THE IMPACT OF PEER VICTIMIZATION ON ADOLESCENT INFLAMMATORY MARKERS

by

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Abstract

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For years, research has linked peer victimization to various outcomes, ranging from those in the psychological realm (e.g., depression, anxiety) to physical health symptoms (e.g., frequent doctor visits, abdominal pain). While there are many possible mechanisms responsible for this relationship, this study focused on immune system dysregulation, specifically concerning the inflammatory markers interleukin-6 (IL-6) and C-reactive protein (CRP). Prior research has found that environmental stress is related to increased production of these markers (e.g., Danese et al., 2007; Kiecolt-Glaser et al., 2003). Furthermore, elevated levels of IL-6 and CRP have been associated with health problems such as cardiovascular disease, cancer, and depression (e.g., Young et al., 1991; Kronfol, 2002). Regression analyses showed that overall victimization, but not bullying, predicted more depressive symptoms and physical health complaints in a sample of 76 adolescents (M_{age} = 15.85). Relational victimization also uniquely predicted levels of CRP and IL-6; CRP and IL-6 were also related to reported frequency and severity of health problems. Bullying and victimization interacted to predict depression, such that those who regularly perpetrated and experienced peer harassment (i.e., bully-victims) were faced with poorer outcomes. Mediation analyses revealed that depression

mediated the relationship between victimization and plasma circulation levels of IL-6 and between victimization and frequency of health symptoms. Process analysis revealed that this mediation relationship held only for those involved in mean and high levels of bullying. These results provide preliminary evidence that bullying and victimization is associated with inflammatory markers and that depression may be an important presage to inflammation and health problems.

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Chapter 1

Introduction

School-aged children and adolescents have long reported being victimized by their peers – some studies report as many as one out of three children are bullied (Hinduja & Patchin, 2010). This statistic may cause some to regard bullying as “everyday schoolyard behavior”, but the consequences of repeated physical, relational, and verbal aggression can be severe and long-lasting. The media has taken notice of some of the harsher outcomes of being bullied, even coining the term “bullycide” after highly publicized suicides were attributed to the internal torment felt by victims of their classmates’ cruelty (Marr & Field, 2001). However, many of the long-term detriments are not as easily noticed. Early-life stress, particularly maltreatment in childhood, has been implicated as an independent and preventable risk factor for systemic inflammation in adulthood (Carpenter et al., 2010). Increased production of certain pro-inflammatory markers has also been linked to cancer, autoimmune disease, depression, and even increased suicidality, thus complicating the link between peer victimization and negative health outcomes (e.g., Janelidze et al., 2011; Yamamura et al., 1998; Szalai, 2004). As such, this thesis examined whether children involved in bullying not only reported more depression and health problems but also had greater levels of inflammatory markers.

Defining Peer Victimization

Peer victimization, more colloquially known as bullying, is defined as the repeated exposure to the intentionally aggressive actions of one’s peers and has been identified as a serious problem in schools worldwide. Bullying is also characterized by an either real or perceived imbalance of power between the individuals involved (Olweus, 1993). However, the term does not apply to peers of similar status arguing or fighting with

one another, individuals teasing one another in a good-natured manner, or when a child or adolescent is the sporadic recipient of an aggressive act (Andreou, 2001). When empirically evaluating peer victimization, it can be considered as a continuum ranging from no abuse to frequent peer maltreatment. For this thesis, the term “victim” was used to denote those who scored high on the continuum and were frequent targets of bullying, while “bully” was used to describe those who report being frequent perpetrators of aggressive acts towards their peers. The outcomes of these individuals were compared to those of the “uninvolved” (adolescents who scored lower on the continuum and reported being neither frequent recipients nor committers of peer abuse).

Victimization manifests itself in many ways: verbally, physically, relationally, and in this modern age, through electronic media. Verbal victimization typically involves psychological abuse such as face-to-face name-calling and yelling, while physical victimization is often characterized by hitting, kicking, or shoving. Similarly, Crick and colleagues (e.g., Crick and Bigbee, 1998; Crick and Grotpeter, 1995) have described the harm of others through physical acts or threats of such behavior as “overt victimization.” Relational victimization, according to Crick, involves the damage (or threat of damage) to relationships as the means of maltreatment (see Crick et al., 1999 for a review). This may include such actions as gossiping, exclusion, spreading rumors, and other methods by which an individual may attack another’s relationships. Finally, bullying can also be committed via electronic communication. Patchin and Hinduja (2006) defined cyberbullying as “willful and repeated harm inflicted through the medium of electronic text,” although this description is often expanded to include posting or circulating hurtful pictures or videos, impersonating someone with the intent to harm, and “liking” or agreeing with negative posts made about an individual online. For this present thesis

proposal, we will examine the various subtypes and overall measures of victimization and bullying behaviors.

Consequences of Peer Victimization

Being the frequent recipient of aggressive behavior from others confers many negative outcomes. Many victims often react to this constant stress by “acting out,” and prior research has shown that persistently bullied children display externalizing behavior problems. Peer victimization has been correlated with delinquency, inattention in the classroom, and aggressive behavior in a diverse sample of elementary school students (Hanish & Guerra, 2002), and similar results were found for adolescents from a sexual minority (i.e., homosexual, bisexual, and questioning; Williams et al., 2004). Disciplinary issues are not the only concern – externalizing problems also take their toll on children’s scholastic performance. Attention problems on their own have long been linked to poor academic functioning (e.g., Hinshaw, 1992a; Mariani & Barkley, 1997), while antisocial behaviors and delinquency also undermine a child’s ability to excel in school, and are associated with problems later in life. Kokkinos and Panayiotou (2004) found that victimized children were also more likely to score highly on an oppositional-defiant disorder (ODD) scale based on the symptomatology provided by the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition Text Revision (DSM-IV-TR; American Psychiatric Association, 2000). Unfortunately, externalizing problems (and negative consequences in general) are not limited to victims of peer bullying – they also found that bullies were more likely to exhibit symptoms of conduct disorder, a childhood behavioral disorder that has been linked to the development of antisocial personality disorder in adulthood. These behavioral problems have been identified by researchers as

relatively stable and often resistant to intervention, making them a major concern for parents and school administrators alike (Olweus, 1979; Kazdin, 1995).

Peer victimization has also been linked to higher rates of internalizing problems such as depression, anxiety, affective disorders, and has been shown to predict future maladjustment. Recent meta-analytic reviews have elaborated on the relationship between bullying and internalizing problems, finding that being chronically victimized is related to anxiety, depression, and loneliness, and that social (i.e., relational) aggression may be more harmful than physical victimization (see Hawker & Boulton, 2000; Iyer, 2013). Rosen and colleagues (2009) also found that socially victimized children exhibited consistently higher levels of internalizing problems. Ironically, these internalizing and externalizing behavioral problems have also been identified as determinants of peer victimization – bullies often pick on others who are socially withdrawn, anxious, and/or disruptive – thus creating a vicious cycle that is difficult to escape (Perry, Hodges, & Egan, 2001).

Of these internalizing problems, the current thesis focused on depression, which has frequently been linked to involvement in peer victimization as well as the development of physical health problems. Research has found that the more frequently a child was victimized at age 8, the more likely that child would be anxious or depressed at age 11 (Averdijk, Müller, Eisner, & Ribeaud, 2011). Bullied children are repeatedly found to manifest more depressive symptoms and psychological distress than non-bullied children; this relationship is sometimes found for bullies as well (e.g., Slee, 1995; Forero et al., 1999). Depression is sometimes joined by a dangerous companion – thoughts about suicide, or suicidal ideation. Studies have shown that bullies and victims alike are at risk for suicidal ideation, more so than the “uninvolved” group of individuals (Roland, 2002). The same discrepancies were found between the groups when appraising suicide

attempts, with victimized adolescents being the most frequent attempters (Cleary, 2000). Suicide is the 10th leading cause of death in the United States, with over 30,000 occurring in 2005 alone (World Health Organization, 2012). In addition to the heightened potential for suicidal thoughts and attempts, depression has been linked to physical health symptoms. Rohde and colleagues (1994) found that adolescents who experienced a depressive episode showed an increase in physical health symptoms, and that early-onset depression may be more pernicious to health than when the disorder affects adults. Depression has also been found to predict medical problems (e.g., cerebrovascular disease, migraines, bladder and kidney infections, back pain) in both older adults and adolescents (e.g., Bardone et al., 1998; Katz, 1996).

Past research has also shown a link between peer victimization itself and health problems. Constant harassment by a peer can lead to the development of physical symptoms aside from the physical injuries that result from being hit or kicked. Knack and colleagues (2012) found that peer victimization predicted more severe and frequent health problems, and that victimized adolescents were more likely to have physician-diagnosed cardiovascular problems. Being bullied was also shown to predict increases in health problems in college students over the course of two semesters. In another study, children who reported being chronically bullied by their peers also reported more stomachaches, headaches, and dizziness (Gini, Carli, & Pozzoli, 2009). Additionally, peer victimization has been linked to alterations in physiological functioning in children and adolescents. Bullied children reported higher levels of stress and were found to exhibit a blunted cortisol awakening response (CAR) and hypothalamic-pituitary-adrenal (HPA) axis dysregulation (e.g., Vaillancourt et al., 2008; Knack, Jensen-Campbell, & Baum, 2011). Much like with internalizing and externalizing problems, health problems on their own have been shown to be a common predictor for poor scholastic performance and

other school problems, like absenteeism. For children who suffer from chronic bullying and health problems, these consequences are often exacerbated (Nishina, Juvonen, & Witkow, 2005).

Markers of Immune Functioning

Recent years have seen the focus of psychological research shift towards a more interdisciplinary approach, utilizing biological measures to examine various theoretical relationships. Previous efforts almost exclusively utilized data drawn from self-, parent-, and teacher-reports. The study of adolescent peer relationships is no exception – HPA axis dysregulation, genetic polymorphisms in the serotonin transport protein 5-HTTLPR, and monoamine oxidase A (MAOA) have all been the subject of such scientific inquiries as of late. This current study sought to evaluate a relationship that has remained relatively untouched by psychological investigation: the association between peer victimization, interleukin-6 (IL-6), and C-reactive protein (CRP). Specifically, this thesis assessed immune dysregulation (via these inflammatory markers) as a potential underlying mechanism explaining the relationship between victimization and health.

IL-6 is a pro- and anti-inflammatory signaling molecule (cytokine) secreted by T-cells, macrophages, and adipocytes to stimulate immune response. It is known to be one of the most important mediators of fever, and has been linked to various medical conditions ranging from autoimmune diseases to cancer. For example, circulating IL-6 levels were found to be higher in adult acute-type leukemia (lymphoma) patients compared to chronic-type patients (Yamamura et al., 1998). Additionally, those with increased levels of IL-6 were shown to have poorer overall survival periods than those with normal IL-6 concentrations.

The link between heightened levels of cytokines and depression is also well-documented; the expression of cytokines and other inflammatory markers in the blood is often distorted in patients suffering from depression and bipolar disorder. Early research indicated impaired immune functioning in depressed patients (Weisse, 1992) and that depression was more common in patients suffering from an illness with an immunological element (Kronfol, 2002). More recently, Janelidze and colleagues (2011) found increased plasma IL-6 circulation in depressed suicide attempters compared to non-suicidal depressed individuals and healthy controls. Given the complicated nature and varied evidence of the association between cytokines and depression, some researchers suggest that cytokines are mediators of depression, or at least of depressive symptoms (Dunn, Swiergiel, & Beaurepaire, 2005). This claim was investigated in this present thesis proposal, framed within the context of peer victimization.

CRP is an acute-phase protein, the secretion of which increases in response to inflammation. Its predictable nature has proven clinical utility, with data illustrating a significant association between increased CRP levels and severity of autoimmune disorders (Young et al., 1991). It is synthesized by the liver as a reaction to factors released by macrophages and adipocytes, including the cytokine IL-6. Hence, the two substances and their functions are closely intertwined.

Similar to IL-6, CRP has also been tied to depression in recent bio-psychological research. Copeland and colleagues (2012a) studied adolescents and young adults and found that cumulative depressive episodes were predictive of later increases in circulation CRP levels. Conversely, another study found that CRP predicted cognitive depression symptoms after controlling for baseline depressive symptoms (Gimeno et al., 2009). Both pathways have been illustrated by previous research, although this present study will focus on the latter example as part of the mediation analysis that will be

conducted (see Aim 3). Prior investigations have also linked CRP to generalized anxiety disorder (GAD; Copeland et al., 2012b) and post-traumatic stress disorder (PTSD; Miller et al., 2001), both of which are frequently comorbid with depression.

Both IL-6 and CRP have been studied as gauges of immunity; thus, it is only a reasonable step forward to examine their relationship with the adverse health outcomes linked to involvement in peer victimization. However, the specific biological mechanisms that govern immune functioning by way of IL-6 and CRP are beyond the scope of this current study. This thesis focused primarily on the effects of stressful peer interactions on circulatory plasma levels of IL-6 and CRP.

Immune Functioning and Stress

Recent research has illustrated various links between increased production of immune markers and stress. Miller, Cohen, and Ritchey (2002) found that even the stress experienced by parents of cancer patients was sufficient to impair the immune system's response to anti-inflammatory signals, resulting in higher production of IL-6 compared to the parents of healthy children. Similarly, Kiecolt-Glaser and colleagues (2003) found that caregivers of dementia patients exhibited an annual increase of IL-6 production that was approximately four times those of non-caregivers. Furthermore, levels of IL-6 did not differ between former caregivers (those whose spouse had died) and current caregivers, even several years after the death of the affected spouse. Examples of the long-term effects of stress on CRP levels in adults can be found in the vast body of literature. A longitudinal study conducted over the span of 32 years showed that maltreated children were 1.59 times more likely to have elevated levels of CRP in adulthood than those not maltreated in childhood (Danese et al., 2007). These maltreated children were also more

likely to experience stress, be in poor health, and engage in unhealthy behaviors as adults than non-maltreated children.

Despite the existing corpus of research concerning the relationship between increased production of IL-6 and CRP and stress, there is no empirical data linking peer victimization to these markers of immune functioning. To the extent that peer victimization is a stressor, children who are victimized and/or victimize others should have higher levels of both CRP and IL-6. As such, the main goal of this thesis was to examine whether children involved in peer victimization not only reported greater levels of depression and health problems but also had higher levels of IL-6 and CRP.

What about Bullies?

While much of empirical research has focused on the plight of those who experience frequent harassment from their peers, it is also important to consider the outcomes of other involved parties. Victims are not the only group who are adversely affected by bullying – the bullies themselves suffer from problems such as stomachaches, sleep disturbances, and psychosocial maladjustment (Nansel et al., 2001). In a study on over 5000 adolescents, Liang, Fisher, and Lombard (2007) found that those who chronically victimize their peers are more likely to participate in risky activities such as smoking, drinking alcohol, and carrying weapons. Symptoms of childhood behavioral disorders like conduct disorder and oppositional defiant disorder have also been linked to children who bully (Kokkinos & Panayiotou, 2004).

In addition to the two main groups who suffer the effects of peer victimization, researchers have also begun to delineate yet another affected group: the bully-victims, who both chronically engage in and fall victim to peer harassment. These individuals seem to possess the negative qualities of both bullies and victims, and may be subject to

the worst outcomes. Bully-victims are often characterized by heightened aggression and impaired self-control, thus exacerbating their situation (e.g., Hanish & Guerra, 2004, Schwartz, 2000). Haynie and colleagues (2001) found that in a sample of over 4000 American middle-schoolers, those who were identified as bully-victims were subject to poorer outcomes than bullies, victims, and the control groups in every psychosocial category that was evaluated; the long list included behavioral misconduct, self-control, deviant peer influences, social competence, school adjustment, depressive symptoms, and parental support, among others. Given these findings, it is important to continue the pursuit of knowledge about this fairly new category. However, bully-victims appear to constitute a small percentage (2-3%) of the total population (Solberg, Olweus, & Endresen, 2007), so the sample size associated with this current study was not sufficient to produce a distinct grouping of bully-victims using a person-centered approach. Consequently, analyses involved a variable-centered approach where the cross-product of bullying and victimization was examined in order to assess outcomes relevant to bully-victims.

Importance of Studying Adolescents

Bullying can and, for many, does occur in various points throughout the lifespan. However, the study of the topic is particularly valuable in adolescence. It is a time of great change – individuals experience significant changes in biological, cognitive, and social functioning during this period that greatly impact their relationships. The onset of puberty ushers in unprecedented physiological and hormonal changes that also influence behaviors and peer interactions. In addition to biological transformations, adolescents are faced with the transition from elementary school to middle school, and middle school to high school. Peers begin to play a larger role in socialization, as the time spent away

from the familial home increases and membership in (and identification with) a peer social group becomes more prominent (Harris, 1995). These social ties to other children have been shown to affect the likelihood of victimization – Perry, Hodges, and Egan (2001) reported that children who were widely disliked by their peers, lacked mutual friends, and participated in aggressive relationships were more likely to be chronically victimized. It is also during this developmental phase that researchers typically encounter the first clear signs of depression and increases in antisocial behavior (McAdams & Olson, 2010).

The combination of a shifting social environment with these internal changes leaves adolescents especially vulnerable to the negative outcomes of being involved in peer victimization. As psychologists continue to make strides in peer victimization research, many states have implemented anti-bullying laws in recent years. Further investigation of this subject will hopefully lead to more awareness of the harmful consequences of bullying, and a subsequent increase in practical applications of this knowledge (such as school anti-bullying programs).

Current Study

Prior research in this field has shown that environmental stress in the form of peer victimization is related to negative physical and psychological outcomes. In keeping with the trend of interdisciplinary study, this current thesis sought to incorporate biological markers of immunity into the current discussion on peer victimization. Specifically, the cytokine IL-6 and the protein CRP were examined, as well as their relationship to bullying and health outcomes. Both have been linked to the body's natural response to inflammation, which often arises out of environmental stress. They are also associated with health problems in adulthood such as heart disease, autoimmune disease, and

cancer. Based on this idea, stress in the form of peer victimization can cause elevated levels of both substances, which could in turn influence the individual's health both presently and later as an adult.

Aim 1: to determine if involvement in bullying, whether as a victim or a bully, predicts depression, poor physical health, and elevated levels of biological markers of immune functioning (namely IL-6 and CRP). I also sought to examine whether these relationships differed depending on the type of victimization experienced or perpetrated (e.g., physical, verbal, or relational).

Aim 2: to examine whether bullying and victimization interact to predict adverse outcomes in immune functioning, depression, and physical health. It was expected that individuals who score highly in both bullying and victimization (i.e., bully-victims) would experience worse outcomes than those who only receive high scores in one of the two categories.

Aim 3: to examine whether the relationship between peer victimization, depression, and physical health outcomes is mediated by alterations in immune functioning. Thus, it was predicted that chronically experiencing and/or perpetrating peer victimization would lead to elevated levels of the pro-inflammatory cytokine IL-6 and the related protein CRP. Given current knowledge of the implications of elevated levels of inflammatory markers, it was expected that higher levels of IL-6 and CRP would, in turn, predict greater physical health problems and depression (Figure 1). Conversely, it is possible that depression may be a precursor to health problems. As such, I examined whether depression mediated the link between being bullied and inflammatory markers (Figure 2) given that depression is often a presage to physical problems such as inflammation and altered endocrine functioning (e.g., Nemeroff & Goldschmidt-Clermont,

2012; Vaillancourt, Duku, Becker, Schmidt, Nicol, Muir, & MacMillan, 2011). I then examined whether higher inflammation led to more reported health problems (Figure 3).

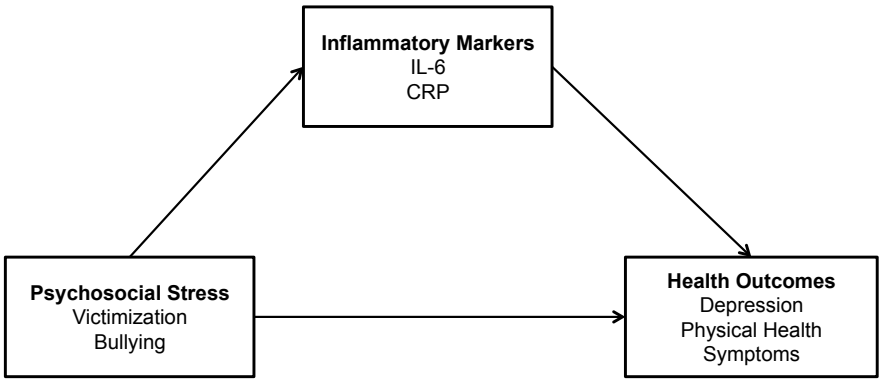


Figure 1. The proposed mediation model

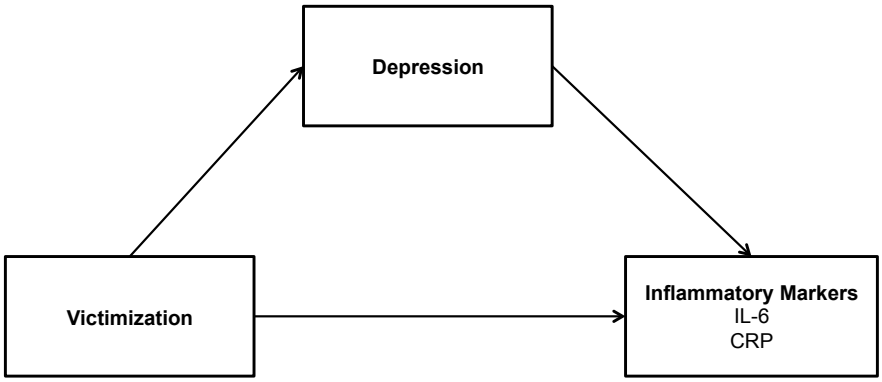


Figure 2. The revised mediation model

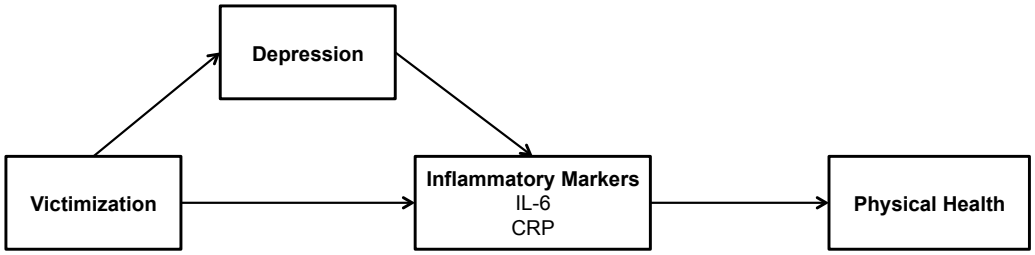


Figure 3. The extended mediation model

Chapter 2

Method

Participants

Participants consisted of 91 adolescent boys and girls in the 8th through 12th grades in various Dallas/Fort Worth area schools who were taking part in a larger ongoing study on peer relationships and health. However, I only evaluated concurrent relationships as they pertained to health and inflammatory markers. The sample was 53.8% female with an average age of 15.85 years (M_{grade} = 10.21), and was ethnically diverse. The ethnic composition was 62.2% white, 17.8% Hispanic/Latino, 14.4% black, and 5.5% Asian.

Recruitment

Several methods were used to initially recruit participants. First, adolescents were randomly selected from a mailing list obtained from area schools and contacted for possible participation in a study on friendship, peer relationships, and health. Additionally, researchers visited several Dallas/Fort Worth area schools to explain the scope of this project. Several local organizations, such as Big Brothers/Big Sisters, a dance and cheer academy, and various summer camps, were also contacted in order to recruit participants. Participants were also recruited via the Personality and Social Behavior lab's website; individuals and their parents who filled out an interest form were contacted about participation in this study. Adolescents and their parent were paid a total of $100.00 for their participation in this study.

Measures

The primary focus of this study was to examine the link between immune functioning (in the form of plasma levels of IL-6 and CRP) and peer victimization. Given

what we know about the consequences of peer victimization, we examined the participant's experiences with peer victimization, along with measures of depression and physical health. In order to limit shared method variance, both the adolescent and their parent completed almost all of the measures. Blood samples were drawn from the adolescents in order to evaluate circulation levels of IL-6 and CRP.

Adolescents also provided saliva samples for DNA and cortisol measurements and answered additional questionnaires as part of the larger on-going project. These measures, however, were not analyzed as part of this study.

Bullying and Victimization Measures

Children's Self-Experiences Questionnaire – Self-Report (CSEQ-SR)

The CSEQ (Crick & Grotpeter, 1995) is a self-report measure that assesses the child's experiences with peer relationships. Three subscales were used: one that measures overt victimization (e.g., "I get hit and pushed by other kids"), relational victimization (e.g., "I am ignored by other classmates when someone is mad at me"), and being the recipient of prosocial help (e.g., ""How often does another kid give you help when you need it?"). Each subscale consists of five frequency items, which range from 1 ("never") to 5 ("all the time"). An adapted parent-report form of the CSEQ was also administered to the parents during their lab visit. Cronbach's alpha for parent-reported overt victimization is $\alpha = .73$, and parent-reported relational victimization is $\alpha = .84$. For the self-reports, the alpha for overt victimization is $\alpha = .66$, and $\alpha = .81$ for relational victimization. There is no adapted form of the CSEQ for bullying behaviors; it will solely be used as a measure of victimization.

Direct and Indirect Aggression Scales (DIAS) – Victim and Bully Versions

The DIAS (Bjorkvist, Lagerspetz, & Osterman, 1992) victim and bully versions examine how frequently one experiences or commits acts of aggression and victimization on three different subscales: physical (e.g., “How often are you hit by/do you hit others?”), verbal (e.g., “How often are you insulted by/do you insult others?”), and indirect (e.g., “How often are you ignored by/do you insult others?”). Each version consists of 24 items scored on a Likert-type scale from 1 (“never”) to 5 (“very often”). Cronbach’s alpha for self-report victimization scales are as follows: α = .73 for physical, α = .86 for verbal, and α = .90 for indirect. For self-reported bullying: α = .69 for physical, α = .75 for verbal, and α = .80 for indirect. Parents also completed these questionnaires with respect to their child’s experiences and behaviors. Cronbach’s alpha for parent-reported victimization scales are as follows: α = .75 for physical, α = .87 for verbal, and α = .92 for indirect. For parent-reported bullying: α = .76 for physical, α = .83 for verbal, and α = .90 for indirect.

Physical and Psychological Health Outcomes

Achenbach: Child Behavior Checklist (CBCL) and Youth Self-Report (YSR)

The CBCL (Achenbach, 1991) is a parent questionnaire for examining problems in 6- to 18-year-olds. The part of the CBCL that was used in the present study contains 120 items on behavioral or emotional problems during the past six months. The possible answers are 0 (“not true”), 1 (“somewhat or sometimes true”), and 2 (“very true or often true”). The YSR (Achenbach, 1991) is a self-report scale containing approximately the same items and was completed by the participant. For this current study, the DSM-oriented affective composites, the anxious/depressed scale, and the withdrawn/depressed scale were used as a measure of depression for the participant.

Past research has demonstrated the reliability and validity of these measures in clinical settings.

Center for Epidemiological Studies Depression Scale for Children (CES-DC)

The CES-DC (Weissman, Orvaschel, & Padian, 1980) is a 20-item self-report scale (α = .69) that measures depressive symptoms in children, particularly how they have felt and acted within the past week. Sample items include: “I was bothered by things that usually don’t bother me,” “I didn’t sleep as well as I usually sleep,” and “I did not feel like eating, I wasn’t very hungry.” Items are measured on a Likert-type scale, from 0 (“not at all”) to 3 (“a lot”), with possible scores ranging from 0 to 60. A similar scale (α = .80) was adapted for parents to complete about their child’s depressive symptoms.

Health Survey

Participants answered 14 questions on frequency (α = .89) and 14 questions regarding the severity of their health problems (α = .90), including extreme fatigue, nausea, sleep problems, fever, headaches, chest pains, and visits to the nurse or doctor. Frequency items are rated from 0 (“not at all”) to 4 (“all the time”) and severity items are rated from 0 (“does not hurt at all”) to 4 (“unbearable pain”). An additional item, asking the participant to rate his/her overall health from 0 (“extremely poor”) to 5 (“excellent”), was also included in this measure. Parents completed the same measure, answering questions about their child’s health (α = .88 for frequency, α = .89 for severity).

Inflammatory Markers

Interleukin-6 (IL-6) and C-reactive protein (CRP)

Blood samples were taken from the adolescents via antecubital venipuncture by a certified phlebotomist. Approximately 4-5mL were taken during the in-lab session, which was scheduled at the same time of day for each participant (around 4-7 pm) in

order to control for diurnal patterns. The sample was then centrifuged and about 2mL of plasma was extracted and stored at -78°C until analyzed for IL-6 and CRP using Enzyme-Linked Immunoabsorbence Assay (ELISA) techniques. Plasma circulation levels of each marker, in picograms per milliliter (pg/mL; for IL-6) and nanograms per milliliter (ng/mL; for CRP), were used for the statistical analyses.

Procedure

A two-step consent process was utilized due to the involvement of minors in this study. Parents were asked to give consent for their child to participate, and the adolescents gave their assent as well. During the recruitment and sign-up period, parents of participants were notified of the blood extraction process and the questionnaires their children would be asked to complete.

Participation consisted of two sessions, both taking place at the University of Texas at Arlington. During Session 1, participants completed a series of questionnaires that assess victimization, depression, and physical health. Their accompanying parent also completed a set of questionnaires evaluating their child's victimization, depression, and physical health. These questionnaires were delivered concurrently but separately so that the two parties did not influence each other's responses. The adolescents then had a small DNA sample taken and were instructed on how to collect salivary cortisol for the larger study; neither of these measures were used in the current study. The researcher carefully debriefed the parent and child, and paid them for their participation in this session ($10.00 for the parent, $20.00 for the child). Session 1 lasted approximately 60 to 90 minutes.

For Session 2, the parent and adolescent returned to the Personality and Social Behavior Lab at UTA. Session 2 took place approximately one week after Session 1, and

appointments were made so that sessions took place from 4 to 6 pm for all participants. Once at the laboratory, the parent and child simultaneously completed the Achenbach measures (the CBCL for the parent and the YSR for the child) and additional online surveys assessing social support and personality. After the child completed these questionnaires, a research assistant escorted them to the 5th floor of the Life Science Building, to room 532. They were greeted by a certified phlebotomist, who then took a small (4 to 5mL) sample of the participant's blood via antecubital venipuncture. Once a sample was obtained, the participant returned to the Personality and Social Behavior Lab for debriefing and payment ($30.00 for the parent and $40.00 for the adolescent, for a total of $100.00 for the pair's participation in this study). Session 2 typically lasted 45 to 60 minutes.

The blood samples were then taken to the Genomics Core Facility at UTA. The samples were centrifuged and approximately 2mL of plasma were extracted from each within four hours (at the most) of collection to preserve their structural integrity. The plasma was frozen at -78°C until assayed. The Genomics Core Facility at the University of Texas at Arlington completed the assays using Enzyme-Linked Immunoabsorbence Assay (ELISA) techniques and returned data concerning the plasma circulating levels of both IL-6 and CRP.

Chapter 3

Results

Preliminary Analyses

Of the 91 participants, 15 (16.5%) elected not to take part in the blood extraction portion of the study. To determine whether these participants differed from the 76 individuals who chose to give a blood sample, a series of univariate analyses of variance (ANOVAs) were conducted. Analyses showed that the two groups did not significantly differ in any of the relevant variables for this study: victimization, bullying, depression, frequency of health symptoms, and severity of health symptoms. As such, the remainder of the statistical analyses for this thesis was conducted using only the 76 participants from whom a blood sample was taken.

Clustering participants into victimization groups (i.e., victims, bullies, etc.), as some previous studies have done, was not a suitable option due to the relatively small sample size. As such, victimization and bullying were treated as continuous variables in all main analyses. The purpose of taking this person-centered approach was twofold: preserving continuous variables prevented the further loss of power associated with categorization, as well as precluded the creation of additional sources of measurement error. In order to evaluate the outcomes of bully-victims (i.e., those who scored highly in both victimization and bullying measures), a cross-product of victimization and bullying scores was created and tested in a moderated regression analysis (Aim 2).

A series of bivariate correlations were conducted to determine the relationships between the various bullying and victimization subtypes. As expected, the five types of victimization measured (overt, relational, physical, verbal, indirect) were all significantly correlated with one another (Table C1). Similar results were found for the three bullying subtypes measured (physical, verbal, indirect; see Table C2).

Correlations to examine the agreement between child- and parent-reports were also performed. Of the five subtypes of victimization, responses concerning all but one were significantly correlated (Table C3). Interestingly, parents and adolescents disagreed on the adolescent's experiences of physical victimization. This discrepancy may be due to the physical aggression being inflicted only when the adolescent is among his/her peers or otherwise unsupervised by adults. Thus, parents may not have been able to pick up on these more obfuscated forms of aggression. Parents and their teenagers also differed on two of the three subtypes of bullying behaviors, only agreeing on the perpetration of verbal bullying (see Table C4). With regard to the measures of depressive symptoms, parents and adolescents were in agreement (Table C5). Intercorrelations were also produced for all of the main variables; see Table C6 for details; tables C1 through C6 are located in Appendix C. Findings for parent- and self-reports were examined separately, but the findings were comparable. As such, singular measures of victimization and bullying were used for further analyses.

Aim 1: Involvement in Bullying as a Predictor of Negative Outcomes

First, I examined whether involvement in bullying, whether as a victim or a bully, predicted depression, poor physical health, and elevated levels of biological markers of immune functioning (namely IL-6 and CRP). I also sought to examine whether these relationships differed depending on the type of victimization experienced or perpetrated (e.g., physical, verbal, or relational).

To test if victimization predicted negative outcomes, I ran iterative regression analyses with depression, physical health, and inflammatory markers as the dependent variables. To control for the effects of bullying, it was entered into the first block of the regression model, with victimization in the second block. For analyses involving

inflammatory markers, age and body mass index (BMI) were entered as additional covariates. Consistent with existing literature, victimization significantly predicted overall depressive symptoms, anxious depression, withdrawn depression, affective problems, frequency of health symptoms, and severity of health symptoms, even after controlling for bullying (see Table 1).

Table 1. Regression results of victimization/bullying predicting depression and health

Predictor	Outcome	*b*	SE_b	β	*t*	*p*	ΔR^2
Victimization	Depressive Symptoms	7.34	1.36	.72	5.40	< .001	.26
	Anxious/Depressed	0.85	0.18	.69	4.82	< .001	.23
	Withdrawn/Depressed	0.62	0.18	.51	3.42	.001	.13
	Affective Problems	0.70	0.16	.60	4.33	< .001	.18
	Frequency of Health Symptoms	4.69	1.51	.41	3.11	.002	.08
	Severity of Health Symptoms	5.75	1.31	.62	4.39	< .001	.19
	IL-6	0.03	0.08	.06	0.41	.686	.002
	CRP	0.00	0.14	.00	0.00	.999	.000
Bullying	Depressive Symptoms	-2.45	1.59	-.20	-1.54	.128	.02
	Anxious/Depressed	-0.47	0.20	-.32	-2.40	.018	.05
	Withdrawn/Depressed	-0.31	0.21	-.22	-1.52	.133	.02
	Affective Problems	-0.12	0.12	-.09	-0.64	.525	.004
	Frequency of Health Symptoms	1.04	1.78	.08	0.59	.560	.004
	Severity of Health Symptoms	-1.60	1.43	-.14	-1.12	.267	.01
	IL-6	-0.10	0.10	-.16	-1.03	.309	.01
	CRP	-0.11	0.18	-.10	-0.64	.523	.01

As part of Aim 1, I also examined whether subtypes of victimization were associated with these negative health outcomes. Iterative sets of regression analyses were conducted where overall bullying was entered on the first block and the subtype of victimization was entered on the second block. All five subtypes of victimization were not entered into the same equation due to problems with multicollinearity. Four out of five subtypes – overt, relational, verbal, and indirect – significantly predicted overall

depressive symptoms, frequency of health symptoms, and severity of health symptoms (Table 2). Relational victimization predicted increased IL-6 concentration, while physical victimization predicted decreased CRP levels, even after controlling for bullying, age, and BMI. This is consistent with Vaillencourt (2008), who found that only verbal victimization was related to altered endocrine functioning.

Table 2. Regression results of victimization subtypes predicting depression and health

Outcome	Predictor Type	*b*	SE_b	β	*t*	*p*	ΔR^2
Depressive Symptoms	Overt	24.70	11.91	.26	2.07	.041	.04
	Relational	32.87	6.21	.57	5.30	< .001	.22
	Verbal	26.34	8.08	.47	3.26	.002	.10
	Physical	12.96	14.86	.11	0.87	.386	.01
	Indirect	39.32	6.83	.65	5.76	< .001	.25
Anxious/ Depressed	Overt	3.13	1.46	.28	2.15	.034	.05
	Relational	3.59	0.79	.53	4.57	< .001	.19
	Verbal	3.57	0.98	.53	3.66	< .001	.13
	Physical	0.07	1.83	.01	0.04	.972	.000
	Indirect	4.99	0.83	.69	6.04	< .001	.29
Withdrawn/ Depressed	Overt	1.62	1.46	.15	1.11	.271	.01
	Relational	2.73	0.81	.41	3.38	.001	.11
	Verbal	2.11	1.01	.32	2.10	.039	.05
	Physical	1.26	1.79	.09	0.70	.485	.01
	Indirect	3.87	0.87	.55	4.43	< .001	.18
Affective Problems	Overt	2.32	1.38	.21	1.69	.095	.03
	Relational	2.85	0.76	.43	3.76	< .001	.13
	Verbal	2.52	0.94	.39	2.67	.009	.07
	Physical	-0.54	1.71	-.04	-0.32	.753	.001
	Indirect	3.90	0.82	.56	4.75	< .001	.19
Frequency of Health Symptoms	Overt	24.83	12.42	.24	2.00	.049	.04
	Relational	22.48	7.03	.36	3.20	.002	.09
	Verbal	15.73	8.75	.24	1.80	.076	.03
	Physical	17.36	15.42	.14	1.13	.263	.01
	Indirect	32.25	7.60	.49	4.24	< .001	.14
Severity of Health Symptoms	Overt	36.27	10.14	.42	3.58	.001	.11
	Relational	26.44	5.68	.51	4.66	< .001	.18
	Verbal	19.52	7.32	.38	2.67	.009	.07
	Physical	15.46	13.17	.15	1.17	.244	.01
	Indirect	32.12	6.25	.59	5.14	< .001	.21

Table 2 – *Continued*

IL-6	Overt	-0.43	0.62	-.10	-0.07	.490	.01
	Relational	0.71	0.35	.27	2.04	.046	.05
	Verbal	-0.11	0.44	-.04	-0.25	.801	.001
	Physical	-1.26	0.78	-.23	-1.62	.111	.03
	Indirect	0.42	0.40	.14	1.04	.300	.01
CRP	Overt	-1.35	1.12	-.16	-1.20	.236	.02
	Relational	0.95	0.65	.19	1.46	.148	.02
	Verbal	0.13	0.80	.03	0.17	.868	.000
	Physical	-3.00	1.40	-.30	-2.14	.036	.05
	Indirect	0.35	0.74	.07	0.07	.473	.003

Similar analyses were conducted to determine whether perpetrating bullying behaviors predicted the array of psychological and physical health outcomes while controlling for age, BMI, and victimization. Contrary to expectations, bullying scores did not significantly predict most of the outcome measures (Table 1). Only the relationship between bullying and anxious depression was significant and in the opposite direction of what was predicted – higher levels of bullying predicted *lower* levels of anxious depression. When evaluating the three subtypes of bullying, indirect bullying significantly predicted affective problems and health outcomes (Table 3). Interestingly, physical and verbal bullying uniquely predicted depressive symptoms, such that higher incidences of bullying were associated with *lower* levels of depression.

Table 3. Regression results of subtypes of bullying predicting depression and health

Outcome	Predictor Type	*b*	SE_b	β	*t*	*p*	R^2
Depressive Symptoms	Verbal	-16.24	8.38	-.24	-1.94	.056	.03
	Physical	-37.92	13.92	-.25	-2.72	.008	.06
	Indirect	11.59	9.38	.14	1.24	.220	.01
Anxious/ Depressed	Verbal	-2.17	1.05	-.27	-2.08	.041	.04
	Physical	-7.56	1.63	-.42	-4.64	< .001	.16
	Indirect	1.95	1.17	.20	1.67	.098	.02
Withdrawn/ Depressed	Verbal	-2.32	1.08	-.29	-2.16	.034	.04
	Physical	-4.69	1.80	-.26	-2.60	.011	.06
	Indirect	1.61	1.21	.17	1.33	.186	.02

Table 3 – *Continued*

Affective Problems	Verbal	-1.05	1.01	-.13	-1.04	.302	.01
	Physical	-5.27	1.63	-.30	-3.23	.002	.08
	Indirect	2.63	1.09	.27	2.41	.018	.05
Frequency of Health Symptoms	Verbal	3.23	9.43	.04	0.34	.733	.001
	Physical	-16.73	15.89	-.10	-1.05	.295	.01
	Indirect	21.87	10.16	.24	2.15	.034	.04
Severity of Health Symptoms	Verbal	-5.87	7.61	-.10	-0.77	.443	.01
	Physical	-33.48	12.44	-.24	-2.69	.009	.05
	Indirect	14.11	8.31	.19	1.70	.093	.02
IL-6	Verbal	-0.19	0.48	-.06	-0.39	.701	.002
	Physical	-1.00	0.90	-.13	-1.11	.272	.01
	Indirect	-0.23	0.60	-.06	-0.38	.706	.002
CRP	Verbal	0.40	0.87	.07	0.46	.648	.002
	Physical	-2.49	1.63	-.17	-1.53	.131	.03
	Indirect	0.36	1.09	.05	0.33	.744	.001

Aim 2: The Interaction of Victimization and Bullying and Its Outcomes

Next, I examined whether bullying and victimization interacted to predict adverse outcomes in immune functioning, depression, and physical health. It was expected that individuals who score highly in both bullying and victimization (i.e., bully-victims) would experience worse outcomes than those who only receive high scores in one of the two categories. Iterative sets of moderated multiple regression analysis was utilized to determine whether victimization and bullying interacted to predict adverse outcomes. Because of the theoretical relationship that age shares with the outcome measures, it was included in the model as a covariate (e.g., McAdams & Olson, 2010). Age was entered into the first step of the regression, then an interaction term was created using the standardized total bullying and victimization scores, and was entered simultaneously with the two predictors into the regression model. Depression symptoms, anxious depression, withdrawn depression, affective problems, frequency of health problems, and severity of health problems were individually tested as dependent variables. Analyses with IL-6 or CRP as the dependent variable also included BMI as a covariate. Results

indicated that the interaction between the two was statistically significant only for depressive symptoms (Table 4) – in other words, scoring high on both bullying and victimization scales was associated with higher levels of depressive symptoms, but not with any of the other measures.

Table 4. Moderated multiple regression results for depression and health

Outcome	Predictor Type	*b*	SE_b	*t*	*p*	sr^2
Depressive Symptoms	Victimization	5.50	1.46	3.78	< .001	.11
	Bullying	-2.12	1.56	-1.36	.177	.01
	V × B	3.41	1.66	2.06	.043	.03
Anxious/ Depressed	Victimization	0.77	0.19	4.13	< .001	.14
	Bullying	-0.47	1.97	-2.37	.020	.05
	V × B	0.24	0.21	1.15	.253	.01
Withdrawn/ Depressed	Victimization	0.52	0.20	2.67	.009	.07
	Bullying	-0.31	0.21	-1.50	.137	.02
	V × B	0.30	0.22	1.38	.172	.02
Affective Problems	Victimization	0.53	0.18	2.97	.004	.07
	Bullying	-0.11	0.19	-0.60	.551	.003
	V × B	0.39	0.20	1.94	.056	.03
Frequency of Health Symptoms	Victimization	4.94	1.68	2.94	.004	.07
	Bullying	1.18	1.80	0.65	.515	.003
	V × B	1.05	1.91	0.55	.586	.003
Severity of Health Symptoms	Victimization	5.77	1.35	4.27	< .001	.14
	Bullying	-1.56	1.46	-1.08	.285	.01
	V × B	1.00	1.54	0.65	.517	.003
IL-6	Victimization	0.001	0.09	0.01	.994	.000
	Bullying	-0.08	0.09	-0.85	.397	.01
	V × B	0.05	0.10	0.47	.643	.002
CRP	Victimization	-0.01	0.18	-0.06	.956	.000
	Bullying	-0.10	0.18	-0.57	.574	.004
	V × B	-0.03	0.19	-0.18	.857	.004

The interaction effect was probed for the relationship between bully-victim scores and depression. Results showed that at low levels of bullying (defined here as one standard deviation below the mean), the slope of victimization scores was significant, b = 7.45, SE_b = 1.30, β = .73, $t(86) = 5.72$, $p < .001$. However, at high levels of bullying, this

relationship was no longer significant, b = 3.55, SE_b = 2.08, β = .35, $t(86)$ = 1.704, p = .092. This indicates that at high levels of bullying, depression scores appear on the "upper" end regardless of victimization status (which is consistent with the results from Aim 1 that show a relationship between bullying and depression). At high levels of victimization, depression scores are also high irrespective of bullying scores. As expected, scoring highly in both bullying and victimization predicted high levels of depressive symptoms. A graphic representation of these results is shown in Figure 4.

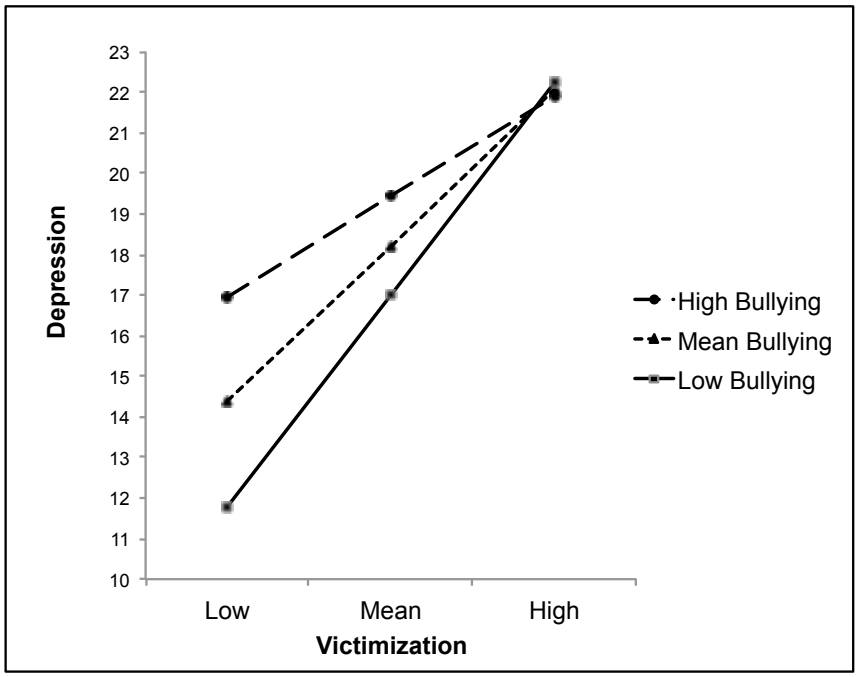


Figure 4. Depression scores at levels of bullying and victimization, controlling for age

Aim 3: Inflammatory Markers as Mediators of the Victimization-Health Link

The third aim hypothesized that markers of systemic inflammation would mediate the relationship between involvement in peer victimization and physical and psychological

health. Linear regression analyses failed to reveal a significant relationship between overall victimization/bullying and either of the inflammatory markers (Aim 1; see Table 1). Thus, the model did not conform to conventional criteria for establishing mediation and the analyses were not pursued (e.g., Baron & Kenny, 1986).

However, as stated previously, depression may mediate the link between being bullied and physical health outcomes given that depression is not only an outcome associated with victimization but may also be a presage of physical problems such as inflammation (e.g., Guarneri-White, Jensen-Campbell, and Knack, under review; Nemeroff & Goldschmidt-Clermont, 2012).

As such, Figure 2 was examined, which involved victimization predicting depression, which in turn predicted inflammation (see also Figure 5). Bullying was not analyzed as a predictor due to the lack of a significant relationship with both depression and inflammation. Because of their theoretical relationship to inflammation and depression, age and BMI were treated as covariates. All variables were standardized prior to analysis; as such, all *b*-weights reported are equivalent to beta coefficients.

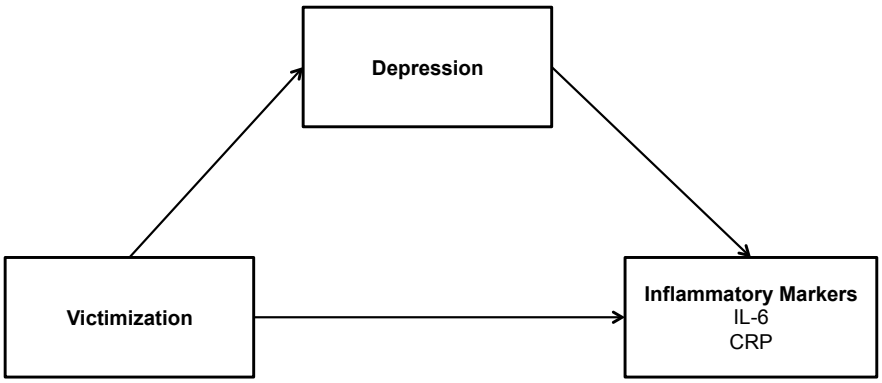
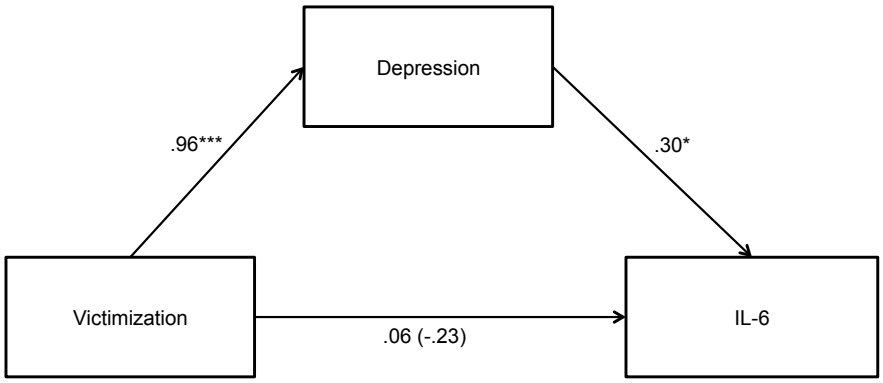


Figure 5. The revised mediation model

To test this model, an ordinary least squares regression-based path analytical framework termed conditional process analysis was utilized. The data were entered into SPSS via Hayes' (2013) PROCESS macro. Due to the low sample size, bias-corrected bootstrapping (i.e., a resampling method with replacement) was utilized for 1000 samples with confidence intervals set to 95%. Victimization, along with IL-6 and CRP, were tested alternately using Model #4 in PROCESS.

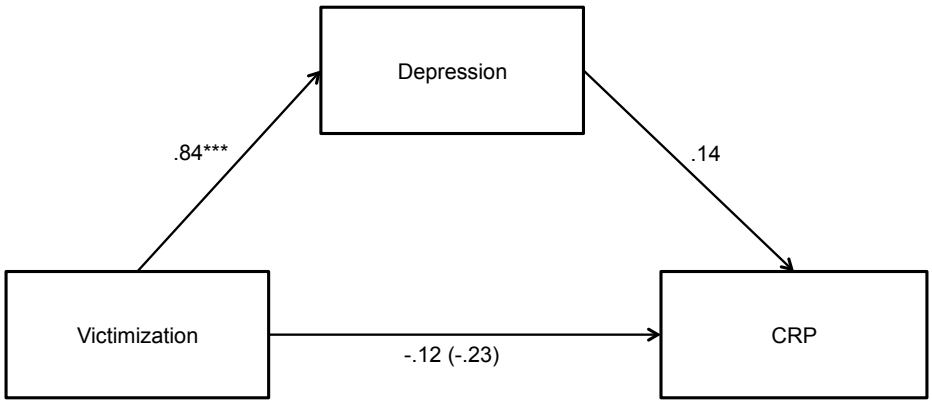
Results showed that victimization significantly predicted depression while controlling for bullying, age and BMI, b = .96, SE_b = .19, $t(73)$ = 4.99, p < .001, 95% CI [0.58, 1.34]. In turn, depression predicted IL-6 while controlling for victimization, bullying, age, and BMI, b = .30, SE_b = .13, $t(73)$ = 2.43, p = .018, 95% CI [0.02, 0.53]. Victimization did not directly predict IL-6, b = -.23, SE_b = .23, $t(73)$ = -2.47, p = .335, 95% CI [-0.68, 0.24]. A Sobel test indicated that depression significantly mediated the relationship between victimization and IL-6, b = .29, SE_b = .14, 95% bootstrap CI [0.03, 0.65], Z = 2.18, p = .029. A graphic representation of this analysis is shown in Figure 6.



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

Figure 6. Depression mediated the relationship between victimization and IL-6

In the model where CRP was the outcome, only the path from victimization to depression controlling for bullying, age and BMI was significant, b = .84, SE_b = .14, $t(73)$ = 6.09, p < .001, 95% CI [0.57, 1.12]. A Sobel test further confirmed the lack of an indirect effect, b = .11, SE_b = .11, Z = 1.01, p = .314; therefore, depression did not mediate the relationship between victimization and CRP (Figure 7).



*** p < .001

Figure 7. Depression as a mediator of the victimization-CRP link

Supplementary Analyses

Testing a Moderated Mediation Model

Because depression mediated the relationship between victimization and IL-6 as well as bullying and IL-6, additional analyses were conducted to see if victimization and bullying interacted to produce significant effects (i.e., testing for bully-victim outcomes). These analyses were conducted using PROCESS' Model #7, in which victimization was entered as the predictor, bullying was the moderator, depression was the mediator, and the inflammatory marker in question was treated as the outcome variable (Figure 8). Bootstrapping procedures for 1000 samples were utilized.

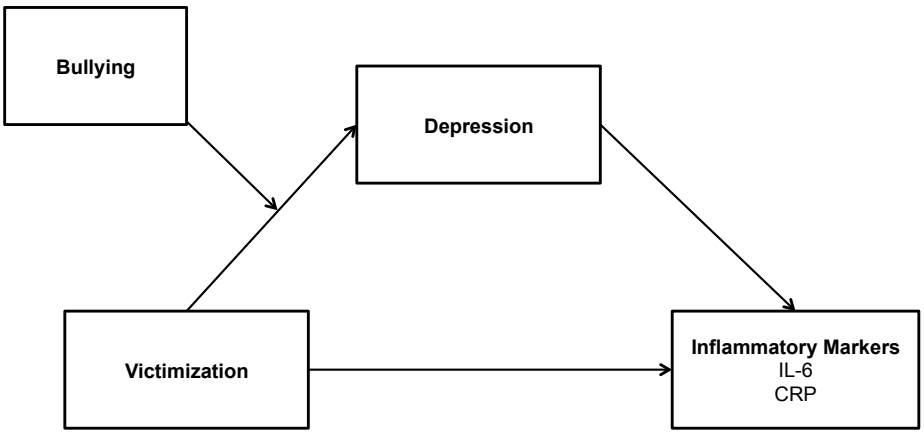


Figure 8. The moderated mediation model

Results showed that the victimization-bullying interaction significantly predicted depression while controlling for victimization, bullying, age and BMI, b = .64, SE_b = .25, t(73) = 1.60, p = .011, 95% CI [0.15, 1.13]. Depression predicted IL-6 while controlling for victimization, age, and BMI, b = .31, SE_b = .12, t(73) = 2.53, p = .014, 95% CI [0.07, 0.56]. However, victimization only marginally predicted IL-6, b = -.33, SE_b = .17, t(73) = -1.91, p = .060, 95% CI [-0.68, 0.01], when controlling for depression, age, and BMI. The slope of the line relating the indirect effect to the moderator ("the index of moderated mediation"; Hayes, 2013) was significant, b = .20, bootstrap SE_b = .11, 95% bootstrap CI [0.32, 0.47], indicating that the mediated effect was in fact moderated by the victimization-bullying interaction (see Figure 9). At low levels of bullying, the indirect effect was not significant, b = .10, bootstrap SE_b = .14, 95% bootstrap CI [-0.08, 0.51]. However, at mean and high (i.e., one standard deviation above the mean) levels, the indirect effect was significant, b = .21, bootstrap SE_b = .13, 95% bootstrap CI [0.03, 0.58], and b = .33, bootstrap SE_b = .15, 95% bootstrap CI [0.04, 0.66], respectively.

Figure 9. The mediated effect for IL-6 at levels of bullying and victimization

Similar analyses were conducted to evaluate the effect of the interaction term with CRP as the outcome variable. The victimization-bullying interaction significantly predicted depression while controlling for victimization, bullying, age and BMI, b = .75, SE_b = .25, $t(73)$ = 2.95, p = .004, 95% CI [0.24, 1.25]. However, depression did not predict CRP in this model, b = .14, SE_b = .13, $t(73)$ = 1.03, p = .305, 95% CI [-0.13, 0.40], nor was the index of moderated mediation significant, b = .10, bootstrap SE_b = .11, 95% bootstrap CI [-0.09, 0.40]. In other words, the mediated effect did not differ based on levels of the moderator.

Testing a Serial Mediation Model

The preceding analyses showed that victimization, depression, and inflammatory markers are causally related. Depression, inflammation, and physical health complaints

were also found to be correlated. For example, both IL-6 and CRP were correlated with reported frequency of health problems, *r*s = .23, .26, *p*s < .05, and depression was also related to frequency of health problems, $r = .50$, $p < .01$ (see Appendix C for correlation tables). Following this line of thought, I tested a serial mediation model in which victimization predicted depression, which predicted levels of inflammatory markers, which then predicted reports of physical health symptoms. Analyses were conducted using PROCESS Model #6 with victimization as the predictor, depression as the first mediator, IL-6/CRP as the second mediator, and frequency/severity of physical health symptoms as the outcome. Bullying, age, and BMI were included as covariates. In the model in which IL-6 and severity were entered, victimization did not indirectly predict the severity of health symptoms via depression and IL-6, $b = .16$, $SE_b = .15$, 95% CI [-0.14, 0.48]. Comparable results were found when I included CRP in the model in place of IL-6 and no indirect effects were found, $b = .15$, $SE_b = .17$, 95% CI [-0.18 0.48].

When IL-6 and frequency of health complaints were included in the model, none of specific indirect effects were significant, nor was the total indirect effect, $b = .28$, $SE_b = .16$, 95% CI [-0.06, 0.60]. However, depression did predict frequency when controlling for all other variables in the model, $b = .29$, $SE_b = .12$, $t(73) = 2.49$, $p = .015$, 95% CI [0.06, 0.52]. These results are illustrated in Figure 10.

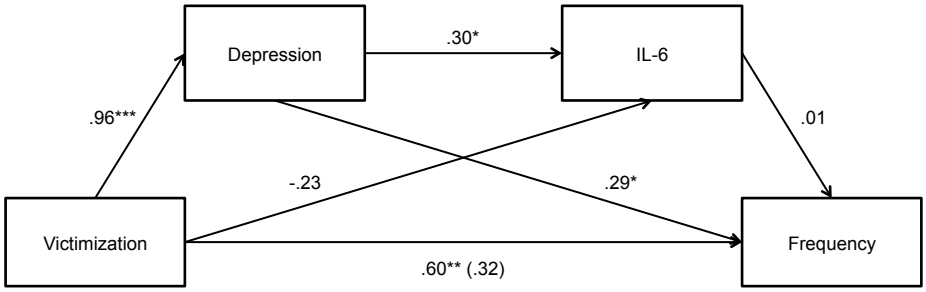


Figure 10. Victimization predicting frequency via depression and IL-6

Similarly, depression predicted frequency of health problems in the model with CRP as the second mediator, b = .28, SE_b = .12, t(73) = 2.42, p = .018, 95% CI [0.05, 0.52]. The overall indirect effect of this model was not significant, b = .27, SE_b = .17, 95% CI [-0.03, 0.62], although the path from victimization to depression to frequency was significant, b = .27, SE_b = .16, 95% CI [0.002, 0.61] (see Figure 11).

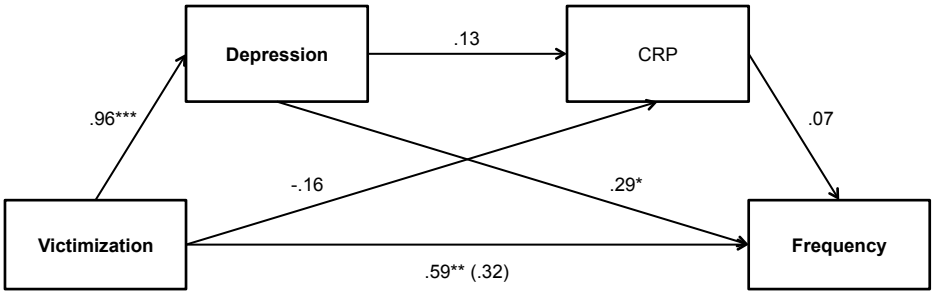


Figure 11. Victimization predicting frequency via depression and CRP

Extending the Serial Mediation Model

Although I used BMI as a covariate control, it could also be an indicator of poorer health. For example, excess production of proinflammatory cytokines over time should leave the adolescent more vulnerable to chronic illnesses such as metabolic syndrome (Kendall-Tackett, 2009; McEwen, 2003). Metabolic syndrome is often defined as a cluster of health problems that involve abdominal obesity and typically develops in childhood and adolescence (Cruz & Goran, 2004). Indeed, in my sample, BMI was associated with IL-6, CRP, frequency of health problems, and severity of health problems (rs = .43, .49, .41, and .28, respectively, ps < .05). As such, I examined whether IL-6 and CRP led to poorer health outcomes via BMI.

First, I tested a serial mediation model in PROCESS (Model #6) in which victimization predicted BMI via depression and IL-6, with bullying and age entered as covariates (see Figure 12). Consistent with the rest of my findings, victimization predicted depressive symptoms, b = .97, SE_b = .19, $t(71)$ = 5.11, p < .001, 95% CI [0.59, 1.35]. In turn, depression predicted IL-6 concentrations, b = .34, SE_b = .14, $t(71)$ = 2.44, p = .017, 95% CI [0.06, 0.61]. Plasma concentration of IL-6 was positively associated with BMI, b = .39, SE_b = .10, $t(71)$ = 4.04, p < .001, 95% CI [0.20, 0.59]. Although no total indirect effect was found, b = .001, SE_b = .13, 95% bootstrap CI [-0.22, 0.29], the indirect path from victimization to BMI via depression and IL-6 was significant, b = .13, SE_b = .07, 95% bootstrap CI [0.03, 0.31]. When CRP was tested in this model in place of IL-6, no indirect effects were found, b = .02, SE_b = .14, 95% bootstrap CI [-0.24, 0.31].

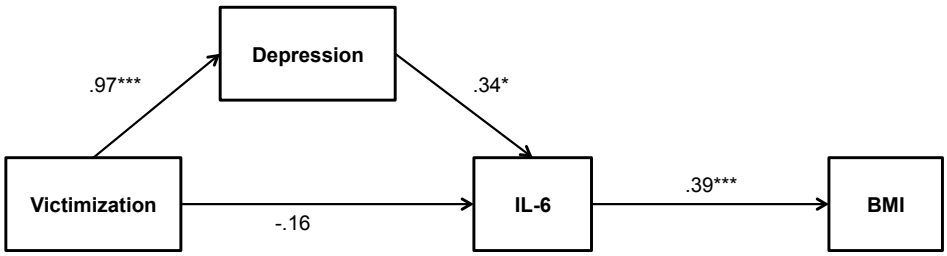


Figure 12. Victimization predicting BMI via depression and IL-6

To further test the influence of inflammatory markers on health, I added reports of health symptoms into the model as the final outcome, with victimization as the predictor, and depression, inflammation, and BMI as serial mediators. With frequency of health symptoms included in the model as the outcome, BMI predicted more frequent physical health complaints, b = .45, SE_b = .12, $t(71)$ = 3.75, p < .001, 95% CI [0.21, 0.68].

Depression also predicted physical health in this model, b = .29, SE_b = .12, $t(71)$ = 2.49, p = .015, 95% CI [0.06, 0.52] (Figure 13). No total indirect effect was found, but the indirect path from victimization to frequency of health via the three mediators was significant, b = .06, SE_b = .03, 95% bootstrap CI [0.01, 0.15].

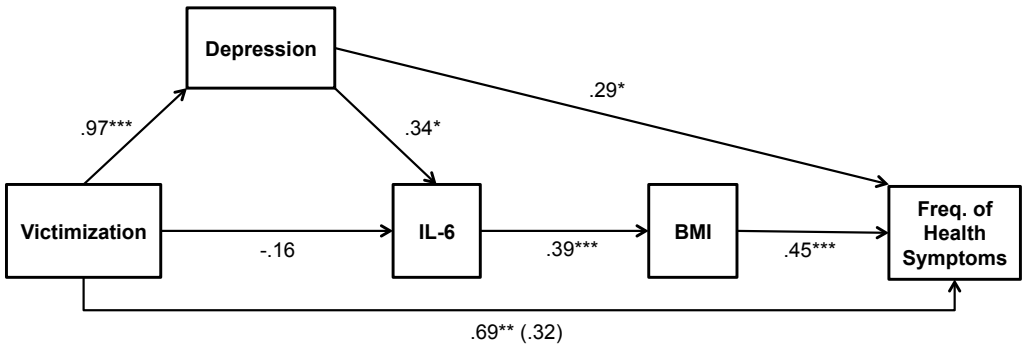


Figure 13. Victimization predicting frequency of health via depression, IL-6, and BMI

Similar results were obtained with severity of health symptoms as the outcome measure – BMI predicted more severe health problems, b = .26, SE_b = .13, $t(71)$ = 2.02, p = .048, 95% CI [0.003, 0.52], although depression did not. Additionally, the indirect path from victimization to severity via depression, IL-6, and BMI was also significant, b = .03, SE_b = .03, 95% bootstrap CI [0.01, 0.12] (Figure 14).

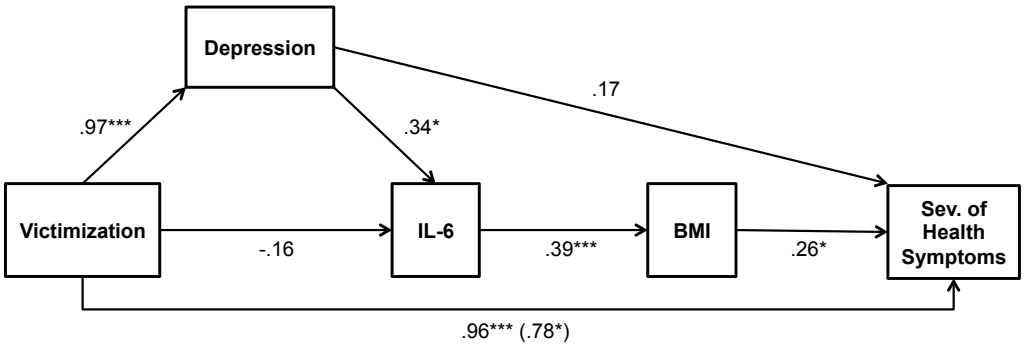


Figure 14. Victimization predicting severity of health via depression, IL-6, and BMI

Chapter 4

Discussion

The relationship between peer victimization and adverse outcomes is a well-documented one, with over two decades of research linking being bullied to depression, poorer health, anxiety, and loneliness (see Hawker & Boulton, 2000, for a review). Thus, it was no surprise that victimization was found to predict symptoms of depression, frequency of health problems, and severity of health problems. When peer victimization was split into five subtypes, overt, relational, verbal, and indirect significantly predicted increased depressive and physical health symptoms. Relational victimization was also associated with higher IL-6 concentrations, which echoes previous findings that showed a positive relationship between psychosocial stress and increased IL-6 (e.g., Kiecolt-Glaser et al., 2011).

However, results indicated that being physically victimized did not predict any of the depression measures. Past research has revealed a trend in victimization changing from more explicit forms (i.e., overt, physical) to more covert types (i.e., indirect, relational) as youth mature, physical aggression becomes less socially acceptable, and adolescents become more savvy to alternative methods of harassing one another (Craig, Pepler, Connolly, & Henderson, 2001; Hinduja & Patchin, 2010). Additionally, due to the increased importance that adolescents place on their peer relationships, relational or social victimization may be especially prevalent (Harris, 1995; Vaillancourt et al., 2008). Thus, physical victimization may not be the most common or emotionally harmful subtype of victimization for the adolescents in this sample. Interestingly, being physically bullied predicted lower levels of CRP, which was contrary to my predictions. These findings are consistent with the theory that stress may also down-regulate the immune response,

meaning that increased levels of stress lead to a dulled or lessened response. Studies utilizing rodent models have provided empirical evidence to support this assertion (e.g., Goujon et al., 1995). Miyahara and colleagues (2000) also found that rodents who experienced chronic and repeated stress showed decreased expression of IL-6 compared to those that were exposed to an acute stressor.

Although peer victimization has been extensively covered in research, bullying behaviors have not received as much attention. This thesis sought to extend the limited literature on bullies, given that previous work has shown a relationship between bullying perpetration and adverse outcomes (e.g., Nansel et al., 2001). However, the hypothesis that participation in bullying behaviors predicts higher levels of depression and physical health problems was not supported by the data. These results were surprising, as harsh relationships and antipathies (as bullies have with their victims and many other peers) are often extremely stressful and have been linked to depression and other psychosocial complications, which in turn have been found to predict physical health symptoms (e.g., Abecassis, Hartup, Haselager, Scholte, & Van Lieshout, 2001; Witkow, Bellmore, Nishina, Juvonen, & Graham, 2005; Raposa, Hammen, Brennan, O'Callaghan, & Najman, 2013). This lack of a relationship may be due to the fact that factors associated with the negative outcomes (age, BMI, and victimization) were treated as covariates in the regression equation. When taking these influences into account, the effect of bullying is diminished.

Interestingly, only the effect of bullying on anxious depression while controlling for covariates was significant, such that higher levels of bullying predicted *lower* levels of anxious depression. This may actually reflect some of the characteristics of the bullies themselves – previous studies have found bullies to be more extroverted and disruptive than their bullied peers (Lowenstein, 1977). Additionally, the act of bullying is itself an

exercise of dominance and an exploitation of a power differential, so it is not all that alarming that bullies did not report exceptionally high levels of anxiety. Something else to consider is the methodology of the aforementioned studies linking bullies to negative outcomes. It is possible that the authors neglected to tease apart “pure” bullies (i.e., those that only bully and are not peer victimized) from bully-victims, so the effects of the relationship between bullying and outcomes may have actually been driven by victimization.

Analyses also involved evaluating each subtype of bullying (verbal, physical, and indirect; the measure assessing relational and overt victimization was not available for bullies) as predictors of depressive symptoms and health problems. Indirect bullying significantly predicted higher levels of affective problems and more frequent physical health symptoms. As previously mentioned, a combination of increasingly sophisticated victimization methods and a greater emphasis placed on peer relationships likely contributes to the popularity (and apparent efficacy) of indirect forms of bullying. Furthermore, the fact that indirect bullying significantly predicted both physical and psychological symptoms may suggest that this form is more noxious to the perpetrator due to its covert nature.

The two overt forms of bullying, verbal and physical, predicted general depression scores, anxious depression, and withdrawn depression, while physical bullying also predicted the severity of health symptoms. Interestingly, these analyses uncovered negative relationships – higher scores regarding physical and verbal bullying behaviors predicted *lower* levels of depressive symptoms and less severe health problems. This suggests that bullies who engage in physical and verbal forms of aggression toward their peers may either be less depressed individuals in general, or

engage in overt bullying as a means of solving conflicts, which may indirectly relieve feelings of anxiety or depression (Bernstein & Watson, 1997).

Moderation multiple regression (MMR) analyses were conducted to determine if victimization and bullying interacted to predict negative outcomes, and significant results were obtained for the depressive symptom measure. It is not surprising that those who were heavily involved in both the bully and victim roles in peer victimization reported the highest levels of depression symptoms. Victims are often rejected by their peers, as are bullies (Boulton & Smith, 1994). Bully-victims, on the other hand, may experience peer rejection for both roles they play, possibly exacerbating their symptoms of depression. These analyses intended to tease apart the effects of being a “bully-victim” while retaining the person-centered approach (i.e., using continuous rather than categorical variables). Although the proposed interaction did not return significant results for most outcomes, this information does not disprove the existence of the bully-victim category, nor does it refute previous findings that bully-victims suffer the worst outcomes of the three involved categories (e.g., Haynie et al., 2001; Isolan, Salum, Osowski, Zottis, & Manfro, 2013; Solberg, Olweus, & Endresen, 2007; Liang, Fisher, & Lombard, 2007). Replicating these methods in the future with a larger group and while maintaining the person-centered approach would provide better insight into the plight of those individuals who find themselves on both sides of the battle.

A novel aspect of this thesis is its incorporation of inflammatory markers into the victimization/bullying-health model. Recent years have seen a boom in biopsychological research, with many studies examining the relationship between victimization/aggression and biological measures such as cortisol production, genetic polymorphisms, and brain activity via functional magnetic resonance imaging (e.g., Decety, Michalska, Akitsuki, & Lahey, 2009; Knack, Jensen-Campbell, & Baum, 2011; Ouellet-Morin et al., 2011; Iyer,

Dougall, & Jensen-Campbell, 2013). For markers of systemic inflammation such as IL-6 and CRP, past research has focused on childhood parental maltreatment, sexual abuse, and other psychosocial stressors (Kiecolt-Glaser et al., 2011; Nunes, Watanabe, Morimoto, Moriya, & Reiche, 2010). Furthermore, studies have shown that increased levels of proinflammatory cytokines are related to a plethora of health complications (Ridker, Cushman, Stampfer, Tracy, & Hennekens, 1998; Godbout & Glaser, 2006).

Nevertheless, no studies have yet been published on the effects of peer victimization on inflammatory markers. This thesis attempted to fill this gap in the literature by assessing whether involvement in peer victimization (as a victim and/or bully) predicted heightened plasma circulation levels of IL-6 and CRP. Although, the initial hypothesis was not supported by the data – neither overall victimization nor overall bullying scores directly predicted increased IL-6 or CRP in this sample (Aim 1; Table 2), relational victimization did uniquely predict IL-6. This finding suggests that these more relational forms of peer abuse during adolescence may be more deleterious to health outcomes than more overt, physical forms. Another possible explanation for this phenomenon is that the stress from bullying or being victimized, and not the victimization or bullying itself, causes dysregulation of the acute phase response. Many studies support this assertion, providing evidence that links stress to alterations in immune functioning, including levels of inflammatory markers (e.g., Kiecolt-Glaser, McGuire, Robles, & Glaser, 2002; Carpenter et al., 2010). In this thesis, stress was manifested in depressive symptomatology, which in turn predicted levels of IL-6, as evidenced by the results of Aim 3.

The third aim of this thesis was exploratory in nature. Previous research provides evidence of various causal models involving depression, inflammation, and health. Analyses showed that depression significantly mediated the relationship between

victimization and IL-6, such that higher levels of victimization predicted greater depressive symptoms, which then predicted higher levels of plasma IL-6. For the model in which CRP was the outcome measure, a significant mediated effect was not found. These findings offer some insight into the nature of the relationships within the peer victimization framework. It is pretty well known that depression is a pernicious result of harsh interpersonal relationships, but this new evidence supports previous research and shows that depression may also be a precursor to further health complications.

Because the moderated regression model (Aim 2) returned significant results for depression and IL-6, the mediation model was also tested using the interaction of victimization and bullying as the predictor and depression as the sole mediator while controlling for age and BMI. Depression mediated the relationship between the cross-product and IL-6, but only at mean and high levels of the moderator (bullying scores). This makes sense in that one would not expect for depression to be a significant component in predicting immune markers in adolescents who have little to no involvement in bullying. As victimization and bullying scores increase, so does the role of depression as a mediator. This model was not replicated using CRP as the outcome due to the lack of consistency in results concerning the inflammatory marker. It is worth noting that the expression and signaling activity of IL-6, CRP, and many cytokines is regulated by an extremely complex interplay among other markers like IL-1, IL-10, TNF-α (Ahmed & Ivashkiv, 2000). Unfortunately, these intricate mechanisms could not be evaluated with the available data and are ultimately outside the scope of this project.

A series of serial mediation models was tested to further establish a connection between victimization, depression, inflammatory markers, and physical health. Only the indirect path from victimization to depression to frequency in the CRP model (Figure 11) was found to be significant. In fact, depression significantly predicted frequency of health

complaints in both the IL-6 and CRP models. This suggests that depression may well be an antecedent of health problems, as speculated in past research (e.g., Katon, 2003). Unfortunately, no significant total indirect effects were found for the models tested, nor were any effects shown for the paths involving inflammatory markers.

The absence of a significant link between systemic inflammation and reported health alluded to the presence of another factor mediating this relationship. The role of BMI in somatic complaints and overall health has been well-researched (Stommel & Schoenborn, 2010; Pi-Sunyer, 1991), and given BMI's significant correlation with both inflammatory markers and reported health (rs = .43, .49, .41, and .28, respectively; ps < .05), it was expected that BMI would mediate the inflammation-health link. For both frequency and severity of health problems, the indirect paths from victimization through depression, IL-6, and BMI were significant – that is, the data were consistent with my expectations that victimization predicted higher levels of depression, which predicted increased plasma IL-6, which in turn was linked to higher BMIs, which then predicted reports of more frequent and severe health symptoms.

While the mechanisms governing immune activity are highly complex and it is probable that the relationship between systemic inflammation and somatic symptomatology cannot be elucidated from a relatively simple statistical model, these results provide preliminary evidence of a few factors that may play important roles in connecting victimization to physical health. With obesity globally reaching an "epidemic" level (Pi-Sunyer, 2002), and given the prevalence of depression, particularly in adolescents (Lewinsohn, Rohde, & Seeley, 1998), the relationships uncovered by these analyses are especially relevant and highlight the perniciousness of peer victimization. It is clearly not acceptable as "normal school behavior" – in fact, it is linked to serious consequences.

Like any scientific endeavor, this study was not without its limitations. The relatively small sample size proved to be a notable restriction. In order to conduct some of the more complicated moderation and mediation models, larger sample sizes are required. The small sample led to insufficient power to detect statistically significant results. It is also important to remember that these data were cross-sectional in nature, and although mediation analyses were performed, one should take caution in assuming causal relationships without further examination. In the future, it would be valuable to conduct similar analyses longitudinally in order to adequately assess causation. Furthermore, the lack of existing research specifically concerning victimization and inflammation leaves many possibilities open for examination. Forthcoming research should take different potential models into consideration in order to build a body of knowledge upon which future work can expand. Even with topics for which there are volumes of information – such as the depression-health relationship – not all parties agree on one theoretical model (see Copeland et al., 2012a; Dunn, Swiegel, & de Beaurepaire, 2005; Dowlati et al., 2010). Some researchers argue that depression is often a precursor of health problems, while others believe health issues lead to depression; research supporting each of these viewpoints exists and contributes to a better understanding of biopsychological functioning.

Despite these limitations, the findings in this thesis are in agreement with the previous literature that shows a significant relationship between involvement in peer victimization and adverse physical and psychological health outcomes. This study also fills the gaps in past research by testing novel causal models that evaluate the involvement of the body's immune response in the victimization-health link. With stories of bullying making headlines with increasing frequency, it is more important than ever to emphasize the real and long-lasting consequences faced by individuals entangled in

these negative peer relationships. Showing that bullying is unacceptable behavior and a health concern, however, is only one step in tackling this widespread issue. A fuller understanding of the mechanisms that underlie the victimization-health relationship would be helpful in developing new ways to prevent bullying and buffer individuals from its harmful effects.

Appendix A

Self-Report Survey Measures

Children's Self-Experiences Questionnaire, Self-Report

(CSEQ-SR; Crick & Grotpeter, 1995)
"Things that Happen to Me at School"

Directions: Here is a list of things that sometimes happen to kids at school. How often did they happen to you while you were at school? Bubble in the circle that best describes your experiences at school.

Scale

1 = Never	3 = Sometimes	5 = All of the time
2 = Almost never	4 = Almost all of the time	

1. At school, other kids make fun of me.
2. At school, I get hit and pushed by other kids.
3. I get picked on by other kids at school.
4. I get beat up by other classmates.
5. I am ignored by other classmates when someone is mad at me.
6. I do not get invited to things (e.g., parties) because my friends sometimes don't like to include me.
7. I get left out of things when someone is mad at me or wants to get back at me for something.
8. Other kids tell rumors about me behind my back.
9. I am very strong.
10. If I were in an arm wrestling contest, I would win.
11. I make fun of people.
12. I hit and push others around.
13. I tell lies.
14. I sometimes take things that belong to someone else.
15. I make noise or bother others in class.
16. I do not follow the rules.
17. I act like a baby.
18. I get upset when called on to answer questions in class.
19. I complain a lot and nothing makes me happy.
20. I try to get other kids to play with me even when they don't want to.
21. On the playground, I just stand around.
22. I don't talk much.
23. I am afraid to do things.
24. I seem unhappy and look sad often.
25. When other kids are playing, I watch them but don't join in.
26. In a group, I share things and give other people a turn.
27. I am always friendly.
28. I am always willing to help my classmates.
29. I try to cooperate with my classmates.

Direct and Indirect Aggression Scale – Victim Version

(DIAS-VS; Bjorkvist, Lagerspetz, & Osterman, 1992)

Directions**:** Answer each question by bubbling in the answer that seems to most closely tell you about how your classmates behave toward you.

Scale

1 = Never
2 = Seldom
3 = Sometimes
4 = Quite often
5 = Very often

1. How often are you hit by other classmates?
2. How often are you shut out of the group by other classmates?
3. How often do other classmates yell at you or argue with you?
4. How often do classmates become friends with another classmate as a kind of revenge?
5. How often are you kicked by other classmates?
6. How often are you ignored by other classmates?
7. How often are you insulted by other classmates?
8. How often do classmates who are angry with you gossip about you?
9. How often are you tripped by other classmates?
10. How often do classmates tell bad or false stories about you?
11. How often do classmates say they are going to hurt you?
12. How often do classmates plan to secretly bother you?
13. How often are you shoved by other classmates?
14. How often do classmates say bad things about you behind your back?
15. How often are you called names by other classmates?
16. How often do classmates tell others “Let’s not be friends with him/her!”?
17. How often do other classmates take things from you?
18. How often do classmates tell your secrets to a third person?
19. How often are you teased by other classmates?
20. How often do classmates write small notes where you are criticized?
21. How often are you pushed down to the ground by other classmates?
22. How often do other classmates criticize your hair or clothing?
23. How often do other classmates pull at you?
24. How often do classmates who are angry with you try to get others to dislike you?

Direct and Indirect Aggression Scale – Bully Version

(DIAS-B; adapted from Bjorkvist, Lagerspetz, & Osterman, 1992)

Directions**:** Answer each question by bubbling in the answer that seems to most closely tell you about how you behave toward other people.

Scale

1 = Never
2 = Seldom
3 = Sometimes
4 = Quite often
5 = Very often

1. How often do you hit other people?
2. How often do you shut other people out of the group by ignoring them?
3. How often do you yell at other people or argue with them?
4. How often do you become friends with another classmate as a kindof revenge on another person?
5. How often do you kick other people?
6. How often do you ignore other people?
7. How often do you insult other people?
8. How often do you gossip about people you are angry with?
9. How often do you trip other people?
10. How often do you tell bad or false stories about other people?
11. How often do you say you are going to hurt other people?
12. How often do you plan to secretly bother other people?
13. How often do you shove other people?
14. How often do you say bad things about other people behind their backs?
15. How often do you call other people names?
16. How often do you tell other people, “Let’s not be friends with him/her!” about another person?
17. How often do you take things from other people?
18. How often do you tell other people’s secrets to a third person?
19. How often do you tease other people?
20. How often do you write notes where other people are criticized?
21. How often do you push other people down to the ground?
22. How often do you criticize other people’s hair or clothing?
23. How often do you pull at other people (their clothes, hair, etc.)?
24. How often do you try to get others to dislike people with whom you are angry?

Depression Scale for Children

(CES-DC; Center for Epidemiological Studies)

Directions: Below is a list of the ways you might have felt or acted. Please check how *much* you felt this way during the *past week*.

Scale

0 = Not at all
1 = A little
2 = Some
3 = A lot

1. I was bothered by things that usually don't bother me.
2. I did not feel like eating, I wasn't very hungry.
3. I wasn't able to feel happy, even when my family or friends tried to help me feel better.
4. I felt like I was just as good as other kids.
5. I felt like I couldn't pay attention to what I was doing.
6. I felt down and unhappy.
7. I felt like I was too tired to do things.
8. I felt like something good was going to happen.
9. I felt like things they did before didn't work out right.
10. I felt scared.
11. I didn't sleep as well as I usually sleep.
12. I was happy.
13. I was more quiet than usual.
14. I felt lonely, like I didn't have any friends.
15. I felt like kids I know were not friendly or that they didn't want to be with me.
16. I had a good time.
17. I felt like crying.
18. I felt sad.
19. I felt people didn't like me.
20. It was hard to get started doing things.

Assessing Health Outcomes – Child Report

Directions**:** Rate the frequency and severity of the following health symptoms.

Scale:
Frequency: not at all sometimes often all the time
Severity: does not hurt at all hurts a little hurts a lot
unbearable pain

1. Extreme fatigue (feeling extremely tired)
2. Allergic reaction
3. Sleep problems
4. Stomach ache
5. Nausea/vomiting (sick to your stomach/throwing up)
6. Diarrhea
7. Muscle aches and pains
8. Headaches or migraine
9. Weight gain of 5 or more pounds
10. Weight loss of 5 or more pounds
11. Respiratory congestion (cold in your chest)
12. Runny nose
13. Coughing
14. Sore throat
15. Sneezing
16. Blocked nose
17. Fever or chills
18. Dizziness
19. Double or blurred vision
20. Trouble catching breath
21. Having a cold
22. Chest pains
23. Numbness or tingling
24. Low energy
25. Ear infections
26. Getting sick
27. Heart beating too fast
28. Visits to the doctor
29. Visits to the school nurse

Appendix B

Parent-Report Survey Measures

Children's Self-Experiences Questionnaire, Parent-Report

(CSEQ-PR; adapted from Crick & Grotpeter, 1995)
"Things that Happen to Me at School"

Directions: Here is a list of things that sometimes happen to kids at school. How often did they happen to your child while he/she was at school? Bubble in the circle that best describes your child's experiences at school.

Scale

1 = Never	3 = Sometimes	5 = All of the time
2 = Almost never	4 = Almost all of the time	

1. At school, other kids make fun of my child.
2. At school, my child gets hit and pushed by other kids.
3. My child gets picked on by other kids at school.
4. My child gets beat up by other classmates.
5. My child is ignored by other classmates when someone is mad at them.
6. My child does not get invited to things (e.g., parties) because his/her friends sometimes don't like to include them.
7. My child gets left out of things when someone is mad at them or wants to get back at them for something.
8. Other kids tell rumors about my child behind their back.
9. My child is very strong.
10. If my child were in an arm wrestling contest, he/she would win.
11. My child makes fun of people.
12. My child hits and pushes others around.
13. My child tells lies.
14. My child sometimes takes things that belong to someone else.
15. My child makes noise or bother others in class.
16. My child does not follow the rules.
17. My child acts like a baby.
18. My child gets upset when called on to answer questions in class.
19. My child complains a lot and nothing makes him/her happy.
20. My child tries to get other kids to play with them even when they don't want to.
21. On the playground, my child just stands around.
22. My child doesn't talk much.
23. My child is afraid to do things.
24. My child seems unhappy and looks sad often.
25. When other kids are playing, my child watches them but doesn't join in.
26. In a group, my child shares things and gives other people a turn.
27. My child is always friendly.
28. My child is always willing to help his/her classmates.
29. My child tries to cooperate with his/her classmates.

Direct and Indirect Aggression Scale – Victim Version

(DIAS-VS; Bjorkvist, Lagerspetz, & Osterman, 1992)

Directions**:** Answer each question by bubbling in the answer that seems to most closely tell you about how your child's classmates behave toward your child.

Scale

1 = Never
2 = Seldom
3 = Sometimes
4 = Quite often
5 = Very often

1. How often is your child hit by other classmates?
2. How often is your child shut out of the group by other classmates?
3. How often do other classmates yell at you or argue with you?
4. How often do classmates become friends with another classmate as a kind of revenge?
5. How often is your child kicked by other classmates?
6. How often is your child ignored by other classmates?
7. How often is your child insulted by other classmates?
8. How often do classmates who are angry with your child gossip about your child?
9. How often is your child tripped by other classmates?
10. How often do classmates tell bad or false stories about your child?
11. How often do classmates say they are going to hurt your child?
12. How often do classmates plan to secretly bother your child?
13. How often is your child shoved by other classmates?
14. How often do classmates say bad things about you behind your child's back?
15. How often is your child called names by other classmates?
16. How often do classmates tell others "Let's not be friends with him/her!"?
17. How often do other classmates take things from your child?
18. How often do classmates tell your child's secrets to a third person?
19. How often is your child teased by other classmates?
20. How often do classmates write small notes where your child is criticized?
21. How often is your child pushed down to the ground by other classmates?
22. How often do other classmates criticize your child's hair or clothing?
23. How often do other classmates pull at your child?
24. How often do classmates who are angry with you try to get others to dislike your child?

Direct and Indirect Aggression Scale – Bully Version

(DIAS-B; adapted from Bjorkvist, Lagerspetz, & Osterman, 1992)

Directions**:** Answer each question by bubbling in the answer that seems to most closely tell you about how your child behaves toward other people.

Scale

1 = Never
2 = Seldom
3 = Sometimes
4 = Quite often
5 = Very often

1. How often does your child hit other people?
2. How often does your child shut other people out of the group by ignoring them?
3. How often does your child yell at other people or argue with them?
4. How often does your child become friends with another classmate as a kind of revenge on another person?
5. How often does your child kick other people?
6. How often does your child ignore other people?
7. How often does your child insult other people?
8. How often does your child gossip about people you are angry with?
9. How often does your child trip other people?
10. How often does your child tell bad or false stories about other people?
11. How often does your child say you are going to hurt other people?
12. How often does your child plan to secretly bother other people?
13. How often does your child shove other people?
14. How often does your child say bad things about other people behind their backs?
15. How often does your child call other people names?
16. How often does your child tell other people, “Let’s not be friends with him/her!” about another person?
17. How often does your child take things from other people?
18. How often does your child tell other people’s secrets to a third person?
19. How often does your child tease other people?
20. How often does your child write notes where other people are criticized?
21. How often does your child push other people down to the ground?
22. How often does your child criticize other people’s hair or clothing?
23. How often does your child pull at other people (their clothes, hair, etc.)?
24. How often does your child try to get others to dislike people with whom you are angry?

Depression Scale for Children

(CES-DC; Center for Epidemiological Studies)

Directions: Below is a list of the ways your child might have felt or acted. Please check how *much* you think your child felt this way during the *past week*.

Scale

0 = Not at all
1 = A little
2 = Some
3 = A lot

1. My child was bothered by things that usually don't bother him/her.
2. My child did not feel like eating, my child wasn't very hungry.
3. My child wasn't able to feel happy, even when his/her family or friends tried to help him/her feel better.
4. My child felt like he/she was just as good as other kids.
5. My child felt like they couldn't pay attention to what they were doing.
6. My child felt down and unhappy.
7. My child felt like he/she was too tired to do things.
8. My child felt like something good was going to happen.
9. My child felt like things they did before didn't work out right.
10. My child felt scared.
11. My child didn't sleep as well as they usually sleep.
12. My child was happy.
13. My child was more quiet than usual.
14. My child felt lonely, like they didn't have any friends.
15. My child felt like kids they knew were not friendly or that they didn't want to be with my chlid.
16. My child had a good time.
17. My child felt like crying.
18. My child felt sad.
19. My child felt people didn't like him/her.
20. It was hard to get started doing things.

Assessing Health Outcomes – Parent Report

Directions**:** Rate the frequency and severity of the following health symptoms.

Scale:
Frequency: not at all sometimes often all the time
Severity: does not hurt at all hurts a little hurts a lot
unbearable pain

1. Extreme fatigue (feeling extremely tired)
2. Allergic reaction
3. Sleep problems
4. Stomach ache
5. Nausea/vomiting (sick to your stomach/throwing up)
6. Diarrhea
7. Muscle aches and pains
8. Headaches or migraine
9. Weight gain of 5 or more pounds
10. Weight loss of 5 or more pounds
11. Respiratory congestion (cold in your chest)
12. Runny nose
13. Coughing
14. Sore throat
15. Sneezing
16. Blocked nose
17. Fever or chills
18. Dizziness
19. Double or blurred vision
20. Trouble catching breath
21. Having a cold
22. Chest pains
23. Numbness or tingling
24. Low energy
25. Ear infections
26. Getting sick
27. Heart beating too fast
28. Visits to the doctor
29. Visits to the school nurse
30. When your child was an infant, how frequently did he/she get sick?
31. Does your child smoke? (yes/no)
32. When did your daughter begin menarche (i.e., her first menstrual cycle)?
33. Is your child currently taking any medication? Yes/no

If so, please note what medication (or what the medication is for, e.g., ADHD, seizures).

Appendix C

Correlation Tables

Table C1. Correlations between types of victimization

Measure	Overt	Relational	Physical	Verbal	Indirect
Self-Report					
Overt					
Relational	.59*				
Physical	.75*	.38*			
Verbal	.69*	.61*	.64*		
Indirect	.58*	.83*	.39*	.68*	
Parent-Report					
Overt					
Relational	.64*				
Physical	.67*	.36*			
Verbal	.65*	.60*	.59*		
Indirect	.60*	.83*	.52*	.77*	

Note. *$p < .01$

Table C2. Correlations between types of bullying

Measure	Physical	Verbal	Indirect
Self-Report			
Physical			
Verbal	.53**		
Indirect	.24*	.64**	
Parent-Report			
Physical			
Verbal	.34**		
Indirect	.25*	.71**	

Note. *$p < .05$; **$p < .001$

Table C3. Intercorrelations between self- and parent-reports of victimization

	Parent Report				
Measure	Overt	Relational	Physical	Verbal	Indirect
Self-Report					
Overt	0.21*	.11	.24*	.36**	.14
Relational	.29**	.35**	.19	.39**	.36**
Physical	.09	.01	.16	.20	.04
Verbal	.16	.13	.16	.33**	.23*
Indirect	.24*	.32**	.18	.40**	.41**

Note. *$p < .05$; **$p < .01$

Table C4. Intercorrelations between self- and parent-reports of bullying

	Parent Report		
Measure	Physical	Verbal	Indirect
Self-Report			
Physical	.11	.04	-.19
Verbal	.00	.23*	.09
Indirect	-.08	.06	.13

Note. *$p < .05$

Table C5. Intercorrelations between self- and parent-reports of depressive symptoms

Measure	Parent Report			
	Anxious/ Depressed	Withdrawn/ Depressed	Depressive Symptoms	Affective Problems
Self-Report				
Anxious/Depressed	.44**	.23*	.54**	.38**
Withdrawn/Depressed	.33**	.37**	.50**	.32**
Depressive Symptoms	.18	.23*	.52**	.28**
Affective Problems	.30**	.26*	.54**	.35**

Note. *$p < .05$; **$p < .01$

Table C6. Correlations between victimization, bullying, and outcome variables

Outcome	Victim	Bully	IL-6	CRP	Freq.	Sev.	Dep. Symptoms	Anxious/ Dep.	Withdrawn/ Dep.	Affective Problems
Victimization										
Bullying	.72**									
IL-6	.02	-.07								
CRP	-.01	-.05	.72**							
Frequency of Health Symptoms	.53**	.42**	.23^{+}	.26*						
Severity of Health Symptoms	.56**	.33**	.10	.11	.80**					
Depression	.53**	.29**	.19^{+}	.10	.50**	.42**				
Anxious/ Depressed	.47**	.18^{+}	.21^{+}	.16	.63**	.60**	.71**			
Withdrawn/ Depressed	.37**	.16	.20^{+}	.17	.51**	.42**	.72**	.66**		
Affective Problems	.50**	.32**	.20^{+}	.20^{+}	.66**	.52**	.80**	.81**	.78**	

Note. $^{+}p < .10$ (marginally significant); $^{*}p < .05$; $^{**}p < .01$

Appendix D

Descriptives Tables

Table D1. Descriptive statistics of self- and parent-reports of victimization

Measure	Range	Min.	Max.	*M*	*SD*	Skewness	Kurtosis	α
Total Victimization	3.78	-0.93	2.85	0.00	0.69	1.47	2.96	
Self-Reports								
Overt	0.45	0.70	1.15	0.78	0.10	1.37	1.64	.66
Relational	0.56	0.70	1.26	0.87	0.15	0.42	-0.90	.81
Physical	0.39	0.85	1.23	0.91	0.08	1.68	2.82	.73
Verbal	0.62	0.70	1.32	0.91	0.16	0.44	-0.38	.86
Indirect	0.56	1.08	1.64	1.28	0.14	0.48	-0.56	.90
Parent-Reports								
Overt	0.38	0.70	1.08	0.78	0.09	1.46	1.78	.73
Relational	0.58	0.70	1.28	0.89	0.15	0.27	-0.90	.84
Physical	0.30	0.85	1.15	0.90	0.08	1.36	0.79	.75
Verbal	0.66	0.70	1.36	0.89	0.15	0.57	0.21	.87
Indirect	0.55	1.08	1.63	1.27	0.14	0.51	-0.22	.92

Note. Total Victimization scores based on the mean of all ten measures (standardized). Self- and parent-report scores reported are based on log-transformed values. The standard error for all skewness measurements is 0.25, and the standard error for all kurtosis measurements is 0.50.

Table D2. Descriptive statistics of self- and parent-reports of bullying

Measure	Range	Min.	Max.	*M*	*SD*	Skewness	Kurtosis	α
Total Bullying	2.28	-0.87	1.41	0.00	0.57	0.62	-0.40	
Self-Reports								
Physical	0.30	0.85	1.15	0.89	0.07	1.63	2.09	.69
Verbal	0.56	0.70	1.26	0.88	0.13	0.30	-0.56	.75
Indirect	0.40	1.08	1.48	1.21	0.10	0.55	-0.49	.80
Parent-Reports								
Physical	0.30	0.85	1.15	0.87	0.05	3.23	11.30	.76
Verbal	0.56	0.70	1.26	0.85	0.14	0.63	-0.01	.83
Indirect	0.49	1.08	1.57	1.22	0.12	0.72	-0.20	.90

Note. Overt and relational measures were unavailable for bullying behaviors. Total Bullying scores based on the mean of all six measures (standardized). Self- and parent-report scores reported are based on log-transformed values. The standard error for all skewness measurements is 0.25, and the standard error for all kurtosis measurements is 0.50.

Table D3. Descriptive statistics of self- and parent-reports of depression symptoms

Measure	Range	Min.	Max.	*M*	*SD*	Skew.	Kurt.	α
Total Depressive Symptoms	33.20	9.80	43.00	19.17	7.10	1.28	1.53	
Total Anxious/Depressed	4.36	-0.98	3.38	0.00	0.85	1.50	2.59	
Total Withdrawn/Depressed	3.57	-1.07	2.50	0.00	0.83	0.85	-0.03	
Total DSM Affective Problems	3.69	-0.95	2.74	0.00	0.82	1.16	1.31	
Self-Reports								
Depressive Symptoms	30.00	12.00	42.00	19.37	7.17	1.45	1.67	.69
Anxious/Depressed	24.00	0.00	24.00	5.77	2.91	1.42	1.65	
Withdrawn/Depressed	13.00	0.00	13.00	3.56	2.91	0.88	0.08	
Affective Problems	18.00	0.00	18.00	5.12	4.72	1.45	1.67	
Parent-Reports								
Depressive Symptoms	42.39	7.61	50.00	18.98	9.07	1.29	1.99	.80
Anxious/Depressed	20.00	0.00	20.00	3.37	3.92	1.71	3.64	
Withdrawn/Depressed	12.00	0.00	12.00	2.50	2.74	1.28	1.24	
Affective Problems	13.00	0.00	13.00	2.53	3.09	1.32	1.19	

Note. Total scores are based on the average of respective self- and parent-reports (standardized). The standard error for all skewness measurements is 0.25, and the standard error for all kurtosis measurements is 0.50.

Table D4. Descriptive statistics of self- and parent-reports of physical health and inflammatory markers

Measure	Range	Min.	Max.	*M*	*SD*	Skew.	Kurt.	α
Total Frequency	36.00	32.50	68.50	45.74	7.77	0.66	0.07	
Total Severity	33.50	29.50	63.00	38.86	6.42	1.18	1.70	
Self-Reports								
Frequency of Symptoms	43.00	30.00	73.00	47.06	9.87	0.56	-0.12	.89
Severity of Symptoms	39.00	29.00	68.00	38.70	8.27	1.23	1.38	.90
Parent-Reports								
Frequency of Symptoms	35.22	29.78	65.00	44.43	7.86	0.37	0.05	.88
Severity of Symptoms	35.00	29.00	64.00	39.02	7.17	1.04	1.33	.89

Note. Self- and parent-report scores reported are based on log-transformed values. The standard error for all skewness measurements is 0.25, and the standard error for all kurtosis measurements is 0.50.

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