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Childhood maltreatment and adulthood obesity among a sample of twin and sibling pairs: Results from the MIDUS Study

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I. Introduction

1. Child maltreatment

The Centers for Disease Control and Prevention (CDC, 2013) defines child maltreatment (CM) as the physical, emotional, psychological, or sexual abuse or neglect of a child or children under the age of 18 years by a parent, caregiver, or other adult, like a teacher or supervisor. The three major forms of CM are child physical abuse, child sexual abuse, and child neglect. CM results in harm to a child's well-being, development, and health and has many long-term consequences. Approximately three million CM referrals are made each year to state and social service agencies (U.S. Department of Health and Human Services- Children's Bureau, 2012). This number appears to be an underestimate of the size of the problem however. Survey data collected by the United States Department of health and Human Services (USDHHS- Children's Bureau, 2012) estimates that about six million children are maltreated in the U.S. per year and about 58.7% of CM reports are made by professionals who come in contact with the child through his or her job. Boys are 48.7% of the victims of CM and girls are 50.9% of the victims of CM (USDHHS– Children's Bureau, 2012). Of the children who have been maltreated, 78.3% have been neglected, 18.3% have been physically abused, and 9.3% have been sexually abused (USDHHS– Children's Bureau, 2012). The estimated yearly cost of CM is about \$124 billion (Fang, Brown, Florence, & Mercy, 2011).

CM negatively impacts the mental and physical health and social outcomes of victims in childhood and adulthood. Individuals who have been maltreated as children are at high risk for obesity (Greenfield & Marks, 2009; Shin & Miller, 2011), substance abuse (Elwyn & Smith, 2013), smoking (Topitzes, Mersky, & Reynolds, 2010), teen pregnancy (National Vital Statistics Report, 2003), and suicidal ideation (Rhodes, Boyle, Bethell, Wekerle, Tonmyr, Goodman et al.,

2013). Furthermore, the World Health Organization (WHO, 2010) reports that victims of CM are more likely to be diagnosed with depression, perpetrate violence, engage in risky sexual behavior, and misuse illicit drugs and alcohol. There are several risk factors for CM victimization including age (victims of CM in the first year of life have the highest rate of victimization) and having special needs, such as a developmental disorder or genetic disease (USDHHS- Children's Bureau, 2012). Perpetrators of CM may be parents who have a history of CM in their own family, attitudes and beliefs that justify CM, and lack parenting skills or understanding of children's needs. The USDHHS- Children's Bureau (2012) found that 80.3% of repeat offenders of CM were parents and 88.5% of those parents were biological parents. They also found that 53.5% of CM perpetrators were women, 45.3% were men, and 82.2% were between the ages of 18 and 44 years old. Parental factors that are associated with increased risk for perpetrating CM are low income, single parenthood, a large number of young and dependent children in the home, stress, child behavior problems, young age, and low educational attainment (Svensson, Eriksson, & Janson, 2013; Rogosch, Dackis, & Cicchetti, 2011).

2.1 Types of child maltreatment:

2.1a Child neglect

The CDC (2013) defines child neglect as the failure by a primary caregiver, usually a parent, to provide the physical, emotional, and psychological needs of a child. Child neglect is the most frequent form of CM that is reported to state and local authorities (USDHHS, 2010).

Physical neglect includes the failure to provide a child's physical needs, such as clothing, food, personal hygiene, shelter and safe living conditions, and medical attention (Stoltenborgh et al., 2013).

Emotional/psychological neglect refers to the failure of a primary caregiver to meet a child's emotional needs, such as providing warmth, care, and allowing the child to witness to or allowing the child to engage in maladaptive behaviors or violence (like domestic violence; CDC, 2008). Emotional/psychological neglect includes the failure to provide supervision to a child and the failure to provide education, such as failing to enroll a child in school, allowing chronic absences, and not providing special education for special needs children. Furthermore, it includes ignoring, rejecting, isolating or corrupting and/or exploiting a child.

Supervisory neglect is another form of child neglect, and it is also one of the most common forms of neglect (Coohey, 2003). It is the failure of a primary caregiver to plan or have awareness of a child's activities or engagement in at-risk behaviors (Knutson et al., 2010). Examples includes when a child is left alone temporarily, abandoned, left to wander around, or is left with an inappropriate caretaker or failing to monitor a child's activities closely. Failure to protect is another form of neglect that refers to failing to protect a child from a third party, such as an individual who is associated with illegal activities, leaving a child with a child abuser, failing to protect a child from environmental hazards, and failing to stop or prevent a child from engaging in harmful and delinquent behaviors (Ruiz-Casares, Trocmé, & Fallon, 2012). Supervisory neglect and failure to protect can result in unintentional injuries in children, such as drowning, falls, car accidents, and burns.

Medical neglect is the failure of a primary caregiver to provide regular medical care to a child, such as regular check-ups, medications, an emergency hospital visit, or failure to follow a physicians' instructions after a medical visit (Jenny, 2007). It accounts for about 2.3% of all CM cases in the U.S. each year (USDHHS, 2010). Parent's might forgo medical care for their child for multiple reasons, such as poverty, lack of health insurance, family disorganization, lack of

trust in medical professionals, lack of skills in identifying children's health care needs, mental or physical handicap of the parent, or the parents' cultural or religious beliefs towards Western health care (Jenny, 2007).

2.1b Child abuse

Child abuse is an explicit act that causes harm to a child. It can manifest in physical abuse, emotional/verbal abuse, or sexual abuse. Physical abuse refers to any act of physical aggression towards a child by an adult. Physical aggression includes hitting, slapping, kicking, spanking, punching, burning, biting or otherwise causing physical harm to a child. The definition of whether a behavior constitutes physical abuse is often determined by the forcefulness, the frequency, and the duration of the behavior. Low level physical punishment is typically deemed corporal punishment (discussed next) and there is some debate as to whether or not corporal punishment (CP) is child abuse (Straus & Stewart, 1999; Gershoff, 2002; Ferguson, 2013). Abuse can occur in a variety of environments, like the child's home or school, and is most often perpetrated by the child's parent (USDHHS, 2012).

Child sexual abuse or child molestation is when an adult uses a child for sexual gratification or stimulation (Child sexual abuse, 2011). Acts of child sexual abuse include sexual activities like rape or attempted rape, indecent exposure, physical sexual contact, or the use of child pornography. According to the American Academy of Child and Adolescent Psychiatry, about 80,000 cases of child sexual abuse are reported annually, although it is estimated that a large number of cases go underreported. The National Center for Victims of Crimes (Child sexual abuse statistics, n. d.) states that one in five girls and one in twenty boys will a victim of child sexual abuse, and in a single year about 16% of adolescents aged fourteen to seventeen

have been victims of sexual abuse. Children between the ages of seven and thirteen are the most vulnerable for child sexual abuse, and about 75% of children who have been sexually abused knew the perpetrator (Child sexual abuse statistics, n. d.).

Verbal/emotional abuse, often called psychological abuse, refers to acts of belittling, humiliating, degrading, shaming, threatening, isolating, and ignoring a child or denying any affection to the child (Coates, Dinger, Donovan, & Phares, 2013). It also includes yelling, ridiculing, criticizing, embarrassing, accusing or making the child feel as if they are a bad person and expressing anger on the child. It includes withholding support, guidance, and affection from the child. Like physical and sexual abuse, verbal/emotional abuse is also associated with various health consequences including the victims' feelings, self-worth, and emotional development. These impacts are discussed further below.

2.2 Corporal punishment

Corporal punishment (CP) is defined as an act of physical force used against a child as a means of correcting their behavior or disciplining them (Afifi, Mota, MacMillan, & Sareen, 2013; Gershoff, 2002). Typical acts of CP include spanking on the buttocks, slapping or striking the face, hitting with an object (like a belt or stick), shaking, or pushing a child (Ferguson, 2013). It has been banned in 33 countries including Austria, Croatia, Denmark, Finland, Germany, Israel, Norway, and Sweden, but not in the U.S., and parents in the U.S. continue to practice CP as a means of disciplining their child (Gershoff, 2002). CP in schools (spanking or paddling) has been banned in 31 U.S. states, but it continues to be a common practice in households (U.S.: Corporal punishment and paddling statistics by state and race, n. d.). Straus and Stewart (1999)

found that about 94% of American parents spank their child at least once by the time the child was 3 or 4 years old.

A growing body of research suggests that CP, like spanking, has a harmful impact on children's mental, physical, emotional, academic, and social wellbeing (Ferguson, 2013; Afifi et al, 2013; Gershoff, 2002; Mulvaney & Mebert, 2010). A meta-analysis conducted by Gershoff (2002) found that CP was significantly associated with negative outcomes such as internalizing and externalizing behaviors and low cognitive performance. A study by Afifi, Mota, MacMillan, and Sareen (2013) found that adults who had experienced CP as children were more likely to have cardiovascular disease, arthritis, and obesity after controlling for child abuse, SES, family disorganization, and Axis I and II mental disorders. CP is more prevalent in African American households, low SES families, and Southern states (Straus & Stewart, 1999). The victims are most often boys and the perpetrator is most often mothers (Straus & Stewart, 1999).

2.3 Risk and Protective Factors for CM

The risk factors for being a victim or a perpetrator of CM are multifaceted and involve the individual, the family, and the community (CDC, 2013). Risk factors for children include young age, and having special needs (ex. chronically ill, physical disabilities, mental health issues) (USDHHS– Child Maltreatment, 2012). Parents are at increased risk for perpetrating CM if they have a history of maltreatment in their own family, have substance abuse issues, have mental health issues (including depression), or are non-biological caregivers (like a step-parent) (USDHHS– Child Maltreatment, 2012). Family disorganization, stress, and family violence (such as domestic violence) are familial factors that put a child at risk for being maltreated (USDHHS– Child Maltreatment, 2012). Community factors that put a child at risk for maltreatment are community and neighborhood violence, high levels of poverty, high levels of

alcoholism, and high levels of unemployment (USDHHS– Child Maltreatment, 2012). Some factors protect and may prevent a child from being maltreated. Those protective factors include a strong emotional bond between the parent and child, a stable family, household rules, parental monitoring of child behaviors, and access to healthcare and other social services (USDHHS– Child Maltreatment, 2012).

2.4 Mental, physical, and social consequences of CM

CM is associated with a wide range of negative long-term mental, physical, and social conditions. CM is associated with Axis I and Axis II mental disorders, such as depression (Afifi et al., 2013). CM is also associated with post-traumatic stress disorder (PTSD) (Chirichella-Besemer & Motta, 2008), anxiety (Allen, 2008; Chirichella-Besemer & Motta, 2008), low-self esteem and self-worth (DeRobertis, 2004), and personality disorders (Allen, 2008).

CM is also linked to various *physical* health conditions. Lissau and Sørensen (1994) found that dirty and neglected children were more likely to be obese and overweight as adults, and there is evidence that CP is associated with arthritis and cardiovascular disease (Afifi et al., 2012). Victims of CM are more likely to have medical problems (Shaw & Krause, 2002) such as ulcers and bronchitis (Springer, 2009), liver disease (Dong, Dube, Felitti, Giles, & Anda, 2003), and inflammation (Danese, Partiente, Caspi, Taylor, & Poulton, 2007), and are more likely to smoke (Chartier, Walker, & Naimark, 2009), and abuse alcohol (Gilbert, Widom, Browne, Fergusson, Webb, & Janson, 2009). Furthermore, childhood sexual abuse is linked to early and unplanned pregnancy in women (Young, Deardorff, Ozer, & Lahiff, 2011), risky sexual behavior (Fergusson, Horwood, & Lynskey, 1997), and illicit drug use (Champion, Foley, DuRant, 2004).

CM is linked to a host of social problems in adulthood, including detached relationships with parents (Davey, Eggebeen, & Savla, 2007), marital difficulties (Waldinger, Schulz, Barsky, & Ahern, 2006; Whisman, 2006), interpersonal difficulties (Wilson, Krueger, Arnold, Barnes, Mendes de Leon, Bienias et al., 2006), and difficulty regulating and controlling emotions (Repetti, Taylor, & Seeman, 2002). In a meta-analysis, Ferguson (2012) found that CP, particularly spanking, was associated with children's internalizing and externalizing behaviors and low cognitive performance. These associations negatively impact an individual's relational, occupational, familial, and educational outcomes in adolescence and adulthood. The impacts of CM may become intertwined with each other; for example, an individual may begin with mental health issues, like depression, which lead to social issues, like difficulty regulating emotions which may be a contributing factor to physical health conditions, like obesity and overweight, through using food to regulate emotions and cope with stress.

2. Obesity is a public health epidemic in the United States

There has been a dramatic increase in rates of adulthood obesity in the past 20 years and it has gained much attention in the United States because of the chronic health complications associated with obesity (Ogden, Carroll, Kit & Flegal, 2012). Overweight is defined by Body Mass Index (BMI), an index for height and weight used to determine obesity and overweight. An adult BMI greater than or equal to 25 kg/m^2 is categorized as overweight, and a BMI greater than or equal to 30 kg/m^2 is classified as obese (WHO, 2013). The CDC estimates that approximately 35.7% of adults aged 20 and older and almost 17% of children aged 2 to 19 are overweight or obese (Ogden et al., 2012). Ogden, Carroll, Kit and Flegal (2012) reported that from 2009 to 2010, there was no significant difference in rates of obesity or overweight between men and

women; however, they did find that adults aged 60 years and older were more likely to be overweight or obese than younger adults. Ogden et al. (2012) also reported that in recent decades, rates of obesity and overweight have been increasing for men from 27.5% in 2000 to 35.5% in 2010, but not for women who have had a steady obesity and overweight rate of 33.4%. The overall rate of obesity across the U.S. has remained stable in the previous few years (Ogden et al., 2012).

After reviewing the global prevalence of obesity and overweight among adults and adolescents and the health consequences of excess weight, the WHO (2000) stated that obesity was a global epidemic and developed guidelines to combating obesity. Overweight and obesity are associated with various long-term and short-term health conditions for adults and adolescents.

1.1 Demographics

African Americans have the highest rates of obesity (49.5%), while Mexican Americans (40.4%) and all other Hispanics (39.1%) come in second and third (CDC, 2013), followed by non-Hispanic Caucasians at 34.3% (CDC, 2013). African American women are more likely to be obese than non-Hispanic Caucasian women (Lovasi et al., 2009). Kirby, Liang, Chen, and Wang (2012) found that racial and ethnic composition is correlated with obesity, and that Hispanics and African Americans lived in areas with fewer recreational centers and gyms with more fast food restaurants compared to non-Hispanic Caucasians. Individuals living in areas with a high percentage of African Americans or Hispanics were more likely to be obese or overweight (Kirby, Liang, Chen, & Wang, 2012). Race and ethnicity have historically been tied to

occupation, educational attainment, and SES, so the relationship between race and ethnicity and obesity is multifaceted.

1.2 Impact of obesity and overweight in adolescence

It is estimated that obesity and overweight are a contributing factor to between 100,000 to 400,000 premature deaths in the U.S. per year (Flegal, Graubard, Williamson, & Gail, 2005). Excess body fat is co-morbid with various health complications, such as Type-II diabetes, hypertension, high blood pressure and high cholesterol, several types of cancer, and cardiovascular disease. Impacts of obesity can begin in childhood. Obese or overweight children are more likely to suffer from high blood pressure, high cholesterol, heart disease, prediabetes and Type-II diabetes, bone and joint problems, and sleep apnea (*F as in fat: How obesity threatens America's future*, 2013). Furthermore, obese children and adults are also more likely to suffer from decreased psychological functioning, such as increased stress, low self-esteem, depression, bullying from peers, impaired motor processes, lower academic achievement and social stigmatization (Li & O'Connell, 2012; Kantomaa, Stamatakis, Kankaanpää, Kaakinen, Rodriguez, et al., 2013). Regarding long-term consequences, children who are obese or overweight are more likely to stay obese or overweight into adulthood (Freedman, Kettel, Serdula, Dietz, Srinivasan, & Berenson, 2005; Guo & Chumlea, 1999).

1.3 Impacts of obesity and overweight in adulthood

Overweight and obese adults are at increased risk for developing heart disease, stroke, osteoarthritis, and cancer of the breast, colon, kidney, gall bladder, thyroid, cervix, and prostate (*F as in fat: How obesity threatens America's future*, 2013). Obese and overweight women are

more likely to experience infertility and irregular menses (WHO, 2013). The WHO (2013) estimates that 44% of the diabetes burden and between 7% and 41% of cancers in adults are attributable to overweight and obesity. Similar to overweight or obese adolescents, overweight adults are at risk for depression and decreased mental functioning. Research has linked obesity in midlife to Alzheimer's disease and dementia in late adulthood (Xu, Atti, Gatz, Pedersen, Johansson, & Fratiglioni, 2011; Whitmer, Gustafson, Barrett-Connor, Haan, Gunderson, & Yaffe, 2008).

1.4 Etiology of overweight and obesity

Overweight and obesity are the result of an energy imbalance of consuming too many calories and not expending those calories to maintain body weight. Obesity and overweight are caused by a combination of contributing factors, such as physical inactivity, a high-fat diet, genetics, and an unhealthy environment. These factors overlap and combine in various ways so it is difficult to disentangle lifestyle factors from the environment or genetics from medical conditions.

1.4a Lifestyle

Lifestyle behaviors, such as physical inactivity, eating an unhealthy diet, alcoholism, and smoking are associated with obesity and overweight (Pietiläinen, Kaprio, Borg, Plasqui, Yki-Järvinen, Kujala, et al., 2008; Lampert, 2010; Grucza, Krueger, Racette, Norberg, Hipp, & Bierut, 2010). Rates of children engaging in regular physical activity have been declining while the rates of obesity have been increasing (Kantomaa et al., 2012). It is estimated that about 33% of children and adolescents are regularly physically active (Kantomaa et al., 2012), and the

American Heart Association (2013) estimates that 32% of adults do not engage in regular physical activity and only 21.0% of adults meet the 2008 federal guidelines for strengthening exercises. Furthermore, literature shows that the fast food consumption and soft drinks are linked to childhood obesity (Chang & Nayga, 2010), and it has also been shown that obese children are more likely to become obese adults (CDC, 2013). James and Kerr (2005) stated that in Western countries, the 'super sized' portions of meals and soft drinks at fast food restaurants has increased in recent decades, and aggressive food marketing techniques contribute to the obesity epidemic. Lampert (2010) found that smoking is associated with obesity. Research has also shown that sleep duration is linked to obesity and overweight through disturbances in circadian rhythms and the metabolic system (Fogelholm, Kronholm, Kukkonen-Harjula, Partonen, Partinen, et al., 2007; Patel & Redline, 2004; Patel, Malhotra, White, Gottlieb, & Hu, 2006). Low levels of regular physical activity, an unhealthy diet, smoking, and irregular sleep patterns all contribute to the etiology of obesity and overweight.

1.4b Genetics and biological factors

Scientists have made a number of major advancements in the area of obesity research as it relates to genetics, hormones, and family history. Because body structure is largely determined by genetics, it is natural to assume that there is a genetic component to obesity and overweight. Since genes determine how our bodies store and process calories, they are a component to the etiology of obesity and overweight (CDC, 2010). Walley, Blakemore, and Froguel (2006) provide evidence that genetics play a significant role in the location of fat storage. In 1962, Neel proposed the "thrifty gene" hypothesis. He proposed that "thrifty genes" evolved because in previous environments food availability was scant and irregular. "Thrifty genes" allowed humans

to survive famines, but now that we live in an era with processed foods and calorie-rich diets, these “thrifty genes” are now making us obese (Neel, 1962). Different racial and ethnic groups have different rates of obesity and overweight and this may be partly due to genetic differences (Walley, Blakemore, & Froguel, 2006). Genetic testing has shown that obesity is a highly heritable trait in both men and women (Walley et al., 2006; Hilbert, Dierk, Conradt, Schlumberger, Hinney, Hebebrand et al., 2009).

There is also evidence that stress hormones may play a component in the development of obesity through changes in the metabolic system and changes in how the brain structure regulates energy (Whitaker, Phillips, Orzol, & Burdette, 2007; Greenfield & Marks, 2009). For example, witnessing domestic violence in childhood or being a victim of sexual abuse can lead to changes in stress hormones and may play a role in developing obesity (Greenfield & Marks, 2009). Using food to cope with stress can lead individuals to become obese or overweight through habitually eating out of stress rather than hunger.

1.4c Medical conditions

Preexisting medical problems may also be a factor in the development of obesity and overweight. Weight gain may be a result of a medical diagnosis. Hypothyroidism and injuries or abnormalities to the hypothalamus, the part of the brain that regulates the endocrine system and the pituitary gland, are a few diagnoses that are associated with weight gain (Wu, Chien, Lin, Chou, & Chou, 2013). Hypothyroidism is when the thyroid gland does not produce enough of the thyroxine hormone; because it is a disturbance in the natural balance of the body, it can cause obesity (Wu et al., 2013). Other symptoms related to hypothyroidism are depression, mood disturbances, and sleep disturbances (Wu et al., 2013). Depression and anxiety is associated with

obesity because of depressed individuals' tendency to overeat (van Reedt Dortland, Vreeburg, Giltay, Licht, Vogelzangs, van Veen et al., 2013; Skilton, Moulin, Terra, Bonnet, 2007).

1.4d Environmental factors

The growth of the processed food industry and the influence of internet and television food marketing campaigns have been associated with obesity (Lascu, Manrai, Manrai, & Amissah, 2013). Children are exposed to soft drinks and unhealthy snacks in school vending machines, and school-based obesity prevention initiatives have been developed to limit the availability of unhealthy snacks in vending machines (Phillips, Raczynski, West, Pulley, Bursac, Gauss et al., 2010). Schools provide daily meals to students, and food preparation techniques and the availability of unhealthy snacks can be a contributing factor in childhood obesity (Phillips et al., 2010). Living in an area with limited access to fresh fruits and vegetables – known as a food desert – is another environmental factor that can contribute to obesity (Walker, Block, & Kawachi, 2012). Residents who live in food deserts are at increased risk for developing diet-related health conditions like obesity and overweight because of the absence of healthy foods and the abundance of fast food restaurants (Walker, Block & Kawachi, 2012). There is a positive association between fruit and vegetable consumption and the availability of those foods in the neighborhood environment (Rose & Richards, 2004).

1.4e Socioeconomic status

Low socioeconomic status (SES) is also associated with obesity and overweight (Shrewsbury & Wardle, 2008). The CDC (2013) reports that women of high SES are less likely to be obese than women of low SES, and women with college degrees are less likely to be obese

than women without college degrees, but the same is not true for men. Behaviors that lead to obesity, such as unhealthy eating and physical inactivity, are more frequent among those living in poorer areas (Craig, McNeill, Macdiarmid, Masson, & Holmes, 2010; Nelson & Woods, 2009). In addition, low income individuals are more likely to live in food deserts and areas where there are an absence of gyms and recreational centers for physical activity, both of which can also contribute to obesity (Rose & Richards, 2004; Lovasi, Hutson, Guerra, & Neckerman, 2009). The relationship between low SES and increased obesity is thought to be due to a multitude of factors including SES's relationship to educational attainment, wealth, race/ethnicity, and occupation.

1.4f Parenting strategies and household environment

Children's weight is determined by a combination of genetics and biological factors, and their interaction with their early environment. The family environment is a key factor in the development of obesity because parents provide food and because children often model eating and exercise habits from their parents (Vámosi, Heitmann, Thinggaard, & Kyvik, 2011). Beyond the specific provision of food and modeling of eating and exercise behaviors, other family factors have been shown to relate to obesity including disorganized family environments, low parental supervision, maternal antipathy, child maltreatment, and family dysfunction (Shin & Miller, 2012; Whitaker, Phillips, Orzol, & Burdette, 2007; Vámosi et al., 2011). Knutson et al. (2010) found that care neglect and supervisory was significantly associated with increased BMI in children and adolescents, possibly because of the lack of parents monitoring their child's eating habits. Vámosi et al. (2011) found that among adults, recalled maternal antipathy and maternal neglect in childhood but not paternal antipathy or paternal neglect in childhood are also

related to adulthood obesity. This could be because of a link between adverse childhood events and distress that may be related to overeating to self-soothe or regulate emotions. Lytle, Hearst, Fulkerson, Murray, Martinson, Klein et al. (2011) found that childhood obesity was associated with fewer positive family meal practices, higher levels of depression and overall stress, more work-related and time-related demands, and fewer household rules as compared to healthy weight sample. Sonnevile, Rifas-Shiman, Kleinman, Gortmaker, Gillman, and Taveras (2012) conducted a cross-sectional randomized control trial and found that obesogenic behaviors in parents are associated with similar behaviors in children. Sonnevile et al. (2012) also found that eating fast food, consuming sugary beverages, and the number of hours per day of watching television was strongly associated between mothers and children.

3. The Association between CM and Obesity

CM and obesity

As stated earlier, several studies have demonstrated that there is an association between CM and obesity (Vámosi et al., 2011). Whitaker et al. (2007) conducted a study about CM and obesity in 2,452 preschool children aged 3 years old using the Parent-Child Conflict Tactics Scale to measure corporal punishment, neglect, and psychological aggression. Whitaker et al. (2007) found no statistically significant association between overall CM and obesity, but did find that children who had been neglected were more likely to be obese. The author's state that the association between CM and obesity may not be present in this age group and an association may appear at a later age.

Min, Minnes, Kim, and Singer (2013) conducted a study examining the association between CM and adult physical health conditions, like obesity, substance abuse, and smoking as

well as psychological distress. The author's used adult self-report data from 279 African-American women about physical, sexual, and emotional child abuse and physical and emotional neglect, including the Health Status Questionnaire (HSQ) to assess chronic medical conditions and the Child Trauma Questionnaire to assess history of CM. Results indicate that after controlling for age, educational attainment, and race, 70% of women reported some form of CM, 42% had some history of substance abuse, and 59% had some type of chronic physical health condition. This demonstrates that negative childhood events are associated with adult physical health. In contrast, Whitaker et al. (2007) did not find an association between CM and a physical health condition (obesity) in a sample of children, and thus age may be related to the relationship between CM and physical health.

Shin and Miller (2012) used data from the National Longitudinal Study of Adolescent Health (AddHealth) to examine the relationship between CM and long-term growth rates in BMI in a sample of 8,471 adolescents and followed them into young adulthood. The AddHealth study used longitudinal, multistage, and school-based sample methods to collect data from adolescents in grades 7-12. The author's controlled for SES, parental BMI, gender, high or low birth weight, and whether or not the child was born in the U.S. Latent curve modeling revealed that adolescents who reported being maltreated had faster BMI growth rates than adolescents who reported no maltreatment even after controlling for various demographics.

Midei and Matthews (2010) conducted a meta-analysis examining the role of interpersonal violence in childhood and obesity in adulthood using 36 studies. The researchers created categories for childhood interpersonal violence, interpersonal violence in the community or neighborhood, and interpersonal violence from peers. Childhood interpersonal violence included witnessing domestic violence, sexual abuse, and physical abuse from primary

caregivers. After ranking the 36 studies based on quality, sample size, study design, and measure of obesity and interpersonal violence, Midei and Matthews (2010) found that 29 studies (81%) found an association between obesity and at least one form of interpersonal violence in childhood.

Knutson et al. (2010) conducted a study examining the role of care neglect and supervisory neglect and risk for childhood obesity using a sample of 571 ethnically diverse and underprivileged children in Iowa and Wisconsin. The researchers used the Home Environment Questionnaire (HEQ), the Care Neglect Index, and the Supervisory Neglect Index to measure neglectful parenting and weight and height measures to calculate BMI. Using hierarchical linear regression analysis, Knutson et al. (2010) found a statistically significant association between care neglect and supervisory neglect and childhood obesity, but the association varied across age. Care neglect and obesity were associated for younger children, and supervisory neglect and obesity were associated for older children. Again, this study demonstrates that age may be a factor in the relationship between CM and obesity.

Rohde, Ichikawa, Simon, Ludman, Linde, and Jeffery (2008) examined the relationship between CM and obesity and depression in middle-aged women and the association between disordered eating (like binge eating) as a mediator between CM and obesity. Data was obtained from Group Health Cooperative, a health insurance plan in Washington and Idaho; the sample size was 4,641 women with a mean age of 52 years. The measures used were the Childhood Trauma Questionnaire, the Patient Health Questionnaire, and the Questionnaire on Eating and Weight Patterns, as well as demographic measures and weight and height to calculate BMI. These measures assessed child sexual abuse, child physical abuse, obesity, binge eating behavior, and depression. Rohde et al. (2008) found that child sexual abuse and child physical abuse were

strongly associated with obesity and depression in middle aged women, although rates varied by ethnicity, but their findings failed to provide evidence that binge eating mediates the association between obesity and CM.

A study by Vámosi, Heitmann, Thinggaard, and Kyvik (2012) demonstrated that neglectful parenting can also be a contributing factor to adulthood obesity. Using 146 same-sex twin pairs from the Danish Twin Registry, self-reported responses to the Childhood Experiences of Care and Abuse Questionnaire and physical measurements of weight and height, the author's found that maternal antipathy and maternal neglect, but not paternal antipathy and paternal neglect, were positively associated with adulthood obesity. This study further demonstrates that neglect in childhood has an impact on adult health.

Using a nationally representative sample from the National Epidemiologic Survey on Alcohol and Related Conditions (NESARC) and a sample of 34,266 American adults aged 20 years and older, Afifi et al. (2013) examined the relationship between harsh physical punishment in childhood and severe physical health conditions in adulthood. Afifi et al. (2013) controlled for various types of child abuse and neglect, like physical, sexual, and emotional abuse and physical and emotional neglect to investigate the relationship between harsh physical punishment and physical health conditions in the absence of child abuse. The NESARC uses items from the Adverse Childhood Experiences study, the Conflict Tactics Scale, and the Childhood Trauma Questionnaire to assess child maltreatment and physical punishment and assessed several health conditions, including hypertension, cardiovascular disease, diabetes, and obesity. Respondent's reported their height and weight, allowing the authors to calculate BMI. Afifi et al. (2013) adjusted for SES, educational attainment, marital status, race/ethnicity, gender and age as well as family dysfunction/disorganization and Axis I and II mental disorders. Results indicate that harsh

physical punishment in childhood is associated with increased risk for cardiovascular disease, arthritis, and obesity. The study found that women were more likely to be obese if they had experienced CM and men were more likely to be obese if they had experienced harsh physical punishment. This study provides further evidence that there is a relationship between CM and obesity.

Possible explanations and mechanisms

Clearly, there is an association between CM and obesity. However, the mechanisms for this link are not well understood. Moreover, it is unclear whether the association between CM and obesity is directly causal, or a result of other factors that are correlated with both CM and obesity (e.g., SES). Several explanations have been proposed to explain the link between CM and obesity, including ones that focus on biological mechanisms, intrapersonal mechanisms, and psychosocial mechanisms.

A first possible explanation for the CM-obesity association focuses on depression, and holds that because CM is linked to depression and depression is linked to obesity, victims of CM may use food as a coping mechanism to self-soothe negative emotions. The causal mechanism by which CM may lead to obesity has not been studied, and further research is needed to discover the mediating variables that influence the relationship between CM and obesity. Shin and Miller (2012) stated that future research should examine the mediators and moderators between CM and obesity, particularly compulsive eating and depression. Midei and Matthews (2010) stated that further research is needed to examine the mechanisms between interpersonal violence in childhood and obesity, particularly the association between interpersonal violence, disordered eating patterns, and obesity.

A second related explanation focuses on negative affect (Carr, Friedman, & Jaffe, 2007; Goldschmidt, Tanofsky-Kraff, Goossens, Eddy, Ringham, Yanovski, & ... Yanovski, 2008). Carr, Friedman, and Jaffe (2007) studied the association between negative and positive affect and BMI using a large study sample from the National Survey of Midlife in the United States (MIDUS). They found that even after controlling for employment status, educational attainment, health conditions, and demographic variables, obese participants were more likely to report negative affect than positive affect when compared to normal weight participants. Negative affect is also associated with binge eating disorder (Racine, Keel, Burt, Sisk, Neale, Boker, & Klump, 2013; Danner, Evers, Sternheim, van Meer, van Elburg, Geerets, & ... de Ridder, 2013) which is also associated with obesity (Schag, Teufel, Junne, Preissl, Hautzinger, Zipfel, & Giel, 2013; Zeeck, Stelzer, Linster, Joos, & Hartmann, 2011; Stice, Presnell, Shaw, & Rohde, 2005). Goldschmidt, Tanofsky-Kraff, Goossens, Eddy, Ringham, Yanovski, and Yanovski (2008) conducted a study about binge eating disorder and negative affect among children and found that children with high negative affect and had more weight concerns, more frequent binge-eating episodes, and their parents reported more parent-child problems.

A third possible mechanism is the role of impulsive behavior in children that may make them more likely to be physically punished by a primary caregiver and may also be related to disordered eating patterns that can lead to obesity (Mobbs, Crépin, Thiéry, Golay, & Van der Linden, 2010; Nederkoorn, Smulders, Havermans, Roefs, & Jansen, 2006; Fields, Sabet, & Reynolds, 2013). Impulsivity refers to the act of acting without forethought, planning, and control and failing to control urges (Staus & Mouradian, 1998). Impulsivity and the ability to control behavior is an important factor in weight status. It is also related to corporal punishment. A study by Straus and Mouradian (1998) conducted interviews with 933 mothers of children

aged 2-14. Straus and Mouradian (1998) controlled for SES, gender, and maternal factors, and after conducting an ANOVA they found that the more CP a child experienced, the more likely they were to engage in antisocial behavior and act impulsively. Impulsivity may be one mechanism through which CP is related to obesity.

Finally, it is also possible that there may be no causal relationship between CM and obesity, and that both are related to, or caused by, important third variables such as poverty, unsafe neighborhoods or living conditions, educational attainment, or mental health. Cancian, Slack, and Yang (2010) conducted a randomized control trial using data from the Wisconsin Statewide Automated Child Welfare Information System (WiSACWIS). Among a sample of 13,519 mothers on welfare, Cancian et al. (2010) found a causal effect between risk of CM and family income. Their results suggest that increased income serves as a protective factor against CM, and support previous literature demonstrating a causal effect between CM and poverty and welfare receipt (Brown, Cohen, Johnson, & Salzinger, 1998; Jones & McCurdy, 1992; Martin & Lindsay, 2003). A qualitative study of 20 in-depth interviews found that adverse life events, including maltreatment, in childhood can influence the risk of poverty and low-income in adulthood, possibly through a chain reaction of negative life events (Frederick & Goddard, 2007).

Regarding mental and physical health, Herrenkohl, Hong, Klika, Herrenkohl, and Russo (2013) used data from the Lehigh Longitudinal Study and found that adults with a history of CM had higher rates of depression, generalized anxiety disorder, somatic problems, alcohol and substance abuse problems, and poorer overall physical health 30 years after the CM reports were made. Sugaya, Hasin, Olfson, Lin, Grant, and Blanco (2012) used data from the National Epidemiologic Survey on Alcohol and Related Conditions and found that child physical abuse

was significantly associated with bipolar disorder, attention-deficit hyperactivity disorder (ADHD), and post-traumatic stress disorder (PTSD). Sugaya et al. (2012) observed a dose-response relationship between the frequency of abuse and types of mental disorders. CM is also associated with unsafe living conditions. For example, Robinson, Boris, Heller, Rice, Zeanah, Clark, and Hawkins (2011) used behavioral, cognitive, and home environment assessments with a sample of 71 maltreated and 70 non-maltreated children to determine how family and home characteristics influence CM. Robinson et al. (2011) found that home environment had a significant effect on maltreated children's social, academic, and cognitive difficulties. Dufour, Clément, Chamberland, and Dubeau (2011) took data from the Quebec Statistics Institute and found that families who maltreated their children were more supporting of corporal punishment, had high levels of domestic violence and psychological hostility, and were less knowledgeable about the long- and short-term harmful impact of CM or family violence.

Lastly, educational attainment level is also linked to CM. Byrne and Taylor (2007) conducted a qualitative study among an Irish sample of welfare workers and social workers regarding their beliefs about children who had been exposed to domestic violence and their self-esteem and academic abilities. Their results supported the current literature that children exposed to domestic violence either become withdrawn and introverted or become aggressive and hostile. Children who witness domestic violence miss more school days than those not exposed to domestic violence, thus hindering their schooling and cognitive development (Byrne & Taylor, 2007). Children who have witnessed domestic violence or have grown up in a home where domestic violence occurred may become overweight or obese because of factors like physical and mental health issues incurred because of witnessing domestic violence in childhood or the accumulation of adverse childhood events and their impact in adulthood.

4. The Current Study

The current study uses a nationally representative data set, the National Survey of Midlife in the United States (MIDUS). The goal of the MIDUS was to study the role of age-related variables on behavioral, cognitive, and social factors. MIDUS includes information about the physical, mental, social, and emotional health, lifestyle characteristics, and family history of individuals in their 20's, 40's, and 60's. For this study, we utilized the public access data from MIDUS. The goal of the current study was follows:

- To examine the relationship between CM and obesity using a large sample of twins and siblings. First, I examined the simple relationship between various form of abuse and obesity, and then, following the methodology of Vámosi et al. (2011), examined twin and sibling pairs to look at differences in experiences of CM and obesity.
- The research questions were, “Is there a relationship between CM and adulthood obesity among a nationally representative sample of twin pairs and sibling pairs?” and “Is there a relationship between CM and adulthood obesity among a sample of twin pairs and sibling pairs after controlling for several covariates?”

II. Methods

The MIDUS Study

From 1995-1996, the MacArthur Midlife Research Networked implemented the National Survey of Midlife Development (MIDUS), a nationally representative survey of Americans between the ages of 25 to 74 with the goal of obtaining data about behavioral, social, economic, and psychological variables that influence health and well-being. The first wave of MIDUS (MIDUS I) had 7,108 participants that were obtained through random-digit dialing (RDD). Eligible participants had to be non-institutionalized, English-speaking, in the continental United States, and between the ages of 25 and 74. The sample includes twin pairs, siblings, and an oversampling of select urban areas. Participants were asked questions about their physical health and health history, their psychological well-being, their level of education, their job history, relationships and family, and several other factors. They were asked an extensive set of questions about their childhood, such as their relationship with their parents, paternal and maternal affection and discipline, physical, verbal, and sexual abuse, and the presence or absence of their parents in their childhood.

To follow-up MIDUS I, MIDUS II was conducted from 2004-2006 by contacting the original participants in MIDUS I and asking them to participate in wave II of data collection. Participants were contacted and interviewed over the phone. The MIDUS II has a sample of 4,963 participants yielding a longitudinal retention rate of 70% and a response rate of 75%. MIDUS II also included twin pairs, siblings, and an oversampling of African-Americans in Milwaukee, Wisconsin.

MIDUS I: Participants and Procedures

The MIDUS I study was conducted from 1995 to 1996 and included 7,108 participants. Three thousand four hundred eighty-seven participants were recruited through RDD, 757 participants were oversamples from five major metropolitan cities, 950 siblings of participants from RDD sample were recruited and 1,914 twin pairs were recruited through RDD. Twin pairs were recruited in a two-step design that included screening a nationally representative sample of 50,000 households for twins. About 15% of respondents who stated that had a twin in their family were then asked whether or not the research team could contact their twin to participate in the surveys. Eligibility criteria included (1) being non-institutionalized, (2) aged 25 to 74 years old and (3) be an English-speaking adult in the U.S. All participants completed a 30 minute phone interview and completed two self-administered questionnaires. The twin samples were administered a screening survey to assess zygosity and obtain twin-specific data. Participants who successfully completed all phases of data collection received \$20. Table 1 on the next page displays the demographic characteristics of MIDUS I study participants.

Table 1. Demographic characteristics of MIDUS I study sample (National Survey of Midlife Development in the United States – Descriptions of MIDUS samples, 2004-2006, n.d.)

		Main RDD	Siblings	Twins	Total Sample
Gender	Male	49%	44%	45%	48%
Age	Range	24-74	24-75	25-75	24-75
	Mean (SD)	46 (13.2)	49 (12.6)	45(12.0)	46 (13.0)
Education	Less than 12 yrs.	11%	7%	11%	10%
	12 yrs.	29%	27%	32%	29%
	13-15 years	31%	32%	31%	30%
	+16 yrs.	29%	35%	27%	31%

MIDUS II: Participants and Procedures

The MIDUS II was a longitudinal follow-up study of the participants in the MIDUS I. The MIDUS II was conducted in 2004 to 2006 by contacting all of the original participants and asking them to participate in the second wave of data collection procedures. MIDUS II study participants received \$60 for successfully completing all measures. Out of the 7,108 participants in MIDUS I, 4,963 were successfully contacted to participate in another 30 minute phone interview. Of the 3,487 MIDUS I respondents from the RDD sample, 2,257 (71%) completed the MIDUS II study. Of the 950 siblings in the MIDUS I study, 733 (77%) were contacted and completed the MIDUS II study. Of the 1,914 twin pairs that participated in the MIDUS I study, 1,484 (78%) were contacted and participated in the MIDUS II study.

The MIDUS II also included two 55-page self-administered questionnaires that were mailed to participants. Because response rates for city oversamples were not provided, overall response rate cannot be calculated. However, 70% of RDD participants, 64% of siblings, and 60% of twins completed the phone interview. Regarding the self-administered questionnaire, 87% of the RDD participants, 81% of the siblings, and 92% of the twins completed the two self-administered questionnaires. Overall, out of the total 7,108 participants in MIDUS I, 6,329 (89%) participants in MIDUS II completed the two self-administered questionnaires. Table 2 on the next page shows the demographic characteristics of the participants in MIDUS II. Overall, 70% of those contacted in MIDUS II completed the survey. Of the 30% who did not complete the survey, the most cited reason was refusal (12%), non-working telephone numbers (10%), and deceased (6%).

Table 2. Demographic characteristic of study participants in MIDUS II (National Survey of Midlife Development in the United States – Descriptions of MIDUS samples, 2004-2006, n.d.)

		Main RDD	Siblings	Twins	Total Sample
Gender	Male	48%	43%	45%	47%
Age	Range	34-84	32-83	34-84	32-84
	Mean (SD)	56 (12.7)	57 (12.2)	54 (11.6)	55 (12.4)
Education	Less than 12 yrs.	7%	4%	6%	6%
	12 yrs.	27%	26%	30%	27%
	13-15 years	30%	32%	31%	30%
	+16 yrs.	36%	38%	33%	37%

Measures

As stated previously, the MIDUS I and MIDUS II study's used phone interviews and self-administered questionnaires in the form of mailed packets to participants. There were a wide range of variables measured including demographics, physical and mental health, history and risk of heart disease and cancer, chronic diseases, depression, and various forms of mental health disorders. Many of these variables are not discussed here. Instead, I will focus on the variable relevant to the analyses conducted here.

Three classes of variables were included in the current study: (1) child maltreatment (the independent variable), (2) BMI (the dependent variable), and (3) control variables (demographics and other control variables).

(1) Child maltreatment

Childhood victimization (MIDUS I, Self-administered questionnaire)

Regarding childhood and family violence, participants were given a list of behaviors and asked to indicate how much each of their parents perpetrated those behaviors towards them. A first set of behaviors focused on psychologically abusive behaviors. The behaviors were: insulted or swore at you, sulked or refused to talk to you, stomped out of the room, did or said something to spite you, and smashed or kicked something in anger. Respondents answered two questions that indicated whether their mother had done any of the psychologically abusive behaviors, and whether their father had done any of the psychologically abusive behaviors. Each item was answered using a Likert scale ranging from 1 to 4, where 1=often, 2=sometimes, 3=rarely, and 4=never. A second list of five behaviors included mild physically abusive behaviors including: being pushed, grabbed, shoved, slapped, or had something thrown at them. A final list included behaviors that indicated severe physical abuse: being kicked, bit, or hit with a fist, beat up,

choked, burned or scalded, or had someone hit them or try to hit them with something. As with psychologically abuse behaviors, respondents indicated separately whether their mother or father had done any of the behaviors to them. Thus, two items each (one mother, one father) were reported for psychological abuse, physical abuse, and severe physical abuse. Reports of mothers' and fathers' abuse were averaged to create an index of psychological abuse, physical abuse, and severe physical abuse for each respondent. For the analysis, the scale was reversed to facilitate interpretation so that a higher score indicated more abuse.

(2) BMI and body measurements

Body measurements (MIDUS I, Self-administered questionnaire)

The information regarding participants' body size was part of the self-administered questionnaire that was mailed to each participant. The MIDUS administrators enclosed a tape measure in the questionnaire packet to help participants and provided a list of tips when taking measurements to make sure they were accurate. For example, they advised participants to take measurements standing up and to record measurements to the nearest quarter of an inch. Participants were asked about their waist size, their hip size, their height in feet and inches and their current weight in pounds, their weight one year ago in pounds, and how much they weighed when they were 21 years old. In the current analysis, I focus on current weight. BMI was computed using the standard formula $\text{weight (pounds)} / [\text{height (inches)}]^2 \times 703$. The current study conceptualized BMI in two forms: categorical BMI and continuous BMI. Continuous BMI was readily available from the data set and had already been computed. This variable was used to create a new categorical variable that categorized participants into one of three groups: normal weight (BMI from 18.5 to 24.9), overweight (BMI from 25.0 to 29.9), or obese (BMI 30.0 and above).

(3) Control variables

Respondent's highest level of education completed (MIDUS I, Phone questionnaire)

To measure participants' highest level of education completed, interviewers asked participants, "What is the highest grade or year of college you completed?" Response options were: no high school/some grade school (1-6 grades), eighth grade/junior high school (7-8 grade), some high school (9-12 grade, no diploma/no GED), GED, graduated from high school, 1 to 2 years of college (no degree yet), 3 or more years of college (no degree yet), graduated from a two-year college/vocational school or associate's degree, graduated from a four or five year college or bachelor's degree, some graduate school, and master's degree, PH.D, ED.D, MD, DDS, LLB, LLD, JD or other professional degree. For the current analyses, response were recoded into five categories (less than high school, high school graduate, some college, college graduate, or advanced degree) and treated as an ordinal variable.

Moderate to vigorous physical activity (MIDUS I, Self-administered questionnaire)

Physical activity was measured through several questions using a Likert scale (1=several times a week or more, 2=about once a week, 3=several time a month, 4=about once a month, 5=less than once a month, 6=never). The following questions were asked: "During the summer, how often do you engage in vigorous physical activity (for example, running or lifting health objects) long enough to work up a sweat," "What about the winter – how often do you engage in vigorous physical activity long enough to work up a sweat," "During the summer, how often do you engage in moderate physical activity (for example, bowling or using a vacuum cleaner)," and "What about during the winter – how often do you engage in moderate physical activity?" I used the total self-reported physical activity scores as a control variable.

Self-rated physical health (MIDUS I, Phone questionnaire)

Participants were asked to rate their physical health from the following question: “The first questions are about your health. In general, would you say your physical health is...” and the options were as follows: 1 = poor, 2= fair, 3 = good, 4 = very good, 5 = excellent, and don’t know. For the analysis, “don’t know” responses were set to missing. The total self-rated physical health scores were utilized in the analyses as a control variable.

Self-rated mental or emotional health (MIDUS I, Phone questionnaire)

Participants were asked to rate their mental or emotional health from the following question: “What about your mental or emotional health” and the options were as follows: 1 = poor, 2= fair, 3 = good, 4 = very good, 5 = excellent, and don’t know. For the analysis, “don’t know” responses were set to missing. The total self-rated mental and emotional health score was used in the analyses.

Depressed affect (MIDUS I, Phone questionnaire)

Depression diagnosis was made through two items. The first item asked, “Please think of a two-week period during the past 12 months when these feelings were worst. During that time, did the feelings of being sad, blue, or depressed usually last...?” Options were: 1 = all day long, 2 = most of the day, 3 = about half the day, 4 = less than half the day, and don’t know. The second question asked, “During the two weeks when these feelings were worst, how often did you feel this way...?” Participants were given the same response options for the second question as for the first question. Total depressed affect scores were used in the analyses.

Analytic Plan

To test the hypothesis, first simple correlations were examined between abuse variables and obesity (BMI). Next, a regression analyses was conducted to examine the relationship between abuse and obesity, while controlling for gender, educational attainment, age, and several other variables associated with CM and obesity. The third analyses focused on examining differences in the abuse – obesity relationship between twin and sibling pairs. These analyses were modeled after a twin study by Vámosi et al. (2011). Twin pairs were used because they have complete genetic overlap (monozygotic twins, MZ) or 50% shared genetic overlap (dizygotic, DZ) while sharing a very similar environment. The differences between continuous BMI and emotional, physical, and severe physical abuse were computed reflecting these differences and new variables were created. Then, correlations were calculated among the differences between continuous BMI and the three types of abuse between twin pairs and sibling pairs. These differences were computed for the total sample, same-sex and different-sex twin pairs, and same-sex and different-sex sibling pairs.

III. Results

Analyses were conducted using IBM SPSS 21. Demographic and descriptive statistics for the sample are provided in Table 3. The total sample was $N = 2302$, consisting of $n = 514$ siblings (257 pairs) and $n = 1788$ twins (894 pairs). Of the twin pairs, 38.6% were monozygotic ($n = 688$), 34.4% ($n = 613$) were dizygotic – same sex, and 25.6% ($n = 457$) were dizygotic – different sex. Due to missing data, not all variable counts total 2302. Regarding gender, 43.6% were male and 54.1% were female. Thirty-six percent had a college degree or advanced degree. Forty-two percent were normal weight (BMI = 18.5 – 24.9), 37.7% were overweight (BMI = 25.0 – 29.9), and 20.3% were obese (BMI \geq 30.0). Regarding the abuse variables, on a scale of 1 to 4 (with higher values indicating more of the characteristic) the mean for emotional abuse was 1.9, the mean for physical abuse was 1.6, and the mean for severe physical abuse was 1.3.

The relationship between BMI and child maltreatment (as measured by emotional abuse, physical abuse, and severe physical abuse) was investigated first using Pearson product-moment correlation coefficient, and then via multivariate regression. Table 4 provides a description of the correlational results. There was a small, positive relationship between continuous BMI and emotional abuse, $r = 0.06$, $n = 1970$, $p < 0.01$, and physical abuse, $r = 0.07$, $n = 1994$, $p < 0.05$. There was a small, positive relationship between each form of abuse and BMI categories; emotional abuse, $r = 0.06$, $n = 1970$, $p < 0.05$, physical abuse, $r = 0.09$, $n = 1994$, $p < 0.05$, and severe physical abuse, $r = 0.05$, $n = 1987$, $p < 0.01$.

Multiple linear regression analyses were used to assess the ability of three levels of CM (emotional abuse, physical abuse, and severe physical abuse) to predict BMI category (the dependent variable). Three models were created with the goal of testing if the three types of abuse are significantly associated with BMI category after controlling for covariates. The eight

covariates include: age (years), gender (male, female), self-rated physical health (scale of 1-5), self-rated emotional or mental health (scale of 1-5), depression diagnosis (yes, no), educational attainment (less than high school, high school or GED, some college, completed college, and master's degree or more), times/month moderate activity (scale of 1-6), and times/month vigorous activity (scale of 1-6). Three regression models were conducted, one for each type of abuse (emotional, physical, and severe physical abuse), plus the covariates. Results of the three models are shown in Table 5. The model for emotional abuse was statistically significant, $F(9, 1252) = 12.88, p < 0.05, R^2 = 0.09$. Among covariates, three predictors were significantly associated with physical abuse, gender ($beta = -0.18, p < 0.05$), vigorous activity ($beta = -0.01, p < 0.05$) and self-reported physical health ($beta = -0.18, p < 0.05$). After controlling for covariates, emotional abuse remained a significant predictor of BMI category ($beta = 0.06, p < 0.05$). Model 2 included the covariates and physical abuse. Results indicate that gender ($beta = -0.26, p < 0.05$), moderate activity ($beta = -0.01, p < 0.05$), vigorous activity ($beta = -0.01, p < 0.05$), and self-reported physical health ($beta = -0.15, p < 0.05$) are negatively associated with physical abuse. Depression was positively associated with physical abuse, ($beta = 0.09, p < 0.05$). Model 3 included the covariates and severe physical abuse. After controlling for covariates, severe physical abuse was no longer a significant predictor of BMI.

Next, the relationship between differences in abuse and differences in BMI by sibling pairs were examined. Recall that the differences were computed in reported emotional abuse, physical abuse, severe physical abuse, and BMI between sibling pairs. Siblings with greater reported abuse should have greater BMI, thus the two difference measures should be positively correlated. Additionally, because monozygotic twins have 100% genetic overlap, any difference in BMI must be attributable to environmental influences (dizygotic twins and siblings share 50%

of their genes), and thus it was expected that there would be higher correlations among monozygotic twins as compared to dizygotic twins or siblings. The relationship between abuse differences and BMI differences was analyzed using Pearson's correlation coefficient. Six separate groups of correlations were computed: (1) the full sample, (2) monozygotic twin pairs, (3) dizygotic twin pairs where twins were of the same sex, (4) dizygotic twin pairs where twins were of different sex, (5) sibling pairs of the same sex, and (6) sibling pairs of different sexes.

Table 6 provides a description of the results. None of the results reached statistical significance.

Table 3. Demographics and Descriptive Statistics

Variable	<i>n</i> *	(%)	M	SD
Gender	2302			
Male	1003	43.6		
Female	1246	54.1		
Age (years)	2268		46	12.3
Major sample identification	2302			
Siblings	514	22.3		
Twins	1788	77.7		
Twin categories				
Monozygotic	688	38.6		
Dizygotic – same sex	613	34.4		
Dizygotic – different sex	457	25.6		
Educational Attainment	1672			
Less than high school	105	6.2		
High school or GED	448	26.8		
Some college	514	30.5		
Completed college	380	22.8		
Master's degree or more	229	13.7		
Self-rated physical	2296		3.6	1.0

health				
Self-rated emotional and mental health	2299		3.9	0.9
Bad mood/negative affect	2105		1.5	0.6
Times/month, moderate activity	2101		9.4	4.8
Times/month, vigorous activity	2098		6.1	5.2
Depressed affect				
No	2075	90.1		
Yes	227	9.9		
Emotional abuse average	2095		1.9	0.8
Physical abuse average	2096		1.6	0.7
Severe physical abuse average	2102		1.3	0.6
BMI category	2040		1.8	0.8
Normal	856	42.0		
Overweight	770	37.7		
Obese	414	20.3		

*Due to missing data, not all frequencies add up to 2302

Table 4. Correlations between BMI and CM

	BMI continuous	BMI category	Emotional Abuse	Physical Abuse	Severe Physical Abuse
BMI continuous	-				
BMI category	0.9** (n = 2040)	-			
Emotional Abuse	0.06* (n = 1970)	0.06** (n = 1970)	-		
Physical Abuse	0.07** (n = 1994)	0.09** (n = 1994)	0.7** (n = 2031)	-	
Severe Physical Abuse	0.05* (n = 1987)	0.05* (n = 1987)	0.5** (n = 2024)	0.6** (n = 2047)	-

**Correlation is significant at the 0.01 level (two-tailed)

*Correlation is significant at the 0.05 level (two-tailed)

Table 5. Predicting BMI category including covariates and abuse

	Model 1: Emotional Abuse			Model 2: Physical Abuse			Model 3: Severe Physical Abuse		
	β	SE	95% CI	β	SE	95% CI	β	SE	95% CI
Age	0.001	0.00	(-0.002, 0.01)	0.001	0.00	(-0.002, 0.004)	0.000	0.00	(-0.003, -0.004)
Gender	-0.26*	0.04	(-0.34, -0.18)	-0.26*	0.04	(-0.34, -0.18)	-0.27*	0.04	(-0.35, -0.19)
Physical health	-0.14*	0.03	(-0.19, -0.09)	-0.15*	0.03	(-0.20, -0.1)	-0.15*	0.03	(-0.2, -0.09)
Emotional health	0.03	0.03	(-0.03, -0.08)	0.04	0.03	(-0.02, 0.1)	0.03	0.03	(-0.02, -0.09)
Depression	0.09	0.08	(-0.06, -0.24)	0.09	0.08	(-0.06, -0.24)	0.11	0.08	(-0.04, -0.26)
Moderate activity	-0.01	0.01	(-0.02, -0.00)	-0.01*	0.01	(-0.02, -0.001)	-0.01*	0.01	(-0.02, -0.001)
Vigorous activity	-0.01*	0.01	(-0.02, -0.001)	-0.01*	0.01	(-0.02, -0.002)	-0.01*	0.01	(-0.02, -0.001)
Education	0.01	0.01	(-0.004, -0.03)	0.01	0.01	(-0.003, -0.03)	0.01	0.01	(-0.003, -0.03)
Abuse	0.06*	0.03	(0.002, 0.104)	0.07*	0.03	(0.02, 0.132)	0.04	0.04	(-0.02, 0.13)
R ²	0.09			0.09			0.09		

*correlation is significant at the 0.05 level

Table 6. Correlations between sibling and twin pairs

	All	Monozygotic twins	Dizygotic twins, different sex	Dizygotic twins, same sex	Siblings, different sex	Siblings, same sex
Emotional abuse difference and continuous BMI difference	0.02 (n = 873) p = 0.52	0.08 (n = 269) p = 0.21	0.002 (n = 168) p = 0.98	0.01 (n = 232) p = 0.94	-0.01 (n = 85) p = 0.93	0.04 (n = 110) p = 0.69
Physical abuse difference and continuous BMI difference	0.02 (n = 897) p = 0.48	-0.03 (n = 280) p = 0.61	0.008 (n = 174) p = 0.92	0.1 (n = 237) p = 0.15	0.12 (n = 86) p = 0.28	-0.04 (n = 111) p = 0.71
Severe physical abuse difference and continuous BMI difference	-0.003 (n = 890) p = 0.93	-0.07 (n = 276) p = 0.22	0.05 (n = 173) p = 0.49	0.03 (n = 236) p = 0.61	-0.01 (n = 86) p = 0.95	-0.09 (n = 111) p = 0.35

IV. Discussion

The results verify the research question that CM is associated with obesity and overweight. Although some statistically significant results were found, they were small. However, analyses between six subgroups of the sample demonstrated that differences between continuous BMI and different experiences of three forms of abuse are not statistically significant. In other words, although there are significant correlations between BMI and different types of CM (emotional physical and severe physical abuse), this significance goes away after controlling for several covariates, like levels of physical activity, gender, and self-rated physical health. This indicates that the covariates are in some way related to or are interacting with the CM and BMI variables. The current study confirms previous literature regarding the positive association between CM and obesity (Min et al., 2013; Shin & Miller, 2012; Midei & Matthews, 2010; Knutson et al., 2010; Rohde et al., 2008; Vámosi et al., 2012; Afifi et al., 2013). However, the results of the current study are not as strong as the results of some other studies. This study contributes to the literature because it is the second known study, after a study by Vámosi et al. (2012), to use twin pairs from a nationally representative data set, and is the first known study to use sibling pairs to examine the CM-obesity relationship. It provides evidence regarding the role of genetics on the etiology of obesity and overweight. The current study fits with the literature because it provides further evidence about the association between CM and obesity and provides direction for future research.

The current study has several implications for future research. First, because the results of this study are not as robust as those of other studies, more research needs to be done regarding the relationship between BMI and CM. More specifically, future research should focus on how different types and combinations of CM, including child neglect, interact with each other to influence physical health outcomes and body weight. Second, research should also examine the

links between the covariates in the current study, like self-reported physical and emotional health and depression, and how they are interrelated with CM and adult physical health. The covariates may have some interaction between CM and BMI that can help provide further information about the nature of this relationship. Third, future research should go beyond correlations and multiple regressions and look at what variables predict obesity in adulthood for individuals who are victims of CM. It should also look at the sequencing of characteristics and events. For example, are obese or overweight children more likely to be maltreated or corporally punished which influenced their adult weight? Or, does being maltreated in childhood cause individuals to overeat and become obese from a third unknown factor? Finally, future research should also examine obesity concordant and discordant twin and sibling pairs for experiences of CM.

These findings have implications for public health practice. Public health practitioners should be sensitive to the physical health of victims of CM, especially concerning obesity and overweight. Many public health practitioners focus on the mental and emotional health of victims of CM, but they should also be made aware of the impact that CM has on physical health. Social workers and counselors who work with victims of CM should not ignore the long-term physical health effects of CM. Public health practitioners should also consider having physical health screenings, like those for obesity, along with mental health screenings, like those for depression or suicidal ideation, for victims of CM. This could alert social workers and counselors about the physical health status of maltreated children, and they could in turn refer CM victims to health services or resources. Regarding public health policy, guidelines should be created to provide social service agencies with a checklist or handbook of how to address the physical aspects of CM, including obesity.

There are several limitations to this study. First, this study uses secondary data analysis

and combines data from two waves of data collection. Using variables from two data sets may have led to inconsistencies, and there may have been issues in the transferring of data from one data set to another. There is also the issue of incompleteness of the data sets. The variables in the current study had missing values which cannot be accounted for. Second, using secondary data does not allow control over the quality of the data. We do not know the quality of the data collection methods and procedures, or how well data collection assistants, like phone interviewers, were trained. We also do not know how consistent phone interviewers were in their implementation of the phone interviews. Although the phone interview included directions for the interviewer, we do not have information on how well phone interviewers followed these directions. The phone interviews were not recorded or transcribed, so there is no way to check the accuracy of data collected from the phone interviews. Another limitation is sampling bias. The MIDUS I and II data collection process was done by phone and mail, which could have led to a sample that is not truly representative in all regards. Furthermore, MIDUS I participants who completed the MIDUS II data collection process may have been different in some way than those who refused to participate in the MIDUS II data collection process.

A fourth limitation is that much of the data is based on self-reported information which could be biased. Participants may have over reported or underreported information or may have had difficulty recalling information. For example, participants may have underreported their weight or over reported their height which would have resulted in inaccurate or skewed BMI. Regarding the CM variables, participants may have had difficulties recalling events from their childhood, so recall bias is a major limitation. Fifth, we cannot draw cause-and-effect conclusions from our analysis because this study is limited to correlational results.

Another set of limitations is based on the variables used in the current study. This study examined emotional abuse, physical abuse, and severe physical abuse. It did not examine child neglect, the most common form of CM, or child sexual abuse. Furthermore, we only used BMI, but other forms of body measurement, like waist-to-hip ratio, could also have been used. The covariates may also be limitations because they are not an exhaustive list. Other important factors, like health insurance coverage, family history of obesity and overweight and medical conditions or use of medications that may lead to obesity were not controlled for in the current study. This study was modeled after a twin study by Vámosi et al. (2012), which examined weight discordant twins where one twin had to meet criteria for normal weight and the other twin had to meet criteria for obesity. They did their analyses differently by analyzing if the obese twin had higher self-reported rates of recalled maternal and paternal antipathy. The current study examined differences between BMI and experiences of CM, so the results of the current study and the study by Vámosi et al. (2012) are not comparable. The current study provides different results because it examines differences between sibling and twin pairs' BMI and CM experiences rather than differences between weight discordant sibling and twin pairs.

This study sample has a mean age of 46 years, meaning that this cohort may have grown up when different child rearing practices were legal, socially acceptable, and practiced. Laws against CP and CM and what aggressive behaviors constitute as CM have changed in the past 50 years, so the results of this study may be confounded with history and societal norms. Moreover, because the current study has an older sample and because societal and parenting norms have changed in recent decades, the results of this study may not be relevant today. Although this study controlled for age, future research should examine the relationship between social norms, child rearing practices, and CM as it relates to physical health. Because CM and CP laws have

changed since these cohorts were children, the results of this study may no longer apply to children growing up today. Future studies should examine possible mediators of the relationship between CM and obesity. Previous literature has shown that there is some type of relationship between CM and obesity, but the mechanism of why or how this relationship occurs is not well understood. The current study has confirmed the literature regarding the relationship between CM and BMI and has provided research and public health implications as well as areas for future research.

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