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YOU MAY BE WHAT YOU EAT, SO CAN YOU BE VIOLENT DUE TO YOUR FOOD?

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ABSTRACT
Research that supports the relationship between nutrition and violence becomes more popular recently. Previous researches mainly explore the impact of specific micronutrients, such as vitamins, minerals, and essential fatty acid on violence, aggression, and antisocial behaviors. However, few studies focus on the influence of dieting patterns and certain type of food on violent behaviors. Does the quote "you may be what you eat" hold true in terms of violence? This paper investigates whether people may become more violent due to their food choice. The result indicates that consumptions of certain food, such as junk food (westernized diet), coffee, soda, and chocolates, can be associated with increased violence by negatively affecting brain development, neurochemical metabolism, few or no beneficial nutrients absorption, and ineffective communication among neurotransmitters, such as serotonin and dopamine. Additionally, this paper suggests people's daily dieting patterns and invisible food sensitivity, such as intolerance to milk and natural salicylates, tend to be associated with more violent behaviors. Therefore, nutritional reforms by replacing potential violence-induced food with beneficial food at schools, companies, and prisons are feasible and promising to prevent violence and intervene antisocial behaviors.

KEYWORDS: Violence, brain development, nutrition, criminology, diet, antisocial behavior.

INTRODUCTION
The link between diet and violence is not new. Trace back to Lombroso's argument, bomb terrorists are more likely to suffer from pellagra, a malnutrition because of a corn-based diet efficient in vitamin B-3 (Gesch, 2002). Violence tends to be resulted from recklessness, irritability, impulsivity, and antisocial behaviors (Sharma, 2009; Werbach, 1995). The slogan "You are what you eat" emphasizes the importance of food and nutrition consumptions, as well as dieting patterns, on shaping human behaviors. Food ingestions and dieting patterns influence human's behaviors by affecting the brain structural development, brain neurotransmitters, and the brain functions (Beseler, 1999; Gesch, 2002). The current paper attempts to provide an overview of the nutrition consumed from an individual's food choices and dieting patterns as risk factors to increase people's propensities of engaging violent, antisocial, and aggressive behaviors. The study includes various aspects of nutritional impacts of daily food consumptions, including early malnutrition, children's dieting patterns, junk food, soda, coffee, sweets, chocolates, invisible food sensitivities, and prisoners' food options, on people's propensities of violence and antisocial behaviors.

Early Malnutrition and Violence
Malnourished children are more susceptible to have low intelligence, disease, and a decreased learning ability due to underdevelopment of brain structure and functions, which, in turn, potentially leads to more violent behaviors (Sharma, 2009). Especially, malnutrition is associated with short-term and long-term deficits in cognition, attentions, and antisocial behaviors (Grantham-McGregor & Baker-Henningham, 2005; Sharma, 2009; Gesch, 2002). Liu and Raine (2006) indicate that both macro and micro nutrients in the prenatal and postnatal period are associated with youth's aggressive behaviors and adulthood criminal activities. Moreover, Kleinman et al. (1998) reveal that malnourished and hungry children are 7 to 12 times more likely to exhibit symptoms of conduct disorders than not hungry or nutrition-balanced children. Malnourished children also tend to exhibit higher levels of irritability, aggression, and externalizing behavioral problems than their low-income, low-SES, but not hungry peers (Halas et al, 1975; Mora, 1979; Gray, 1986). Although Kleinman et al.'s research (1998) cannot determine the causality between malnutrition and violence, the finding still suggests a significant impact of nutrition and food sufficiency on children's externalizing behaviors from an epidemiological perspective. Table 1 shows the comparison of externalizing behaviors between

malnourished and not hungry children (Kleinman et al, 1998).

Malnutrition may predispose people to psychopath and criminal offenders because of brain cell maldevelopments, alternations of biochemical processes, and increasing neurotoxicity (Liu et al, 2007; Sharma, 2009). Liu et al. (2004) further demonstrate that the malnourished children are more likely to have lower cognitive ability and suffer more psychosocial adversity. Early malnutrition negatively influences brain formation and development (Liu et al., 2004). Therefore, brain dysfunctions and cognitive impairments, such as lower IQ, tend to predispose children to future antisocial and violent behaviors (Donnellan & Wenk, 2000). Malnutrition reflects in deficits in protein, low iron level, and low zinc level, which further is associated with impaired prefrontal cortex development, presentation of DNA, and protein synthesis (Liu et al., 2004). Generally, protein deficiency, zinc, and iron-deficient anemia tend to lead to children's antisocial behaviors and adult's aggression (Raine, 1993; Rosen et al., 1985; Moffitt, 1990).

Furthermore, by examining the cortical thickness, Epstein (1986) finds that brain weight, head circumference, and brain functional development peak at age of 7, 12, and 15. There are great demands of nutrients for brain development (Raine, 1993). If nutrition is inadequate, the structural and the functional development of the gray matter in the prefrontal cortex, which involves in judgment, attention, planning, and self-control, will be compromised (Benton, 2007). Especially, children who suffer protein and energy deficiencies caused by malnutrition are more likely to be aggressive and antisocial (Liu et al., 2004). Winick et al.'s adoption study (1975) shows that Korean children who are adopted by American families and benefit from subsequent adequate nutrition tend to have higher IQ, better school performances, and exhibit fewer conduct disorders. Liu et al. (2004) further confirm the same relationship between malnutrition and children's externalizing behaviors, independent of social background and demographic characteristics. Therefore, it is clear and consistent that early malnutrition is associated with more violent and aggressive behaviors though its negative impacts on brain developments structurally and functionally (Benton, 2007).

Dieting Patterns and Violence

The nature of diet and eating patterns can influence human's behaviors by affecting the supply of nutrients for brain structural and functional developments (Benton, 2007). Although Pollitt and Mathews (1998) do not find conclusively casual impact of breakfast on cognition, they reveal that omitting breakfast is significantly associated with children's decreased cognition, lower intelligence, and lower learning abilities, particularly for children who are malnourished. Several more recent studies (Vaisman et al., 1996; Busch et al., 2002; Mahoney et al., 2005) support the correlation between dieting patterns and children's externalizing behaviors. Children who have breakfast rather than fasting has been found to show better cognitive performance (Mahoney et al., 2005). Especially, consuming cereals or fruits instead of a non-caloric snack for breakfast tends to improve children's memory, attention, and activations in prefrontal cortex (Busch et al., 2002; Wesnes et al., 2003). The low glycemic breakfast, such as dieting or non-sugar cereals, tends to slow and reduce the span of attention over the morning due to different speeds of releasing glucose into the blood and brain (Ingwersen et al., 2007; Benton et al., 2003). However, the negative effects diminish if young adults eat midmorning snacks. Similarly, Nabb & Benton's research (2006) demonstrates that when various amounts of carbohydrate are combined with dietary of fiber, a slower release of glucose has a positive impact on children's cognition, thereby leading to a better memory and school performance, as well as fewer externalizing behaviors.

Gesch's prison study (2002) indicates that prisoners given nutritional supplements for meals tend to commit 35% fewer violent crimes than those given the placebo meals. Derek McGill even says that he never suspects that the prison food, such as fried potatoes and burgers, may be a cause of violence. "Dieting patterns definitely make differences," said by Craig, a 19-year-old gang member who is serving a 9-year sentence for culpable homicide. A diet with less sugar and highly processed food but more supplements with minerals, vitamins, and fatty acids is more likely to reduce prisoner's aggressive behaviors, thereby leading to fewer future violent crimes and recidivism (Gesch et al., 2002). Table 2 reports the impacts of different nutrients in prisoner's diet on brain functions. Also, Schoenthaler's experiment (1982) demonstrates that a dietary revision involved the replacement of soft drinks and junk food with nutritious snacks as well as the elimination of high sugar content desserts is associated with a 71% increase in well-behaved juveniles and a 48% decrease in their antisocial behaviors.

Moreover, Schauss' research (1984) reveals that overconsumption of milk for breakfast is associated with more antisocial and chronically violent behaviors. Bateman et al. (2004) conclude that artificial food coloring and sodium benzoate preservatives in the diet may lead to more hyperactivity and antisocial behaviors through their negative effects on brain formations and neurotransmitters, such as serotonin and dopamine. (McCann et al., 2007; Sharma, 2009). Egger et al. (1985) reveals that certain food for breakfasts or snacks may produce adverse reactions, thus leading to children's externalizing behaviors. For example, cow milk may result in an adverse reaction in 64% of children; chocolate (59%), grapes (49%), wheat (49%), oranges (45%), cows cheese (40%), and hens eggs (39%) (Benton, 2007). In addition, Gedye's partial-blind experiment (1991) indicates that aggression decreases

67% for women on buspirone alone meals and 85% on buspirone with a serotonin-enhancing diet by changing the meal's protein-carbohydrate ratio, such as adding bananas, pineapples, and papayas into each meal (Wurtman & Wurtman, 1988). Table 3 shows the details of the food components in the experiment (Gedye, 1991). However, Gedye (1991) points out that buspirone not only is a partial agonist for serotonin receptors, but also has weak dopaminergic agonist and antagonistic properties (Algeri et al., 1988; Riblet et al., 1982). Thus, some undesirable dopaminergic effects may explain why some participants do not benefit or even worsen.

Although Randy Nelson, whom specializes in the mechanisms of aggression, criticizes the link between nutrition and violence, Gesch (2002) argues that the nutrition-violence effect is confirmed by several well-established double-blind studies (Liu et al., 2004; Liu & Raine, 2006; Wurtman & Wurtman, 1988). Poor diet and different dieting patterns are able to explain some of the violence and antisocial behaviors in schools, prisons, and even the community (Gesch, 2002).

Junk Food (Westernized Diet) and Violence

It is not surprising to see the link between junk food and violence. Dr. Pottenger, Jr.'s longitudinal research (1983) on nutritional deficiencies in 900 cats reveals that an increase in consumption of junk food is associated with an increase in violence. By replacing the soda machines, refined and processed food with water and wholesome fresh fruits, vegetables, and lean proteins in the school, the school tends to report fewer discipline problems, children's behaviors tend to change dramatically, and the drop-out rates decrease (Stitt, 1999). High fructose corn syrup, food dyes, preservatives, highly processed foods, and fried foods, which are consistently considered as junk foods, are found to be associated with chemical, physical and mental imbalances to the body and the brain (Stitt, 1999). 60% of the dry weight of the brain is fat, which is "unique in the body for being predominantly composed of highly unsaturated fatty acids." When the brain lacks essential nutrients, such as vitamins, Omega-3, and minerals, the neurotransmitters are not able to communicate with each other (Gesch, 2002). This clearly is associated with short attention, low self-control, low IQ, and more violent behaviors (Gesch, 2002). Consequently, the more junk food you eat, the less room you have for necessary nutrients and chemicals to feed your brain, which predisposes to more violence (Monbiot, 2009).

Vitamins. It is also well-established that deficiencies of several vitamins due to inadequate intake are associated with irritability, impulsivity, and aggression (Benton, 2007; Gesch, 2002; Sharma, 2009). Thiamine (Vitamin B-1) deficiency significantly impacts human's aggression by altering the brain neuro-functions and several neurotransmitters in the central nervous system (Butterworth, 1982; Witt, 1985; Sharma, 2009). Lonsdale & Shamberger (1980) report that people who eat junk food tend to have biochemical evidence of thiamine deficiency, thereby increasing their aggressive and antisocial behaviors. Poor food choices may result in lower nutrient intakes, thereby causing more violence and higher recidivism rates (Gesch, 2002; Schauss, 1984). Clearly, a vicious cycle may begin: you eat junk food when you are in emotional pain or behave aggressively, and the junk food creates more psychological problems, which prompt more consumptions of junk food.

Omega-3 (Essential Fatty Acid). Another feature of junk food is lack of essential fatty acid, such as Omega-3, which significantly influences brain functions and communication among neurotransmitters (Benton, 2007). Commercially-baked goods (i.e. cookies, crackers, cakes, pizza dough), packaged snacks (popcorn, chips, candy), and fried foods (French fries, fried chicken, chicken nuggets, taco shells) all have low levels of Omega-3 but high levels of unhealthy saturated fat (Simopoulos, 1999). Appleton' research (2008) indicates the important role of essential fatty acid on emotional regulation, aggression, impulsivity, and attention deficit hyperactivity disorders (ADHD). In addition, Gesch et al.'s prisoner study (2002) illustrates that consumptions of Omega-3 for two weeks tend to reduce violent offenses by 26.3% to 35.1%. Poor and cheap food choices by prisoners may lead to lower nutrient intakes, especially essential fatty acids. Furthermore, a meta-analysis, from nine methodologically rigorous studies exploring the potentially causal relationship between essential fatty acid and violence, consistently reveals that lacking essential fatty acid is associated with increased aggression and violence for both adults and adolescents (Benton, 2007).

Hamazaki et al. (1996) further explore the underlying neurological mechanism by suggesting that Omega-3 is not only crucial for normal prenatal and postnatal brain development, but also important for central nervous system functions. Food, rich for essential fatty acid or DHA, such as fish oil and salmon, significantly influences many physiological and pathological aspects of human and animal brain developments (Siess et al., 1980; McLennan et al., 1988). Hamazaki et al.'s double-blind random controlled experiment (1996) demonstrates that although the speed of judgments and executive functions are not moderated by DHA consumption, DHA significantly decreases the extra-aggression. Based on frustration-aggression hypothesis (Berkowitz, 1969), frustration increases the probability of being aggressive against external triggers. Consequently, the declined extra-aggression percentage in the DHA group supports the aggression-controlling effects of essential fatty acid, compared to the control group (Hamazaki et al., 1996). Omega-3 plasma essential fatty acids predict levels of the metabolites of serotonin and dopamine taken from cerebrospinal fluid (Hibbeln et al., 1998). Raised levels of corticotrophin-releasing hormone in the cortical-hippocampal-amygdala pathway are associated with increased aggression (Hibbeln et al., 1998). Junk food,

with its nature of simply lacking Omega-3 fatty acids, can be largely associated with people's increased violence and antisocial behaviors (Benton, 2007; Hibbeln et al., 1998).

Caffeine and Violence: Coffee and Soda

Many studies have examined the relationship between taste/drinking preferences and personalities (Elfhag & Erlanson-altertsson, 2006; Saliba, Wragg, & Richardson, 2009). Having a high sensitivity to bitter drinks, such as coffee, wine, and beer, is consistently found to be linked with increased emotionality and impulsivity, compared to non-tasters who do not like bitter tastes (Dess & Chapman, 1990; Macht & Mueller, 2006). Recently, Keller and Siegrist (2015) reveal the complex relationship between antisocial personality and coffee consumption because sensation or stimulant seeking is also one of the personality traits (Sagioglou & Greitemeyer, 2014). Caffeine consumption correlates with sensation seeking behavior and aggression (Mattes, 1994). Specifically, Sagioglou and Greitemeyer's experiments (2014) demonstrate that psychopathy, everyday sadism, and aggression are significantly positively correlated with general bitter taste preferences (i.e. coffee, dark chocolate, and wine). General bitter taste preferences are strong predictors for violence and aggression (Sagioglou & Greitemeyer, 2014). Matcht and Mueller (2006) indicate that people who are less sensitive to PROP tend to show faster acceptance of bitter foods (Duffy & Bartoshuk, 2000), and they tend to be less emotionally aroused by the anger-inducing film, after examining how emotional reactions to an anger-inducing vs. sadness-inducing vs. neutral film clip differ based on the sensitivity to the bitter tasting compound PROP. PROP super-tasters show a decrease in joyfulness, yet an increase in negative emotions towards the film than their less-tasting counterparts (Matcht & Mueller, 2007). This finding reveals a positive correlation between the enjoyment of bitter foods and a propensity of sadistic traits, aggression, and violence.

To be more specific, Sagioglou and Greitemeyer (2014) argue that people who take their coffee black are more likely to exhibit psychopathic personality traits, according to their questionnaires, which measure personality qualities, such as narcissism, aggression, and sadism. The research (Sagioglou & Greitemeyer, 2014) also infers that daily bitter foods, such as tonic water, radishes, and celery, are associated with psychopathic behaviors and aggression. It is clear that caffeine causes insulin spikes and increased blood sugar level, as well as leads to urinary excretion of calcium, magnesium, and potassium, which negatively affects brain metabolism (Sylvia & Onusic, 2013). Furthermore, caffeine can increase dopamine and cortisol level, while reducing the serotonin levels and the speed of blood flow in the brain (Sylvia & Onusic, 2013). Serotonin reduction or serotonin deficiency are found to be related to psychopathic personality, violence, and aggression. Consequently, high dose of coffee may worsen anxiety and trigger mania or psychosis, psychomotor agitation, and aggression by negatively influencing brain functions and the neurotransmitters (Sylvia & Onusic, 2013).

Moreover, a preference of soda is associated with more neuroticism and violent behaviors in kids (Hale, 2015). Chumley (2013) shows that children as young as five years' old are more likely to be violent, withdrawn, and distracted after drinking four sodas a day. Furthermore, they are more likely to get into fights and wreck properties than those children who drink other beverages, regardless of their gender and ethnicity (Chumley, 2013). Researchers from the University of Vermont analyze survey responses from teenagers from 22 public schools in Boston. They find that the more sodas the adolescents consumed, the more likely they report violent behaviors. The probability of aggression for those heavy soda consumers is 9 to 15 percentage points higher than that of low soda consumers. Especially, over 23 percent of adolescents, whom report they consume at least one soda a day, are found to have ever carried guns or knives. Heavy soda-consumption teenagers report 12 percent higher to perpetrate violence towards partners or friends. Together, caffeine, either from coffee or soda, is associated with high level of psychopathy, aggression, and violence (Chumley, 2013).

Sugar and Violence: Sweets, Aspartame, and Chocolate

Sugar tends to be the most ubiquitous toxin (Buchanan, 1984). However, the relationship between sugar or aspartame and violence is inconclusive and mixed. On the one hand, Kruesi et al.'s experiment (1987) shows that habitual sugar or aspartame consumption has no significant effect on aggression and disruptive behaviors for preschool boys. The behavioral effects of aspartame and acute sugar loading are either extremely subtle or absent (Kruesi et al., 1987). On the other hand, Schoenthaler's longitudinal study (1992) with a sample of 276 incarcerated juveniles indicates that the well-behaved juveniles increase by 71% and the chronic offenders decrease by 56% if they eliminate the high sugar content desserts and chocolates, even controlling for gender, age, race and SES status. Additionally, Gans et al. (1990) show that teenage boys with a history of delinquency have significantly lower levels of serum glucose during an oral glucose tolerance test (GTT).

Moreover, Virkkunen (1982) suggests that hypoglycemia is common among criminals and delinquents, which could potentially link the relationship between sugar consumption and violence (Kanarek, 1994). One possible explanation is the functional deficit in serotonergic neurons in the central nervous system which leads to abnormalities in glucose metabolism, thereby being conducive to violence and aggression (Roy et al., 1988; Kanarek, 1994). Donohoe and Benton (1999) further find that even a low or declined level of blood glucose, but not hypoglycemic, is significantly associated with aggression. Too much sugar or aspartame may lead to

more violence, conduct disorders, and impulsivity in adolescents (Bateman et al., 2004; Egger et al., 1985; Benton, 2007).

Moore et al.'s recent research (2009) reveals a long-term negative effect of confectionery consumption during childhood, such as candies and chocolates, on adult violence by surveying 17,415 participants at ages 5, 10, 34 respectively. Those who eat sweets or chocolates every day at age 10 are significantly more likely to be convicted for violent crimes at age 34 (Moore et al., 2009). Overall, 69% of violent participants by the age of 34 reports they eat confectionery nearly every day during childhood, compared to their non-violent counterparts (Moore et al., 2009). Clearly, the study reveals the significant association between confectionery consumption at age 10 and violence at age 34 (Moore et al., 2009). One plausible mechanism is that consistently using candies or chocolates to shape childhood behaviors may prevent children from learning to defer gratification. Not being able to wait to obtain what they want may increase children's impulsivity and decreases their self-control, which is strongly associated with delinquency (Moore et al., 2009). Another possible explanation is that children who are already more impulsive, aggressive, and demanding are more likely to be given sweets and chocolates to keep them quiet (Maryon-Davis, 2009). Regardless of the inconclusive casual explanations, limiting children's confectionery consumption and improving childhood diet may improve their mental and physical health, as well as reduce adulthood violence and aggression (Moore et al., 2009).

Invisible Food Sensitivity and Violence

Aggression and antisocial behaviors can be triggered by an adverse reaction to common food due to individual's invisible food sensitivities. After eliminating certain food, people's personalities change dramatically, and become happier and more social (Clarke, 1950). Swain et al. (1985) reveal that 81 out of 140 children with conduct disorders and behavioral problems experience significantly improvements after eliminating certain food and food additives. Take G L. as a case study example. He has uncontrollable temper, low IQ, and aphasia. His initial EEG shows large amounts of sharp activity in the motor leads, temporal single, polyphasic sharp waves, and sharp waves in the temporal area, as well as allergy to milk, chocolate, and yeast. After a diet free of milk, chocolate, and coke for a week, his EEG becomes normal with fewer aggressive behaviors. Moreover, MacKarness (1976) reports that a woman who has been hospitalized 13 times for violence becomes better and obtains a regular job after common food are eliminated from her diet. Thus, it seems like that any commonly ingested food or food additives can invisibly be responsible for antisocial and violent behaviors (Werbach, 1995).

Particularly, Schauss and Simonsen (1979) find that juvenile delinquents tend to consume significantly much more milk than the matched controls. Therefore, they conclude that overconsumption of milk may lead to adolescents' antisocial behavior and aggression (Schauss & Simonsen, 1979). When Michigan detention center reduces their inmates' consumption of milk, the antisocial behaviors decrease significantly (Schauss, 1984). Based on Feingold's clinical work (1975), he argues that a diet free of food additives and natural salicylates (i.e. almonds, apples, oranges, tomatoes, and raisins) may lead to dramatic improvements for children with conduct disorders and ADHD. Rapp (1979) also supports Feingold's arguments that two-third of children with behavioral problems have unrecognized food sensitivities. In addition, Bennett and Brostoff (1997) indicate that 75% of offender population has behaviors linked to food sensitivity, compared to 18% of non-offenders. Children with or without a history of offending answer differently to the questionnaire, which aims to identity the nutritional risk factors associated with the criminal behaviors (Bennett and Brostoff, 1997). Robert Melillo (2015) further explains that sensitivity to milk makes body to produce cytokines and the resulting inflammation in the brain causes meltdowns, irritability, and aggression. The sensitivity to milk also leads to vitamin and mineral deficiencies due to poor absorption, which can start a vicious cycle for antisocial behaviors and other behavioral problems (Melillo, 2015). This meta-analysis of double-blind studies of food sensitivity in children indicates that there may be an association between violence and food sensitivity (Benton, 2007).

Table 1: Mean Score Risk Factors of Hungry and Not Hungry Children.
(higher score means worse)

Factors	Hungry (n= 56)	Not Hungry (n = 108)
Oppositional behaviors/ aggression	185.8	135.9
Attention Problems	169.9	154.2
Irritability/ Anxiety	192.7	141.2
Hyperactivity/Impulsivity	175.9	150.8
Antisocial Behaviors	163.9	149.5
School Problems	178.6	151.9

Table 2: Nutrient Intakes and Possible Effects on Brain.	
Nutrients	**Possible Effects on Brain**
Vitamin B-12	Linked to CVS disease and hostility
Vitamin B-6	Factor for conversion of tryptophan to serotonin and regulate attention, memory
Vitamin B-1	Reduced learning ability associated with impaired hippocampal neurogenesis
Iodine	Thyroid hormones—comment cause of mental deficiency worldwide
Folic acid	Associated with serotonin synthesis, aggression, and depression

Table 3: Food Components in Gedye's Experiment (1991).	
Serotonin-Enhancing Foods	Banana, Pineapple, Papaya, Nuts
Restricted to Minimal Intake (High Protein Food)	Milk, Cheese, Eggs, Fish, Beans
Not Given Foods	Chocolate, Caffeine, High-Salt Foods

CONCLUSION

This paper explores the relationship between daily food intakes, dieting patterns, and violence. A lot of well-designed studies reveal that violence is significantly associated with nutrition intakes through people's daily food consumptions, such as junk food, fried food, coffee, soda, sweets, and chocolate. Early malnutrition or hunger may predispose children to aggression through its negative influences on brain structural developments, biochemical processes, and the functions of neurotransmitters (Liu et al, 2007; Sharma, 2009; Benton, 2007). Furthermore, people's dieting patterns, such as skipping breakfast, eliminating snacks between meals, and overconsumption of artificial food, tend to increase the probability of violence and antisocial behaviors by negatively altering brain structures, serotonin and dopamine levels (Egger et al., 1985; McCann et al., 2007; Sharma, 2009).

It is clear that junk food makes the brain lack of vitamins, minerals, and Omega-3, thereby limiting the communications among neurotransmitters (Benton, 2007). Junk food (westernized diet) is associated with increases in aggression and violent behaviors by impacting the cortical-hippocampal-amygdala pathway (Hibbeln et al., 1998). Bitter food and caffeine, such as coffee and soda, also negatively affects brain metabolism, dopamine, cortisol, and serotonin levels, which are related to psychopathy, violence, and antisocial behaviors (Sylvia & Onusic, 2013). Additionally, sweets and chocolate can lead to functional deficits in central nervous system, abnormal glucose metabolism, and hypoglycemia, which link the correlation between confectionery consumption and violence (Roy et al., 1988; Kanarek, 1994; Virkkunen & Huttunen, 1982). One surprising finding is a potential relationship between invisible food sensitivity and violence, as well as criminal behaviors. A diet free of milk and natural salicylates may be able to improve children's behavioral problems and ADHD (Feingold, 1975; Rapp, 1979; Melillo, 2015). Consequently, diet may change a neurobiological predisposition for violence. People may be what they eat. People may be able to eat their violence out or vice versa.

Although nutrition-violence effects may subsume within the social and psychological risk factors, dietary reforms can still be promising to change violent and antisocial behaviors. More studies are still needed to evaluate the nutritional effects on violence in order to develop more effective multi-diagnostic treatment plans and prevention/intervention programs.

Conflict of interest statement.

On behalf of all authors, the corresponding author states that there is no conflict of interest.

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