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Review Article

FACTORS INVOLVED IN THE ETIOLOGY OF EATING BEHAVIORS AND CHOCOLATE CRAVING

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ABSTRACT
Past research studies have indicated that the response of brain to high-calorie food cues predicts long-term weight gain/weight loss. Little analysis has been done on the short term neural correlates that predict food intake. Relative high prevalence of eating disorder pathology accounts for higher chocolate craving in women of America, compared to many other countries. Role of disordered eating in the etiology of craving in women is on rise, but less is known so far in men on the extent to which food cravings are associated with disordered eating behaviors. Brain responses predicted the subsequent intake than self-reported craving. Hence, study this review study might provide for a missing link by analyzing the brain activity, with the weight change and short-term intake. The antioxidants in dark chocolate probably boosted the resistance levels and energy in scuba divers.

Keywords: *Eating Behavior, Chocolate, Nutrient Displacement, Craving*

INTRODUCTION
Past research showed that people with elevated restrained eating (RE), have higher level of binge eating, future bulimic symptom onset and to gain body weight. High RE scores were associated with greater activation in impulse control region of the brain, especially the dorsal-lateral prefrontal cortex (DLPFC) during the completion of difficult decision trials. This indicates higher cognitive demands and resource depletion in relation with easy decision trials (Dong *et al.,* 2016). Phaseolus. vulgaris dry extract reduced seeking behavior for a highly palatable nourishment in an experimental model of relapse into disordered eating of palatable foods. The study showed that the observed effect of the P. vulgaris dry extract was secondary to inhibition of carbohydrate metabolism. Hence, is the probable consequence on a central action on the rewarding and hedonic properties of food (Lorrai *et al.*, 2016).
Lisdexamfetamine (0.8 mg/kg po [d-amphetamine base]) reduced the consumption of chocolate by 55% in binge-eating rats and markedly reduced compulsive and perseverative responding. The study findings complemented to clinical results indicating that lisdexamfetamine decreased compulsiveness in subjects with binge-eating disorder (Heal *et al.,* 2016). The study in Turkey indicated that adolescent friendly health services need to be generalized all over the country. Physicians must evaluate every adolescent for his/her health behaviors in every single visit and implement the prevention programs that adopt a health promotion perspective right from the elementary school onwards (Çavdar *et al.,* 2016). Parental monitoring was associated with child sweet snack food intake. Maternal psychological control was associated more with the child's total snack food consumption. Research indicated the necessity to evaluate the complex relationship between child eating and parenting, especially with regard to subgroups of foods (Liang *et al.,* 2016). Energy compensation occurred for intervention snacks in sample of non-obese population. Regular nut consumption improved nutrient profiles better than other snacks with changes occurring with the snack level (Pearson *et al.,* 2016). Among in digenous and arrived population of Yakutia of elderly and senile ages, high content of general fat, saturated fat acids, polyunsaturated fat acids and refined sugar due to low consumption of general carbohydrates was found. Low consumption of fresh and tinned vegetables, potatoes, eggs, fresh fruit and berries was also found (Neustroeva *et al.,* 2015).
Soft drinks gave most of the needed energy and were popular non-core foods consumed by adolescents regardless of context among adolescents of UK. Forming a target for interventions to reduce non-core

food consumption (Toumpakari *et al.,* 2016). Instructed extinction (IE) had no effect on the short-term and long-term extinction of eating desires. Eating desires were related to conditioned evaluations to a little extent. The study revealed that expectancy violation had a little role in cue exposure therapy in cutting down the eating desires (Van den Akker *et al.,* 2016).

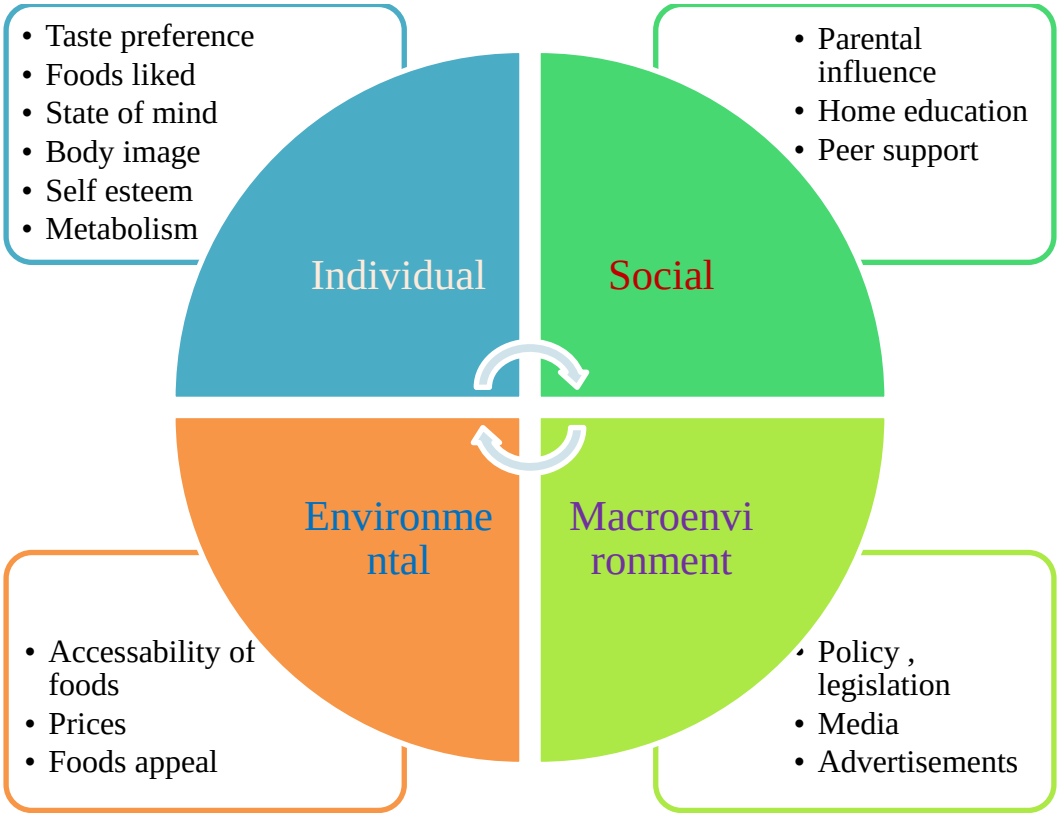

Figure 1: Factors Affecting Eating Behaviours

Heavy metal content was low in candies and chocolates of India than reported in other countries. Reduction in the content of heavy metals in the diet through candies and chocolates can be achieved by monitoring regularly the content and especially to Pb as the children are more susceptible to the toxicity (Devi *et al.,* 2016). The most addictive foods among children in decreasing order of frequency were chocolate, ice cream, carbonated beverages, French fries, white bread, rice, candy, chips and pasta. Frequent feeling of hunger was associated with a 2.2-fold increase in food addiction risk. But the consumption of French fries ≥1-2 times per week was associated with a higher increase in risk. Hence, it was concluded food addiction plays a critical role in childhood obesity (Keser *et al.,* 2015). The study showed that consuming a cows' milk exclusion (CME) diet during infancy has persistent and long-term effects on eating habits and food preferences of infants. Hence, recommends that children's exclusion diets must be as varied as possible to reduce future negative eating behaviours. Reintroduction of cows' milk products has to be monitored (Maslin *et al.,* 2016).

Study done on rats showed that lisdexamfetamine (LDX), via metabolite, d-amphetamine, decreased chocolate bingeing, by indirect activation of α1-adrenoceptors and D1 receptors (Vickers *et al.,* 2015). Past research study indicated the role of environmental cues in eliciting healthy habits when self-control resources were depleted. People trained to choose carrots habitually to a pictorial stimulus like habit cue, consequently resisted choosing M&Ms as long as the cue was present. Manipulation of such cues provides a means of meeting self-regulatory goals of portion control (Lin *et al.,* 2016). Study done on

humans using conditioned stimuli, showed that negative emotions acted as conditioned stimuli. Suggested that classical conditioning was involved in emotional eating (Bongers and Jansen, 2015). Trait self-control and self-regulatory resources both interacted with one another, to moderate the prediction of implicit attitude on eating behavior. Study results showed that high trait self-control had a buffering effect of self-regulatory depletion on impulsive eating among females (Wang *et al.*, 2015).

Chocolate

Study showed that inclusion of dark chocolate daily in the diet had no changes on blood pressure and other cardiovascular risk factors during a reduced snack period among 22 adults with mild hypertension (Koli *et al.*, 2015). Those females higher in restrained eating, consumed less overall and fewer calories after watching TV or talking. However, they consumed more overall and more calories (five times more chocolate) when the cereal bar was eaten while walking. Hence, the study indicates that 'Eating on the go' may disinhibit restrained eaters either as a form of distraction or by contributing a justification to overeat (Ogden *et al.*, 2015). Study results suggested that visual cues that have been pre-associated with winning, but not consuming, a liked food reward, modified the food intake in the subjects. This is in fair logic with the existing concept that the abundance of food associated cues as a factor underlying the 'obesogenic environment' (Ridley-Siegert *et al.*, 2015). Cumulative research indicates that higher chocolate consumption was associated with a lower risk of future cardiovascular disorders, even when the residual confounding not excluded. Not any evidence indicated that chocolate must avoided in humans who are concerned about cardiovascular risk (Kwok *et al.*, 2015). Components of eating disorder risk influenced basic conditioning strength to places associated with food reward. Correlations between eating disorder risk subscales and conditioning variables were investigated in males and females. Implications for future research were proposed in an approach to understand how conditioning paradigms provide insight into treating and preventing eating disorders (Astur *et al.*, 2015).

Post-dive endothelial dysfunction was prevented by ingestion of 30 g of dark chocolate 90 minutes before scuba diving. The antioxidants present in dark chocolate scavenge free radicals (Theunissen *et al.*, 2015). Higher momentary chocolate craving correlated to higher laboratory chocolate consumption. Exploratory analyses showed that increases in salivary flow were associated with increased chocolate consumption in participants scoring high on trait chocolate craving. The chocolate versions of the questionnaires were reliable and valid self-report measures for the assessment of trait and state chocolate craving (Meule and Hormes, 2015).

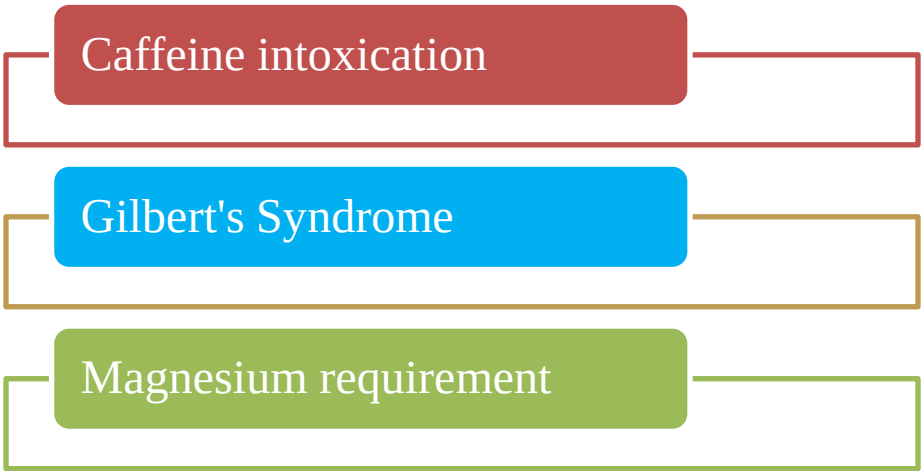

Figure 2: Causes of Chocolate Cravings

Research indicated that chocolate consumption was associated with a short-term reduction in blood pressure and cholesterol and improvement of insulin sensitivity. Inspite, the participants were not aware of presenting hypertension or hypercholesterolemia. The present research analysis showed no evidence of

an association between chocolate intake and the physical or mental components of health-related quality of life (Balboa-Castillo *et al.*, 2015). Ready-to-eat cereals (RTEC) is a nutritious food, well accepted by most of the schoolchildren in Kuala Lumpur. The research suggests the need of nutrition intervention to be conducted in the future to include a well-balanced breakfast with the utilisation of RTECs for schoolchildren (Koo *et al.*, 2015). Research emphasized the importance of gene-environment interplay in the manifestation of compulsive eating. Hence, the hypothesis that low accumbal D2R availability is a constitutive genetic risk factor for compulsion like eating behavior. The potential neuroadaptive responses that parallel the shift from motivated to compulsive eating are D2R upregulation and α1R down regulation in the striatum and medial prefrontal cortex, respectively (Patrono *et al.*, 2015).

Obese individuals showed higher sensitivity and preference for an odor associated with energy dense foods. Also the differences in sense of smell offer a promising area for future research in obesity (Stafford and Whittle, 2015). Food-specific inhibition training promoted development of automatic inhibition associations, which facilitated inhibitory control over unwanted food-related urges. Food that was consistently mapped onto stopping was associated with stopping versus going afterwards. Participants in the no-go condition were having lesser desire to eat and reduced food intake in relation to the go condition (Houben and Jansen, 2015). Attentional bias for chocolate cues was high in the 'attend' group of trainees, while the bias was lower in the 'avoid' group post training. The 'avoid' group subjects ate unevenly low chocolate food product in a taste test than the 'attend' group (Kemps *et al.*, 2015). The study results indicated that brain responses form predictor of subsequent food intake than self-reported craving. The findings elucidate for a missing link by associating brain activation, previously shown to predict weight change, with short-term intake (Frankort *et al.*, 2015). A positive correlation was found between disordered eating behaviors and chocolate craving to be unique to women especially in North America. This research gives understanding of cultural and psychosocial factors that can cause food cravings (Hormes *et al.*, 2014).

Elimination of chocolate milk from school cafeterias decreased the consumption of calorie and sugar. This lead student to take less milk overall, drink less of the white milk they do take, and not purchase any further school lunch more. This alerted the food service managers to carefully weigh the costs and benefits of eliminating chocolate milk as well consider alternative options that make white milk more convenient, easy, and normal to choose (Hanks *et al.*, 2014). Craving was associated with the amount of chocolate consumed per week, but guilt correlated more to restraint. Female subjects got high score in most scales, but no gender difference with regard to chocolate consumption. Dieters had more disinhibition, restraint, food-thought suppression and guilt than the non dieters. No difference with regards to their levels of craving, hunger or consumption was noticed (Van Gucht *et al.*, 2014). Studies done with functional magnetic resonance imaging (fMRI) and event-related potentials (ERPs) identified neural regions and electrical signatures that are elicited by chocolate cue presentations. The study done by Asmaro and Liotti, (2014), analyzed the findings in fMRI and ERP in studies that used high-caloric food and chocolate cues as stimuli (Asmaro and Liotti, 2014). Compared to satiety, hedonic deprivation triggered increased chocolate wanting, liking, and chocolate consumption. Feelings of frustration and startle potentiation during the intertrial intervals was high as well. This characterized by startle inhibition during both chocolate and food images relative to the intertrial intervals. Those who responded with frustration to the manipulation and those with high impulsivity showed relatively high startle inhibition (Blechert *et al.*, 2014).

Chocolate consumption was associated with higher emotional eating and depression. Fruit consumption was associated with lower anxiety, depression, and emotional distress than with the consumption of chocolate crisps. Somatic symptoms, cognitive difficulties, and fatigue were high in the crisps/chocolate condition (Smith and Rogers, 2014). In the study done by Kuijer and Boyce (2014), those subjects associating chocolate cake with guilt showed decreased perceived behavioural control over eating and were less successful at maintaining their weight in a duration of 18 months time period. Subjects who associated chocolate cake with guilt were losing little weight in duration of 3 months period compared to those associating chocolate cake with celebration (Kuijer and Boyce, 2014).

CONCLUSION

Monitoring by parents was associated with child sweet snack food intake. Maternal psychological control was associated with child total snack food consumption. Popular food consumed among the adolescents were soft drinks that promote immediate and fast energy. Lisdexamfetamine had a negative effect on the chocolate addiction. Dark chocolate taken regularly by hypertensive individuals had no changes in the blood pressure.

Chocolate intake has not been associated with higher risk of cardiovascular events. Obese people were found to have greater sensitivity to the odors of high calorie diet foods. Disorders of eating behaviour and craving for chocolate was more among women than men. Fruit consumption has better healthier effects than the consumption of chocolates and chips.

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