpose and procedures of the study and is an agreement for the protection of your rights as a human participant involved in psychological research. This project was reviewed by the Internal Review Board at Colorado State University and has been deemed ethical and risk free.

My name is Julian Nolen, and I am conducting this study in affiliation with Colorado State University in fulfillment of my thesis project. Dr. Lee Rosén is supervising this study. This study was designed to examine the relationships between traumatic life experiences, exercise habits, and adult psychological functioning. The surveys included in this study should take you approximately 15-30 minutes to complete. Please respond to all of the questions in this study, and with as much accuracy as possible. Your honesty is greatly appreciated.

You will not be required to record your name on any of the included surveys, nor will your name be attached to any data. Your signature is required on this form in order to verify that you have read and understand the nature of my study, but will not be associated with your individual test scores. No other identifying information will be required at any other point in this study, and all information will remain confidential. Your scores will be kept in a private, secure place, and they will not be shared with anyone. Because this analysis will focus on collective results, your individual responses will not be accessible to others.

Please note that your participation in this study is entirely voluntary. You are free to withdraw from this study at any time and for any reason.

If you have any further questions or wish to receive the results of this study you can reach me through email at Julian.Nolen@Colostate.edu

Researcher signature _____ **Date** _____

Participant signature _____ **Date** _____

APPENDIX G

Debriefing Information

Objective of Research

This study is concerned with the interaction between exposure to negative events, exercise habits, and current psychological functioning. Previous studies have suggested that exercise might help some people to recover from the negative effects traumatic life experiences. The present study will expand upon existing research by also examining whether physical activity might help to *prevent* the consequences of these experiences.

General Information

Your participation is greatly appreciated and will help psychologists to better understand the relationship between traumatic experiences, exercise habits, and psychological functioning. If you would like to receive a report of this research when it is completed (or a summary of the findings), please contact Julian Nolen at Julian.Nolen@colostate.edu. If your participation in this study has caused you concerns, anxiety, or otherwise distressed you, you may contact the CSU Counseling Center at 970-491-6053.

Confidentiality

All information collected in today's study will be confidential, and there will be no way of identifying your responses in the data archive. Identifying the responses of individual participants is not important. Instead, this research will be focused on examining general patterns that emerge when the data are aggregated together.

Please do not disclose research procedures and hypotheses to anyone who might participate in this study between now and the end of data collection, as this could affect the results of the study.

Thank you for your participation!