Food Insecurity Is Associated with Cognitive Function

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Food insecurity (FI) has negative implications across the life course that include poor health outcomes among both children and adults. However, the behavioral mechanisms by which FI impacts health behaviors are not clear.

food insecurity hunger cognitive function cognition

1. Introduction

Food insecurity involves reduced quality, variety, or desirability of the diet, and can also include disrupted eating patterns with reduced food intake [1]. In 2019, 10.5% of households (13.7 million) in the U.S. experienced food insecurity [2]. Certain groups are at higher risk of experiencing food insecurity, including households with children [3], unmarried people [4], and communities of color [5].

Food insecurity has negative implications across the life course that include negative outcomes among both children and adults [6]. Childhood food insecurity and hunger are linked to poor general health outcomes [7][8]. Food insecurity during childhood may include the onset of mental health struggles with anxiety [9], depression [10], and even suicide ideation [10]. Behavior problems [11] and physical aggression [9] are also related to childhood experiences with food insecurity. Numerous research studies have shown that schoolchildren experiencing household food insecurity have impaired levels of academic performance [12][13][14]. Adults experiencing food insecurity and hunger also tend to suffer poor health outcomes including heart disease [15], diabetes [16], obesity [15], hypertension [15][16], and sleep problems [17]. Among children and parents, there has been a demonstrated bi-directional relationship between food insecurity and depression [9]. Poor mental health is also associated with food insecurity among adults [10][18] through pathways such as stress [18], anxiety [9], and depression [9].

Extensive research has yielded study findings that elucidate how poverty-related circumstances, such as food insecurity experiences resulting from being low income, incur negative health outcomes among vulnerable children [19] and adults [20]. Past studies have explored the relationship between varying degrees of undernutrition and numerous cognitive and behavioral outcomes. Results indicate inverse associations between these proxy factors and poor cognitive faculty functioning outcomes [21][22][23][24][25][26][27][28]. Researchers have also examined how malnutrition impacts the brain by using magnetic resonance imaging [29] and electroencephalography [29][30]. For example, A case–control study of post-mortem children studied the unique effects of severe undernutrition on neural development, and cases had significantly altered structural development of neural cells when compared with healthy controls [31].

Despite different etiologies, eating disorders (a psychological condition related to health) and food insecurity (a sociological condition related to health) share deficits in food consumption that may produce similar cognitive function outcomes. Past research has determined that anorexia can result in cognitive deficits related to reduced brain volumes [32]. Other studies on eating disorders and cognitive function have yielded contradicting results, as one study found no severe cognitive function impairment among anorexic adolescent females [33], while other research suggested that bulimic and anorexic women incur negative effects on cognitive function [34].

Research on voluntary caloric restriction (e.g., intermittent fasting) has provided additional insights on how food intake impacts cognitive function. Past research findings indicate that periodic caloric restriction can either maintain [35] or impair cognitive function [36]. Additionally, the results from studies examining caloric deprivation are similar to those evaluating caloric restriction, with cognitive function maintained [37][38] or impaired [39]. Some studies have shown working memory improvements with caloric restriction [40], while a systematic review of voluntary experimental fasting showed either impaired or maintained cognitive function among participants [41].

It is possible that food-insecure populations have an overabundance of cheap, less healthful foods. Research has indicated that populations at risk for food insecurity have the double burden of an inadequate intake of key nutrients combined with the overconsumption of high-calorie, low-nutrient foods (sometimes referred to as overnutrition), [42][43] which is often linked with an increased prevalence of obesity and other chronic diseases [44][45][46]. There is an ongoing movement within the scientific community to examine food insecurity more holistically as nutrition [47], because the quality of food is as important as the quantity of food to promote health and prevent disease [48]. Dietary quality, overnutrition, and obesity have been linked to food insecurity [49][50][51][52] and cognitive function [53][54][55][56]. However, the literature linking overnutrition and obesity to food insecurity and cognitive health does not seem to be not as consistent or robust as the literature on eating disorders and caloric restriction [51][57][58].

2. Food Insecurity Is Associated with Cognitive Function

Differences in general cognitive abilities such as attention, orientation, associative learning, and perceptual speed by food security status were assessed in almost every study of middle- or older adults identified in this review [59][60][61][62][63][64][65][66][67][68][69]. Tests that assess general cognition may indicate moderate to severe forms of cognitive dysfunction that may affect daily living and quality of life [70][71][72]. For example, cognitive impairment may affect relationships with others and, in some cases, may impair a person's abilities to live independently [73]. Given that general cognitive faculties are known to decline with age [74][75], the evidence of associations between food insecurity and general cognitive decline is particularly worrisome for older adults, as food insecurity may pose a compounding burden on cognitive health. For those experiencing food insecurity, issues of endogeneity may be at play in the relationships observed in the reviewed studies; however, most studies adjusted for socio-cultural variables often associated with food insecurity such as education, poverty/income, maternal age at birth, or race/ethnicity.

While cognitive function among middle-aged and older adults with food insecurity has been discussed previously [76], our review yields novel study findings indicating significant inverse associations between food insecurity and general cognitive function in studies of toddlers and young children [77][78]. Impaired cognitive development in children is associated with behavioral issues such as irritability, impatience, and distractibility [79]. Related evidence has established links between food insecurity and behavioral issues in children (e.g., aggression, anxiety, hyperactivity) [80][81][82][83], thus raising the question of whether the impairment of cognitive development is a mediating factor in such associations. Only one study, to our knowledge, provided credible evidence of an association between food insecurity and impaired cognitive development in children [78], thus highlighting a need for further research in order to better understand how food insecurity impacts human development in children.

Executive function, another commonly explored aspect of cognitive function, involves higher-order cognitive processes allowing individuals to plan, regulate behavior, and achieve goals [84]. Related research has shown that food insecurity is associated with aspects of children's academic performance [12][81], and executive functions such as working memory abilities are known predictors of academic performance [85]. The impairment of working memory may play a role in the association between food insecurity and academic outcomes, although no research has directly explored this possibility. However, it has been proposed that the association between food insecurity and impaired executive functioning in both children and adults may result from the effects of unhealthy stress on the prefrontal cortex [86][87], an essential brain region for carrying out executive functions [88]. Future research is needed to examine the relative effects of factors associated with cognitive functioning such as stress and food insecurity.

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