STUDY OF TASTE GENETICS

AND MATERNAL FACTORS ON WEIGHT STATUS IN PRE SCHOOL CHILDREN

By

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ABSTRACT OF THE THESIS

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Genetic and environmental factors are important determinants of food intake and weight status children. Our laboratory has previously shown that weight status in high SES, Caucasian children is influenced by maternal eating attitudes (dietary restraint & disinhibition), child feeding practices and genetic taste sensitivity to 6-n-propylthiouracil (PROP) a trait that is controlled, in part, by the bitter taste receptor gene, TAS2R38 (Keller, 2004; Goldstein, 2007). The present study was undertaken to determine if these same or related factors play a role in lunchtime energy intake and adiposity in a cohort of low-income, Hispanic children at risk for overweight. A total of 78 children (51.8 ±0.6 mo; 82± 2.0 BMI%-ile) and their mothers (BMI 27.2± 0.6kg/m^2) from a local "Head-Start" preschool participated. PROP status was measured in both mothers and children. Mothers completed the Child Feeding Questionnaire and the Dutch Eating Questionnaire for restraint, external and emotional eating. Children's food intake at lunch, were recorded during two observations on separate days at the preschool. Results showed that overweight children (>85th BMI%-ile) of mothers who were overweight themselves ($p<0.0001$), who had high dietary restraint ($p<0.01$) or who reported using a less restrictive feeding style ($p<0.05$) consumed more energy at lunch than overweight children whose mothers did no display these characteristics. BMI-z score was highest in PROP non-taster children of mothers with high dietary restraint (2.02) as compared to any of the other groups (0.97-1.31; $p<0.02$). Hierarchical regression predicted 41.7% of the variance in BMI-z scores. Key steps in this model included: main effects (gender, child taster status and perceived weight of child; 18% variance); child energy intake at lunch (16% variance); maternal/child variables (perceived responsibility, pressure to eat and child food reactivity; 3.4% variance); and the interaction of maternal restraint and child taster status (5.84% variance). This study identified maternal and genetic factors associated with higher energy intakes and greater risk of overweight in Hispanic children. A better understanding of these variables lead to more effective weight management programs to tackle obesity within in this community.

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CHAPTER 1: INTRODUCTION

1.1 Obesity Overview and Prevalence

The occurrence of obesity and related co-morbidities has seen a steady rise all over the world, particularly in the United States [1]. Research has shown that variations in weight are caused by both genetic and environmental factors and their subtle interactions [2]. Though genetic causes for obesity have been relatively constant, there is a steady rise across age, gender and ethnic boundaries due to changes in environmental conditions in recent years. Research has shown that while genetic inheritance is a non-modifiable risk factor, risks associated with age and gender can be modified. Modifiable risks include behavioral (diet, activity, alcohol and tobacco use), biological (lipid profile, insulin resistance) and societal factors (complex mixture of socio economic, cultural, environmental practices). The modern obesogenic environment has contributed to obesity. Obesity is now considered a public health crisis that has increased health care costs, discrimination lawsuits and has decreased productivity.

The joint FAO/WHO expert consultation reports that epidemiologic evidence now point towards rapid urbanization and changes in lifestyles and food consumption patterns as the underlying causes for the increase in obesity [2]. A declining indulgence in activities that demand high physical activity with the advent of extensive motorized transport, labor saving devices at home and less physically demanding leisure time activities have also contributed to this growing problem. Studies have repeatedly shown that children with a high physical activity level are less likely to be overweight than children who are not engaged in regular activity.

The health consequences of overweight and obesity include sleep apnea, hypertension, coronary heart disease, diabetes, dyslipidemia, liver and gall bladder disease [2]. Childhood obesity preempts the onset of disease conditions as well as creates psychosocial effects like discrimination, stigmatization, lowered self esteem and hinders academic performance that could persist into adulthood. Studies have shown that children who were overweight by preschool age continued to be overweight during adolescence [6]. Additionally, eating patterns and food behaviors that are established in childhood are believed to track into adulthood [7,8]. Understanding the various genetic, lifestyle, home environmental, feeding styles, food choices and preferences will help preventative and therapeutic actions to stem the obesity epidemic.

Four NHANES surveys conducted among 20 to 74 year olds between 1976 and 2004 has shown a steady rise of overweight adults (BMI >25 kg/m^2) from 47% to 66% of the prevalence of obese adults (BMI>30 kg/m^2) has risen from 15% to 32.9%. The trend of increased obesity in the last 25 years is not limited to adults only; childhood obesity beginning with children as young as two years of age until nineteen years has also been recorded [9]. Results from the 2003-2004 National Health and Nutrition Examination Survey (NHANES) shows that overweight (≥ 95 percentile BMI for age) increased from 7.2 to 12.4% among 2-5 year olds between 1988-94 and 2003-2006. The most recent NHANES data indicate that among 2- to 5-year-old children, 11.5% of non-Hispanic Whites, 13.0% of non-Hispanic blacks, and 19.2% of Mexican Americans are overweight [10].

1.2. Genetic Factors

1.2 a. Obesity Genes with Age, Gender, Ethnicity

. CDC reports [9] that nation-wide, there are significant differences in obesity among age groups, gender, race or ethnic groups. Information on the obesity rates in the Mexican American population is available from the CDC. The prevalence of overweight in Mexican-American and non-Hispanic black girls was higher than among non-Hispanic white girls. Among boys, the prevalence of overweight was significantly higher among Mexican Americans than among either non-Hispanic black or white boys. In a study done to assess childhood overweight prevalence in New York City's WIC program participants in 2004 in children 2-4 years, it was found that Hispanic children were more than twice as likely to be overweight or at risk for overweight and overall, 40% of the children had a BMI $\geq$ 85 percentile. Two year olds were less likely to be overweight than three to four year olds [125].

Among adults, similar differences existed. Approximately 30% of non-Hispanic white adults were obese, 45.0% of non-Hispanic black adults and 36.8% of Mexican American adults were obese. There were significant differences in obesity by age. Adolescents were more likely to be overweight than younger children, and older adults were more likely to be obese than younger adults. Between 1999 and 2004, there was a significant increase in the prevalence of overweight among both boys and girls. The prevalence of obesity among men also increased while there was no change in obesity among women in 2004.

Heritability estimates from various twin studies, has suggested 80-90% variance in body fat among children is attributable to genetic factors with the remaining variation attributable to environmental influences [11]. Molecular studies are continually aiding in the understanding of which specific genes or their combinations are likely to contribute to obesity. Childhood obesity is known to reflect the effect of multiple obesity genes that cause increases in body fat [11].

1.2 b. Genetic Influence on Eating Patterns

Faith reported that studies that examined the role of possible genetic influences on child food preferences and those of parents, show that though correlations were small in magnitude (r=0.14-0.19), they were statistically significant [13]. Interestingly, Wardle et al reported that children from the obese/overweight families showed higher preference for fatty foods in a taste test and a lower liking for vegetables [14]. This indicated that the genetic risk of obesity could be transmitted to the next generation through differences in diet and activity preferences. Susceptible individuals who were at risk of a positive energy balance could become obese in the current obesogenic environment.

Early life nutrition studies have shown that under-nutrition predisposed the child to be overweight when environmental conditions were favorable [11]. A Brazilian study [15] showed that stunted children have impaired fat oxidation and passively over consume energy when compared with healthy children in the same towns. Studies have also shown that under-nourishing circumstances, when removed could potentially allow over-consumption and obesity. On the other hand, environmental food insecurity, also an under-nourishing environmental situation, has also been associated with childhood obesity [16].

1.3 Environmental Factors

1.3 a. Food Availability and Insecurity

Evidence from studies in the US has shown that household food insecurity is also a major contributor to the vicious cycle of obesity. Household insecurity, common in low income populations, is defined as limited or uncertain availability of nutritionally adequate and safe food [16]. According to the results of the Census Bureau survey, those at greatest risk of food insecurity live in households that are headed by a single woman, Hispanic or Black, or with incomes below the poverty line [17]. Food insecurity affects 21.7% of Latino households compared to 8.6% of non-Hispanic white households. Food insecurity is shown to be a mixed phenomenon which lies in between abject poverty, under-nutrition and consumption of obesogenic diets of high energy density when food is available [18]. The impact of this unpredictable cycle of consumption would depend on food choices, distribution, selection, preparation and availability of resources in the family.

Poor accessibility to fresh produce was associated with consumption of higher energy-dense low cost foods that are unhealthy [19]. Often low income, disjointed family structure, lower education and working parents with negligent feeding styles has resulted in children with fewer healthy food choices. With the advances in food technology, the availability of energy dense foods at low cost that is affordable to lower income population has become a reality [20]. However, these foods are often not always nutritious and healthy. The ability to afford cheap, convenient, time saving, ready to eat prepackaged foods has reduced the stress of cooking in working families but has increased the prevalence of obesity. In some communities, access to fresh produce is often neglected by the local administration, increasing the chances of consuming unhealthy, pre-packed foods. It has been seen that reducing energy density (kcal/gram of food) of entrée meals served in schools has helped reduce the overall energy intakes [21,66]. Patterns of food consumption often explain changes in dietary habits, acculturation [22, 33] and body weight trends in migratory populations.

Some studies have suggested that episodes of food shortages or anxiety about food supplies may lead to overeating later when food is more available [23, 24]. Among preschool children attending Head Start (MI), that mostly serviced low income populations, Lumeng et al [24] reported the increased consumption of food on ‘Monday’ each week, which was thought to be the result of compensation for the inadequate availability of food during week ends when the child was home. Teachers were aware of the voracious appetites of children and believed it was due to food insecurity at home but confessed being ill-equipped to address these issues.

However, factors other than food insecurity and acculturation could affect eating behaviors. This was observed by Fisher and Birch [25] who showed that in girls who were reportedly restricted at home, overate snacks in the absence of hunger in the laboratory. Hence, it is essential to understand that not only is the home availability of food important, the underlying maternal feeding practices that also share influences at home, could potentially contribute to over eating and weight gain in children.

1.3b. Maternal Feeding Styles and Child's Dietary Intake

It is known that the balance between energy intake and energy expenditure is important to maintain a healthy weight. While some energy consumption patterns have been genetically determined to some extent depending on intrauterine and post natal nourishment, studies show that children are able to self regulate their energy intakes if allowed and if necessary, through interventions, could be trained to do so [7,26]. Apart from larger body size and presence of palatable foods, lower self regulation has been linked to family feeding practices in children [26, 27]. Mothers are often the primary care givers, controlling and exerting influence over the food consumption, eating habits and portion sizes of young children [28, 7]. Maternal control in the form of attempts to restrict their daughters' intake are related to cognitive factors like restraint (conscious control of food intake) and disinhibition (over eating due to external or emotional cues) that direct self eating behaviors, food choices, amounts, child's feeding styles and concern for her child [28]. These maternal cognitive factors along with maternal weight have the potential to influence disregulation of energy intake in the children [26]. Three types of feeding patterns were described with differing control between parents and children: highly controlling, mothers do not give their children a chance to self regulate their own meals, portion sizes or foods selection; Laissez-faire mothers assume their children are able to regulate when, what and how much to eat; and Responsive mothers acknowledge their child's needs and demands for food and respond accordingly [29]. Using the same classification, Brann et al found more controlling child feeding practices among mothers of boys with average BMI (33^{rd} to 68^{th} percentile) than the boys with high BMI (>85^{th} percentile) [30].

Children of parents who control their child's food intake to a greater extent do not compensate for energy density (kilocalories per gram of food) as appropriately as children of less controlling parents [30]. The relationship between parental feeding styles and child weight has been shown to depend on child obesity predisposition, suggesting a gene-environment interaction [37]. Among children predisposed to obesity, elevated child weight appears to elicit restrictive feeding practices, which in turn may produce additional weight gain [37]. Parenting guidelines for overweight prevention may benefit from consideration of child characteristics such as vulnerability to obesity and current weight status [37].

In Hispanic populations however, indulgent child-feeding practices and lack of parental awareness about the health risks of childhood obesity were associated with childhood obesity [31, 22, 74]. Because restricted access was relatively atypical in Latino families, use of that strategy may be apparent only after they perceive their children to have a serious weight problem [31]. In a study done among children 7 years and older, recruited from a mixed population of a pediatric clinic in San Diego, it was seen that parents of 'at risk of overweight' and 'overweight' children were less likely to recognize their own child's weight status as compared with normal and underweight counterparts [124]. A contrasting effect of greater child access to food and lower observed energy intake was noted in preschool-aged Mexican-American children [32].

Another parenting style classification uses three classifications of Authoritarian (high control, low warmth), Authoritative (high control, high warmth) and Permissive (low control, low or high warmth) styles based on dimensions of control/demandingness or warmth/responsiveness [34, 74]. The authoritative feeding style is known to encourage children to make healthy choices and was associated with higher fruit and vegetable intakes [35, 36]. Hubbs-Tait et al evaluated the association of the three parenting styles with the Child Feeding Questionnaire factors. The CFQ factors have subscales based on questions related to maternal perceived responsibility (who feeds the child and how much), monitoring and pressure to eat (more or have no leftovers), restricting food intake, concern about child and her perceptions about her own weight and her child's weight. He found that the amount of variance explained in Authoritative, Authoritarian and Permissive Parenting styles were 19%, 14% and 8% respectively [38]. Responsibility, restricting (negative) and monitoring (positively) predicted the Authoritative style. Restricting, pressuring and monitoring (negative) predicted Authoritarian style while restricting (negative) predicted permissive parenting. Spruijt-Metz et al showed that two subscales of the Child Feeding Questionnaire, 'Pressure to Eat' and 'Concern for Child's Weight' explained 15% variance in the total fat mass in both African American and Caucasian boys and girls of 7 to 11 years of age, indicating the importance of key behavioral variables that influence obesity in children [39]. Multiple regression models to predict child BMI using CFQ subscales have shown that 'maternal restriction', 'perceived child weight' and 'concern about child' were positively correlated while 'pressure to eat' was negatively correlated with the children's BMI percent for age [40]. Apart from feeding styles, parental weight, especially that of the mother, is an important genetic factor and a factor that determines her dietary habits. These maternal cognitive factors potentially affect child eating habits and body weight. Hence, it is important to understand that parental obesity status, especially maternal weight, is a strong risk factor for childhood obesity [41].

1.4 Cognitive Factors- Maternal Dietary Restraint, Disinhibition

Eating in response to emotional or external signals like sight and smell of food lead to higher disinhibited eating while conscious dieting could lead to higher restraining that could prevent weight gain. Over-restriction of food can lead to disordered eating practices such as bulimia or anorexia nervosa [42]. However, it was also found that restraint and disinhibition were not always causally linked [43].

1.4 a. Maternal Dietary Restraint, Nutrient Intakes and Body Weight

At the same time as obesity rates have increased, dieting or dietary restraint, defined as the intentional efforts to achieve or maintain desired weight through reduced caloric intake, has also increased dramatically [121]. Although the term dietary restraint originally referred to tendency to oscillate between periods of caloric restriction and overeating, it is now synonymous with 'dieting' [121]. Paradoxically, studies have shown that adolescent girls and adults with elevated scores on dieting scales are at increased risk for future onset of obesity and weight gain [122]. The interpretation by the restraint theory is that over-reliance on cognitive control over eating rather than physiological cues may leave dieters vulnerable to overeating when these cognitive controls are disrupted by emotions or the intake of forbidden food. It is also possible that individuals with chronic overeating tendency find themselves attempting to restrict their intake, but ultimately fail in these efforts and show weight gain [122]. It is also postulated that although restrained eaters eat less than desired, they eat more than is required and thereby gain weight [122]. The latter three interpretations have in common their conclusion that most individuals in the general population scoring high on dieting scales fail to show true weight loss dieting.

Restraining from eating food to control weight versus binging after a period of restraint could capture two different subsets of the population at opposite ends of the spectrum who might display varying dietary habits and perhaps eating pathologies. Lowe et al. have noted that the assessment of dietary restraint does not identify the nature of the motivation behind restrained eating, i.e., the extent to which restraint may be motivated by the desire to lose weight or to prevent weight gain [42]. Another theory suggests that disinhibition may be dependent on a 'rigid-type' of restraint which is the "all or nothing" approach to eating and food, avoidance of like foods that give pleasure by rigid restrained eaters as opposed to the more flexible control of eating exhibited by long-term, successful restrained eaters [54]. However, the authors who designed the Dutch Eating Behavior Questionnaire (DEBQ) define restraint as the overeating after a period of slimming when the cognitive resolve to diet was abandoned [43].

Randomized controlled trials indicate that low-calorie/fat diets produce significant weight loss suggesting that weight loss dieting is possible [121]. Dietary restraint has been associated with lower reported energy intake, lower fat intake [45-48] and more frequent use of reduced fat foods and more healthful choices [48,49,71]. Interestingly, few studies show influence of such relationships in men as they are less likely to be concerned with weight issues. One study by Tepper et al found that the men with high restraint scores tended to have lower BMI and reported consuming less high fat foods like fast foods, cured meats, fats and oils, regular soda and whole fat dairy foods [50]. However, the influence of dietary restraint on food habits has been shown in girls as young as 5 years of age [126]. Keller et al, in a study among the Caucasian population, found that maternal dietary restraint score was positively correlated with children's reported consumption of discretionary fats [81]. Similar positive association between maternal restraint and child fat intake as percentage of calories has been corroborated by Birch et al [127].

In the context of maternal restraint and child weight associations, mixed results have been noted. Carper et al [126] proposed a pathway of parental feeding practices in relation to child outcomes. Study results indicated that the effects of the transmission of maternal cognitive dietary behaviors are apparent in girls by the age of 5 years. A majority of the 5-year- olds indicated that they sometimes ate in response to external cues, such as the sight and presence of palatable food, even when they weren't hungry. Further, about 30% of girls reported at least moderate levels of dietary restraint. Taken together, mothers played a central role in transmitting cultural values, impressions of body size, weight and body image to their daughters. Daughters also gathered information about their mothers' own regulation of food intake through observations [126]. For our lab studies, Nolen et al also showed that maternal restraint was positively correlated with higher weight in pre-adolescent middle income mostly Caucasian population [113], and Goldstein et al in her study of pre adolescents (7-11 years), found that maternal restraint was a positive predictor of body weights of the children in the regression model [40].

However, among adults, there has been mixed reports of both high [46, 47, 72, 71] and low BMI [45,52] with highly restrained eaters depending on success or failure of restraint practiced. This duality of the restraint factor, in part has been attributed to the distinction between ‘intention versus behavior’ structures in questionnaires [53].

Maternal disinhibition has been linked to chronic, unsuccessful dieting, episodic binge eating and greater adiposity [54,52]. Maternal disinhibition has been a good independent predictor of daughters' weights [28, 40, 72] and less healthful choices [72] Goldstein et al found that girls of highly disinhibited mothers had higher mean reported energy intakes while no differences were seen in the sons [40].

Self-reported disinhibition is repeatedly associated with greater energy intakes in studies where subjects are given a preload before a meal [55, 56]. Other studies have indicated that high levels of dietary restraint may induce disinhibition episodes [57, 63]. For example, Polivy et al had one group of subjects deprived from chocolate for one week, simulating restraint, while another group of subjects was not deprived. When presented with chocolate, the deprived group exhibited disinhibition, consuming more than the group that was not deprived [57]. Attempts to distinguish dieters with low or high disinhibition displaying restraint have been made. It was found that only restrained eaters with high disinhibition scores showed overeating after an experimentally induced preload [123]. Similarly, when the variable attributed to overeating was removed, restrained eating no longer predicted food consumption [124].

Several eating behavioral questionnaires like the TFEQ (Three Factor Eating Questionnaire) [44] and DEBQ (Dutch Eating Behavior Questionnaire) [43] are validated for use in adults and children [58]. The DEBQ involves assessing emotional and external eating separately, which can be combined to arrive at a disinhibition score while the restraint score evaluates the restriction of eating practiced. The authors of the DEBQ associate high emotional eating scores with lack of interoceptive awareness, feelings of social inadequacy, low self esteem and other psychological problems [43]. High external eating scores unsupported by emotional eating, indicates difficulty in controlling impulses to over eat in the presence of appetizing food, which could be addressed by stimulus control or food exposure during therapy [43]. Both maternal restraint and disinhibition have been shown to be related to child weight and child food choices [29, 40, 12, 72] indicating that mothers who had greater cognitive control over her eating had a child who had lower self regulation in energy intake.

1.5. Taste Genetics and Food Choices

1.5.a Bitter Taste in Foods

As Leanne Birch, a leading researcher in taste perception said, 'children eat what they like and leave the rest'. Taste sensitivity plays an important role in acceptance or rejection of foods. Genetics play an important role in food preferences. For example, at birth, humans prefer sweet foods [64] and reject bitter tastes [65]. Studies have shown that infants reject bitter foods possibly as a result of evolution [65]. Infants instinctively have food 'neophobia', a natural tendency to reject new tastes, as a natural protective response to toxic compounds that are bitter to humans. Repeated exposure by the mother has shown to improve acceptability [67]. However, a possible link of childhood 'fussiness' or 'pickiness' to higher taste sensitivity to oral stimuli, suggests that taste is a primary determinant of children's food choices. Food neophobia is an unwillingness to eat novel foods, whereas pickiness is an unwillingness to eat many familiar foods [68]. These two attributes have been shown to reduce the consumption of vegetables and fruits in young children [69, 68]. Vegetables like broccoli, spinach, kale, brussel sprouts, are bitter and disliked [70]. A bitter-tasting compound that is common to the cruciferous vegetables (*Brassicae family*) mentioned above, is called isothiocyanates and is commonly present as a sulfurophane in broccoli and a goitrinogen in rapeseed.

1.5 b. Bitter Taste, PROP and PTC

A chemist named AL Fox in 1931 discovered Phenyl thiocarbamide (PTC) serendipitously when he was synthesizing a crystalline white compound that his friend perceived as a bitter taste on his lips but he tasted nothing. [79]. Investigations over several years added to the body of information that now shows that bitter taste sensitivity to PTC is inherited and can be attributed to the gene TAS2R38 [59].

Genetic studies reveal that there are 25 bitter receptor genes located as clusters on chromosomes 5p, 7q and 12p known in humans [59]. These genes belong to the TAS2R family of bitter taste genes. The bitter receptor is sensitive to the C-N=S moiety of PTC and a related compound called 6-n-Propyl Thiouracil (PROP), which is similar in structure to isothiocyanates (ITC). Three single nucleotide polymorphisms at positions A49P A262V and V296I give rise to the major haplotypes of PAV (tasters), and AVI (non tasters). PROP sensitive persons possess one or two dominant alleles (PAV/PAV or PAV/AVI), whereas insensitive persons are recessive for the trait (AVI/AVI). A rare variant (AAV and PVI) is found in sub Saharan Africa [59]. The mode of transmission of PTC sensitivity is not clear but, it is stable with high test-retest reliability [73,76,12]. PTC is known to have a slightly sulfurous odor; PROP is being used more commonly in taste studies.

Phenotypically, approximately 70% of Caucasian adults in the US are PTC/PROP tasters. The remaining 30% are taste blind and called non-tasters [78]. The populations that are taste blind varies by gender and ethnicity but reasons are still unclear. In China, Japan and sub-Saharan African, non taster incidence is generally lower (10-20%) while in countries like India, over 50% could be non tasters [12]. 10% of the Puerto Ricans, 10% of the Mexicans, 4-7% of the Peruvians, 9% of the Jamaicans and 17% of the Chileans are known to be PROP non tasters [79]. The percentage of non-tasters in the Hispanic populations was notably less than 20% [79]. Phenotypic sensitivity can be affected to some extent by gender and age. Percentage of non tasters does not differ by gender in young children [61, 80, 81, 83] yet, among older children, more girls were found to be tasters [40, 62]. Though the predominant taste groups are either tasters or non tasters, tasters could be further classified as 'medium tasters' or 'super tasters' based on their ability to taste the bitterness of PROP 'moderately' or 'strongly'[84]. Genotypically, the medium tasters possess a combination of the dominant and recessive alleles (Tt); super tasters possess the dominant alleles (TT) and the non tasters possess the recessive alleles (tt) [84].

1.5 c. PROP Sensitivity, Oral stimuli, and Taste Preferences

Continual research in taste genetics suggests that PROP tasters are sensitive at varying intensities not only to bitter taste but also to other oral stimuli like bitterness in fruits, vegetables, sweet tastes, oral irritation from chili peppers and textural sensations of fats that leads them to dislike and avoid these sensations in various foods whereas non tasters tended to prefer them [83, 85, 86]. Anatomical differences in the density of taste papillae (fungiform) in individuals with different taste sensitivity are noted [83, 85, 86, 117]. Higher papillae density was associated with increased trigeminal innervation to the tongue, resulting in tasters having greater sensitivity to textures and chemical feeling factors [83]. Non tasters had lowest fungiform density while super tasters have the highest [86]. Super tasters also had a higher lingual tactile acuity [87,117]. Non tasters prefer strong tasting, hot pungent, high fat foods and have a generally broader range of foods that they eat when compared to the tasters who might restrict their food choices due to higher taste sensitivity to many oral sensations [81,83,85,86, 88].

1.5 d. PROP sensitivity and Bitter Preferences

Some other studies in adult women showed that PROP tasters had lower preferences for bitter citrus fruits like grapefruit [89, 95] and cruciferous vegetables like cabbage, brussels sprouts and green leafy vegetables, [90]. In a PROP study among preschool children, it was seen that non taster children consumed more bitter vegetables (olives, cucumber and broccoli) than taster children in a free choice test [75]. In the first cohort of Keller et al's study, tasters were found to have lower liking of raw broccoli and American cheese [88]. The findings related to bitter food preferences were in agreement with the patterns reported in adults in the lab[75]. Drewnowski et al reported that the tendency of tasters to reject bitter foods like legumes, cocoa, wine, green leafy vegetables, broccoli and others, which are known to have anti-carcinogenic and tumor blocking effects, could be disadvantageous to health in the long term [89]. However, another study does not support the hypothesis that PROP super tasters, through heightened sensitivity to, and avoidance of, bitter-tasting fruits, vegetables and other foods with antioxidant properties, may be at increased risk for diet-linked diseases such as cancer [117]. Future studies need to address the barriers to adoption of vegetable rich diets for healthy living as taste sensitivity to bitter compounds could increase likelihood of rejection of antioxidant rich bitter fruits and vegetables.

1.5 e. PROP sensitivity, Fat Preferences and Nutrient Intakes

The ability to discern fat levels in foods in relation to PROP taster status has been studied extensively. The perception of fat in food is primarily due to textural sensations, such as creaminess, smoothness, oiliness and crunchiness [85]. Tepper and colleagues showed that PROP tasters were better able to discriminate between high fat (40% fat) and low fat (10%) salad dressings with no preference, while non tasters preferred the high-fat sample [85,86]. Kirkmeyer et al. found super tasters to use a greater number of terms to describe the creaminess of dairy and texture perceptions and texture perceptions were more important than flavor perceptions in rating liking attributes of dairy [112]. In the study by Nasser et al., PROP status was related with the ability to detect a difference in ice creams with addition of conjugated linoleic acid compared to the original ice cream [119]. Drewnowski et al. [91] observed no effect of PROP taster status on sensory perception or preference for mixtures of milk, cream, and sugar in females whereas Hayes et al. found that super tasters had a heightened perception for the creaminess of fat in sweetened dairy beverages [128].

The effect of PROP status on macronutrient selection not been studied extensively and some of the studies are contradictory. Gender specific factors might influence fat preferences as they relate to PROP status. This was seen in the study by Keller et al., where non taster girls consumed 2-3 servings more of discretionary fats than taster girls. Taster girls also showed lower acceptance of full fat milk than non taster girls. This effect was absent in boys [88]. In a study by Yackinous et al [117] female tasters derived a greater percentage of their energy from fat compared to non tasters. Yackinous et al study however, did not measure actual intakes. Kamphius et al measured actual intakes offering an ad libitum lunch consisting of macronutrient-specific ‘High-Fat’ and ‘High-Carbohydrates’ food products [118]. Tasters (both super tasters and medium tasters) ate relatively more fat and less carbohydrate than non tasters did. Thus, despite tasters’ better ability to discern fat levels in food, it was not necessarily less preferred and it is unclear as to what degree and direction this affects food preferences and macronutrient intakes in adults. However, in our lab, Goldstein et al [40] was the first to show significant differences in reported daily energy intakes as a function of taster group. The mean reported energy intake of non taster children was 293 kcal/day higher than the mean reported energy intake of super taster children. No significant differences in percent of energy consumed from protein, fat or carbohydrate were observed as a function of taster status. No interactions between PROP status and gender for either reported energy or micronutrient intakes.

1.5 f. PROP sensitivity and Sweet Preferences

Looy & Weingarten first linked increased PROP sensitivity in adults ‘sweet dislikers’ and those with lower sensitivity to PROP to be “sweet likers”[93] .Yeomans reported that adult super tasters showed a stronger dislike for concentrated sucrose than the other taster groups [95]. A study by Drewnowski et al. tested hedonic response and intensity perception over a range of sucrose/ fat mixtures in women, and did not find heightened PROP sensitivity associated with enhanced perception of sweetness [91].

In children however, the liking of sweets with respect to taster status have been reported to be the opposite. In the second study by Keller et al., taster children consumed sweeter snack foods like table sugar, soft drinks, candy and bakery sweets than non-tasters [81]. Manella et al. also reported that 8yr old tasters preferred high concentrations of sucrose solutions and liked sweeter breakfast cereals. Super tasters and medium tasters preferred significantly higher concentrations of sugars in liquids and solid foods when compared with non taster children, a finding that is in disagreement with the studies in adults. Sweet preferences were strongly influenced by age and race/ ethnicity, confirming previous reports that children prefer higher levels of sweets than adults and in individuals of African descent prefer higher levels of sweet than those of European descent [93].

1.5 g. PROP Taster Status and Body Weight

The idea that PROP sensitivity and body weight might be related was first introduced by Roland Fischer's team who found that tasters tended to be endomorphs, manifesting thin angular bodies while non tasters tended to be ectomorphs, with a fleshy body type [96]. Later studies focused on food choices, likes and dislikes; and the relationship between body weight and taster status was not explored further for the next few decades.

In 1998 Tepper and Nurse found a small negative association between BMI in college males and their taster status but not in females [85]. Several other studies among children and adults studied the relationships between taster status and weight. Keller et al. found that among preschool children, there was an inverse relationship between BMI percentile and taster status in boys, but an opposite effect in girls [[81]. Despite this initial start, the role of PROP status in body weight remains controversial and unclear as most studies had a relatively lean population to begin with. Another study by Keller et al in a similar population showed no relationship between PROP status and body weight

[88]. This was believed to be attributed to the relative leanness of the population. Yakinous et al found no significant differences in BMI values and energy intake among taster groups in college students [117].

However, in a recent study done in an isolated cohort in Italy [97], in females only, non taster phenotype was negatively associated with BMI and waist circumference. Similar female gender specific negative relationship of PROP status and body weight was seen [98, 40] and no relationship in males [85, 81] in our lab. In contrast, some other studies also failed to show a relationship in adult women [77, 89].

The difficulty in observing differences in PROP status and weight might be due to the influence of cognitive variables which may independently or through interaction affect BMI [97, 98]. Tepper and Ullrich showed that restraint mediated the relationship between PROP status and body weight in middle aged women [98]. In the low restraint groups, non tasters were heavier than super tasters whereas in the high restraint group, no PROP related differences in body weight were seen [98].

In the Italian cohort study [97], it was found especially among women that a significant interaction between dietary restraint and PROP phenotype on BMI existed. Among unrestrained females, non tasters had higher BMI and waist circumference than the other groups. Disinhibition on the other hand has been a strong independent predictor of BMI and has shown no relationship to PROP sensitivity [28, 115, 97]. Hence, it is important to consider the extent of influence restraint and disinhibition exert in understanding the relationship between PROP status and BMI.

1.6. Nutrient needs of Preschoolers (2-5 year olds)

Dietary patterns develop during childhood and are important to understanding the pathogenesis of several chronic diseases. The USDA establishes Dietary Reference Intakes (DRI) for adults and children [104]. However, for children aged 2-5 years, energy needs are estimated to be between 1300-1800 kilo calories per day [105]with 130 g carbohydrates, 19-25g fiber and 13-19g protein per day [104]. The average recommendations would be: 1500kcal; 130g carbohydrates; 22g fiber and 16g proteins per day. There are no recommendations for fat consumption, however, a range of 25-35 % energy intake has been suggested for children 4-18 years of age; this amounts to about 41-51g/day while that for saturated fat is 7-10g/d [104]. Dietary intake recommendation by USDA food groups' for the full day for 2-3 year old and 4-5 year old children are shown in (Appendix 2) [106].

1.7. Head Start Program and Nutrition Policies

1.7 a. National Head Start Program

The Head Start Program purpose is intended to help build early childhood systems, enhance access to comprehensive services for low-income families, encourage collaboration among Head Start and other appropriate programs and services and facilitate the involvement of Head Start in state policies, plans, processes, and decisions affecting the Head Start target population [100]. Head Start Program participation eligibility necessitates the child to be of 3 or 4 years of age and belong to a family of total income at or below the U.S. Poverty Income Guidelines [101]. Ninety percent of Head Start families have incomes under 100 percent of U.S. Poverty Income Guidelines. Head Start Programs also serve the 10 percent of Head Start families who exceed the federal poverty level (family incomes under 185 percent of poverty). The federal government provides 80 percent of the yearly cost to operate a Head Start program, and the remaining 20 percent must come from a "local match" or "in-kind" contributions, which may be in the form of monetary contributions, donations of goods or services, or volunteer hours [100].

1.7 b. Nutrition Policies at Head Start

Nutrition related activities at Head Start include health and nutritional status screening within 90 days of enrollment, providing healthy and nutritious meals at no cost to preschoolers and nutrition education through an integrated approach of the daily curriculum and separate workshops for parents that discuss individual needs of the child and services available to parents [102]. Meals served at the participating Head Start Centers include breakfast, lunch and snack. Each child is served at least two meals. The decision to not consume is optional by the children and families. Morning children eat breakfast and lunch at school, afternoon children eat lunch and a snack, and all-day children receive breakfast, lunch and snack. Head Start performance standards stipulate that children who attend Head Start in a part day program (4-7 hours) received one-third of their daily nutritional requirements from meals and snacks. The program mandates that the children attending the full day program (more than 8 hours) should receive one half to two third of their daily needs from meals and snacks. Meals are provided free of cost and are required to meet USDA Child and Adult Care Food Program meal pattern requirements (Appendix 1). Special diets needed for medical reasons or other dietary requirements are accommodated. A variety of foods are served with the purpose of broadening each child's food experiences and mealtime is supposed to be considered a learning opportunity that is integrated into the overall curriculum. Staff, children, and volunteers eat together family style and to the extent possible, share the same menu. The children pass the food bowls from which they served themselves. Research has shown that that self-served portions may play an important role in circumventing children's exposure to excessive portion sizes and the consequent effects on intake [21]. The USDA Child and Adult Care Food Program meal pattern for lunch is shown (Appendix 1) [103]. However, this document does not provide macronutrient intake guidance and it not very clear.

1.8. Summary of Introduction

The current body of literature is continuously expanding the realm of understanding of the complex relationships between taster status, food preferences, body weight and maternal factors. The number of Hispanics in the U.S is expected to quintuple by 2050 (from 4.7% in 1970 to 24.4% in 2050). As the largest racial and ethnic minority population in the United States, the youngest (34% below 18 in 2004), largely living below poverty levels and making up a significant portion of obese or overweight children in the U.S., it is important to understand these interrelationships in this population.

There has been only one study done so far that studied the relationship of PROP taster status and nutrient intakes in a low income population of the preschool age in Head Start, Michigan [60]. However, this population did not consist of a Hispanic majority. A previous study from our laboratory was similar in design to the current study, but consisted of a homogeneous, population of Caucasian children who had a relatively low risk for obesity development [40]. Hence, it is important to understand the extent of influence of maternal taster status, feeding styles, maternal cognitive factors and weight on children’s food intakes and body weights in the Hispanic population.

CHAPTER 2: OBJECTIVES

In view of the need to explore and understand the complex relationships in the obesity matrix, and to fill gaps in knowledge of the role of taste genetics and behavioral factors on weight status among children of ethnic populations, who have high rates of obesity, the present study was conducted among preschool aged (4-5 years) children attending the government Head Start Program in Perth Amboy, NJ. Previous studies in this laboratory have explored taste status and obesity relationships in preschool aged children of Caucasian, mostly normal weight children belonging to upper income families in NJ [40,81,88,113]. There is a need to explore issues among the Hispanic ethnic populations.

The aims of this study are two fold: 1) to understand the relationship of PROP taster status and its relationship to food intakes at lunch and body weight in children; and 2) explore the extent of influence of maternal taster status, feeding styles, her cognitive factors and weight on the child's food intakes and body weights.

Objective 1: To establish the taster status of children and understand its role in the influence on body weight patterns among preschool children.

Hypothesis 1: Non taster boys will have a higher BMI percentile than Taster boys and Taster girls will have a higher BMI percentile than Non taster girls.

Objective 2: To establish the role of PROP taster status of the children in their lunch-time food consumption patterns.

Hypothesis 2: Non Taster children will consume higher energy, proteins and fat and will consume more fruits and vegetables than taster children from lunch at school.

Objective 3: To determine the roles and interactions between PROP taster status, maternal cognitive and family environment factors in weight status of preschool children

Hypothesis 3(a): Maternal restraint and disinhibition will be positively correlated to child weight status and food consumption at school.

Hypothesis 3(b): Maternal child feeding practices and child temperament influence child weight status and food consumption at school.

Hypothesis 3(c): Maternal factors and family environmental factors interact with child taster status and weight.

CHAPTER 3: METHODS

The present study was conducted among preschool aged (4-5 years) children attending the government initiated education program called Head Start in Perth Amboy, NJ. The objective of the study was to investigate the relationship of children's taste sensitivity and weight status with food intake patterns at lunch in the preschool and maternal factors including feeding styles.

3.1 Study Environment and Subjects

Head Start Program participation eligibility necessitates the child to be of 3 or 5 years age and belong to a family of total income at or below the U.S. Poverty Income Guidelines. As Head Start is fairly representative of low income families in the US, it was chosen as a study environment. The sample population, mostly Hispanic, was recruited from a population serviced by the Head Start Program in Perth Amboy, which operates under the Community Development Institute (CDI) of Middlesex County, NJ.

Every child over the age of 3 years attending Head Start was given the opportunity to participate in the study. Parents were invited to an informal information session about the research study. Those parents who attended and gave written consent for both mother and child to participate were accepted into the study. Research protocols were approved by Rutgers University Institutional Review Board for the protection of human subjects in research. The school had an enrollment of 120 students out of which about two thirds responded for screening. A total of 82 subjects were screened for eligibility but final sample size was reduced to 78 due to drop outs or inability to collect complete information. One time data was collected on child and mother related factors using various standardized tools. The data was collected over one academic school year period (July 2007-July 2008). Data from some summer camp children of the previous academic year was also captured during the early part of the study period (Table 3.1.1).

Table 3.1.1 Data Collection Points for Mothers and Children (July 2007-July 2008)

Venue	**Subject Population**	**Data Collected**
At School	**Preschool children**	Pyramid Game-child PROP Taste Test (Liquid Taste Test)-child Anthropometric Data-child Nutrient Intakes at Lunch-Child
At Home	**Mothers**	PROP Taste Test (Paper Disc Method)-Self Demographic data -Self DEBQ (Dutch Eating Behavior Questionnaire)-Self Fruits and Vegetable Availability in the past week-for family
At Home	**Mothers**	Demographic Data-child Colorado Child Temperament Inventory –child Child Feeding Questionnaire -child

Demographic data collected included questions on pre-existing states of health of mothers and children for possible elimination if serious conditions were found. Upon return of the completed information packet, families were compensated with a cash amount of $10.

3.2 Study Design (Figure 3.2.1)

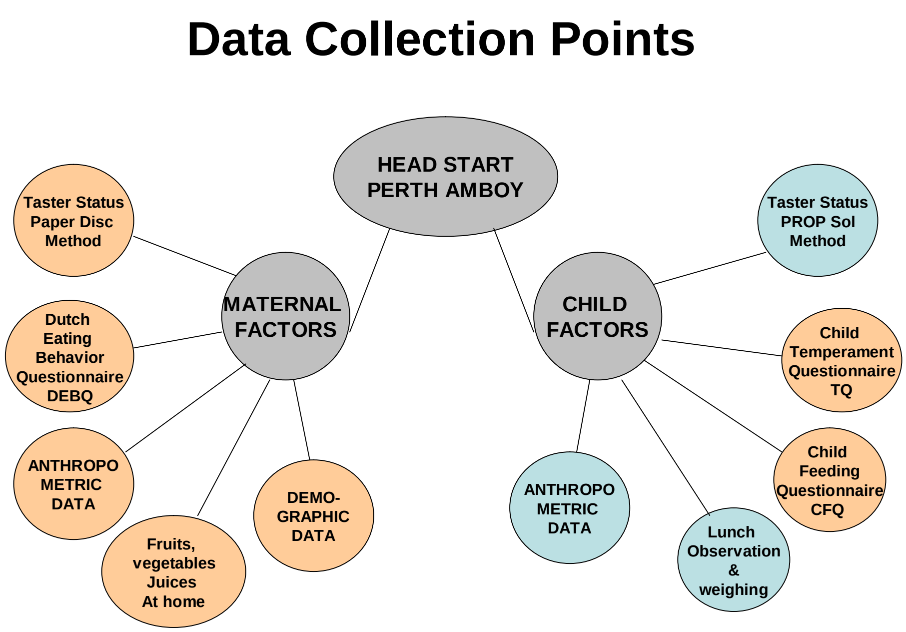
Once the consent was obtained, data was collected in two ways; firstly by working with children at the preschool and secondly through questionnaires sent home with the children that mothers filled out and sent back to the school. All written communication and questionnaires were available in both English and Spanish and the parents chose their language of preference. At the preschool, the investigator collected data that included the taste test to classify the children into taster groups, anthropometry and lunch intake information among participating children. Other Child Factors included demographic data, temperament data and child feeding practices information which was obtained using standardized, pre-tested questionnaires that were filled out by mothers in the packet sent home.

Mothers performed the Taste Test on herself using detailed instructions and filled out other Maternal Factors related questionnaires that included demographic, food availability at home and questions related to her eating behaviors. The completed questionnaire packet was returned to the child’s class room teacher at Head Start within the same week.

A food pyramid game was played with each child to develop child-investigator familiarity. Most children were developing bilingual skills (Spanish and English) and were able to understand and respond in simple English. However, the help of the bilingual classroom teacher was sought in instances when the child seemed to have difficulty in communication. Each participating child was led to a separate testing area set up close to their class rooms to ensure that the child felt secure. The child played the food pyramid game and then, was administered the modified taste test. After the taster status of the child was determined, the child’s height and weight was measured accurately.

The investigator discussed the day’s lunch menu with the cook and details of the recipes were recorded. At lunch time, the chosen child’s lunch intake data was recorded with notes on number of servings, food weights (initially and finally, left over). This was accomplished using observation, monitoring and appropriate weighing methods. The teachers were informed about the children targeted for meal intake data collection. Her cooperation was welcomed during meal times. The questionnaires packet for both mother and child was sent home with the child thereafter. Details of each of the factors are discussed below.

Figure 3.2.1



3.3 Classification of Taster Status

Keller's method [88] modified from the Lawless Method [81] was used to classify preschoolers as Tasters or Non tasters. Children tasted 10ml of 0.56mM PROP solution from a plastic cup. They were then observed for signs of rejection like frowning or grimacing and were allowed to spit out the solution if they chose to. If the solution was rejected, they were classified as Tasters. Apart from the facial expression observations, they were further questioned, "Do you taste anything?" or "Is it good or yucky"? If the reply was that it was good, they were classified as Non Tasters and were further asked if it tasted like water. If it was answered in the affirmative, then, child was confirmed as a Non Taster. If the child replied to the first question as “yucky”, then, they were confirmed as a Taster. Children whose responses were ambiguous were retested the next day to ascertain status. If taster status could not be established, the subject was eliminated from study.

Mothers’ taster status was assessed using the Paper Disc Method [107]. The PROP ballot used for the study can be found in Appendix 3. Detailed instructions, labeled paper discs and test ballots were provided to the mothers in the packet sent home. The mothers were asked to rinse with spring water before they began tasting and between each sample. They were instructed to taste the disc marked with a ‘blue’ dot and then, the disc marked with a ‘red’ dot. After each disc was tasted, the intensity on a Labeled Magnitude Scale (LMS) was rated. The LMS is a semi logarithmic line scale. The scale had anchors starting with “barely detectable”, “weak “moderate”, “strong” and “strongest imaginable” with range from 0 to 100.

The first paper disc marked ‘blue’ was dipped in 1.0mol/L Sodium Chloride, and was used as standard while the second disc marked ‘red’, contained 50mmol/L Propylthiouracil (PROP), the bitter compound. Classification of taster status was based on the ratings on the LMS. Those who rated the intensity of PROP “moderate” or below (less than or equal to 17mm) were classified as Non tasters while those who gave a rating between 17 and 69 mm were Medium tasters and those who rated as greater than 69mm on the scale were classified as Super tasters. The standard sodium chloride solution rating was used to clarify only when borderline ratings to PROP occurred. It was based on the rationale that non tasters give much lower ratings to PROP than to sodium chloride and super tasters give much higher ratings to PROP than to sodium chloride. Thus, if a subject gives a borderline rating to PROP, the sodium chloride rating was used to help clarify the classification.

3.4 Anthropometric Measurements

Each child's weight and height was measured in kilograms and meters using a standard Stadiometer provided by the preschool. For each child, two separate measurements were recorded on separate days (within the same week) and averaged to ensure accuracy. The child was instructed to remove heavy clothing and shoes before standing on the platform. The Body Mass Index (BMI) percentile for age and z-score was calculated for each child using CDC charts that could be run on a SAS Statistical Software program (SAS Institute Inc., Cary, NC). BMI percentile is considered a more reliable method to classify obesity in children than BMI values as it reflects current national obesity trends as recorded by the CDC [108]. Children with BMI percentile less than the 85^{th} percentile were considered "normal" while those between 85^{th} and less than 95^{th} percentile was classified as "risk of overweight" and those who were at or above 95^{th} percentile were classified as "overweight" according to CDC classification [108]. BMIZ calculations are done based on gender and age. BMI Z scores were calculated as the difference between BMI value and Mean BMI divided by standard deviation of BMI for the sample population. Z score is the number of standard deviations that a given value is above or below the mean. Unusual values are those with scores less than -2.00 or above 2.00. Z scores are useful to comparing values from different data sets [120].

Current heights and weights were self reported by mothers in their Demographic questionnaires. BMI was calculated as weight in kilograms divided by height in meters (kg/ m^2). CDC classification was used in the current study which was as follows: BMI less than 25 is “normal”, 26 to 29 is “overweight” while 30 and above is considered “obese” [108].

3.5 Lunch Intake Data Collection

After the classroom for the day was chosen, the participating children and teachers were informed. At lunch, data was collected on not more than three children. The children chose their seating as usual. The investigator set up the weighing scales on a separate nearby table. Each table had six to eight children and one teacher. Sometimes, an additional table for children was set up. The kitchen helper wheeled in a cart with food. The meals consisted of one entrée, milk, a vegetable and a fruit. The meals were served ‘family-style’ as mandated by Head Start regulations (WIC and Head Start Services document). The food bowls were passed along and children served themselves. The investigator weighed the food (Salter Kitchen Scale, Boca Raton, FL) and placed it back. The children served other foods and each time foods were weighed and accurate measures were recorded. Care was taken to minimize intrusion. The investigator monitored and recorded for extra helpings and left over food. Lunch intake data was collected on two separate days (within two weeks) and averaged for nutrient consumption information for each child so that inconsistencies and aberrations were minimized.

The actual consumption of meals was calculated by subtracting left over foods from the foods served. The menu recipes and actual nutrient and food group consumption calculation was then done using Nutrient Data System for Research (Nutrition Coordinating Center, University of Minnesota, Minneapolis, MN). Mean consumption was then calculated.

3.6 Food Groups

Individual foods were grouped together to further investigate diet patterns by habitual intake of food categories. NDS-R output files automatically separate foods into 160 different food groups with serving sizes based on standard USDA reference amounts. Those food groups were condensed into standard USDA Food Guide Pyramid groups [106] (grains, fruit, vegetables, meat, dairy, fats) with sweets, sugars and snack foods excluded. A description of the food groups is displayed in Appendix 2.

Appendix 1 shows the USDA Child and Adult Care Meal Program [103] requirement of serving amounts per child. This served as a guideline for Head Start meal patterns.

3.7 Maternal and Child Factors – Demographic Data and Food Availability at Home

Important demographic information about the child like gender, age, birthday, contact information, race and ethnicity and health history that included chronic illnesses, dental condition, food and environmental allergies was collected through the forms filled out by mothers.

Mothers also filled out demographic information about themselves related to education level, age, height, weight, weight history, breast-feeding history for the participating child and history of illnesses either chronic or allergenic. Appendix 4 has Demographic information about mothers and Appendix 5 has Demographic information about child.

Research has shown that poorer low income communities with limited accessibility to fresh produce often consume more energy dense low cost foods that are unhealthy [60]. Hence, information regarding availability of juices and drinks, fresh fruits and vegetables in the home in the past one week was collected through a form filled out by mothers (Appendix 6).

3.8 Child Factors-Child Feeding Questionnaire (CFQ) (Appendix 7)

In view of the rise in obesity rates in children across the U.S., the CFQ was designed to assess parental perceptions, beliefs, practices, concerns and control of their children's eating habits and environment [109]. The response options varied based on type of factor being questioned and coded from 1 to 5 for analyses. The response categories were: never (1) to always (5); disagree (1) to agree (5); markedly underweight (1) to markedly overweight (5); and unconcerned (1) to very concerned (5). As number of items in each factor varied, the scores were averaged for each factor based on number of items in that sub scale. These factors are as following:

(i) Perceived Responsibility (PR) assessed mothers' perception of their responsibility for child feeding.

(ii) Monitoring Scale (MS) assessed the extent to which mothers' oversee her child's eating.

(iii) Restriction Scale (RS) assessed the extent to which mothers' restrict the child's access to foods.

(iv) Pressure to Eat (PE) assessed tendency of mothers' to pressurize the child to eat more especially at meal times.

(v) Concerns about Child Weight (CC) assessed mothers' perception of child's risk of being overweight.

(vi) Perceived Weight of Child (PWC) assessed mothers' perception of child's current weight and weight history.

(vii) Perceived Weight of Mother (PWM) assessed mothers' perception of self current weight and weight history.

3.9 Child Factors – Colorado Child Temperament Inventory (CCTI) (Appendix 8)

Mothers play a key role in creating the environments for their young preschool aged children which often reflects their own securities, habits, beliefs and practices [28]. The parent and teacher versions of the CCTI [110,111] assess Emotionality (negative emotionality including distress, fear, and anger), Activity (the tempo, energy, and vigor with which the child behaves), Sociability (a preference to be with other people), Shyness (wariness with strangers), and Attention/Persistence (the tendency to attend and persist when working on tasks). Keeping this in mind, the CCTI was used to assess the mother's perception of three important child factors: sociability, physical activity and food reactivity in environments other than the school. 5 point score ranging from 1= 'not typical' to 5= 'typical' was used. Some responses were reverse coded during analyses. As number of items in each factor varied, the scores were averaged for each factor based on number of items in that sub scale. Responses to these factors would in turn allow the investigator to understand the home environment, child's socializing skills and acceptance of foods offered as perceived by mother; thus providing a more complete picture of the family's lifestyle.

3.10 Maternal Factors – Dutch Eating Behavior Questionnaire (DEBQ) (Appendix 9)

The DEBQ is a 33 item questionnaire that is designed to measure dietary restraint, external eating and emotional eating [43]. In this research, the DEBQ was sent home in the questionnaire packet which the mothers filled out about their own eating habits. The questionnaire uses a 5 point scale (1= never, 2= rarely, 3= sometimes, 4= often and 5=very often). The external eating and emotional eating components were also combined to obtain a 'disinhibition' score that basically reflected maternal response to external cues (sights and smells of food) and internal cues (emotional states) that lead to overeating.

3.11 Statistical Analyses

PROP taster classifications for children were done on the basis of ability to taste PROP liquid or not (taster or non taster). T-tests and ANOVA's were also done. In mothers, PROP was classified using three taster groups (non taster, medium taster and super taster) and later on medium taster and super taster were collapsed into one taster group.

SAS was used for all statistical analyses. Correlations were considered significant only at $p \leq 0.01$. For all other statistical analyses (ANOVA, χ^2 tests, Regression, ttests) significance was established at $p \leq 0.05$.

Weight status and diet information were analyzed by Analysis of Variance (ANOVA) with PROP taster status, gender and the taster by gender interaction as factors. For most factors a median split was used to classify children and mothers as restrained vs. unrestrained, disinhibited vs not disinhibited, and emotional vs. non-emotional eaters. This classification was used because it is mandated to have dichotomous or classification variables in ANOVA models. Diet information collected during meal times was calculated accurately and compared between the two taster groups.

Pearson's Correlations among weight status, caloric intake maternal disinhibition and restraint were investigated. Food intake, child eating behaviors, mothers' weight and eating behaviors and child temperament were factors for regression modeling for BMI z-score. Additionally, Stepwise Multiple Linear Regression and correlation matrix outcomes were used to identify factors that significantly contributed to weight status in children. Forward stepwise regression was conducted for all children specifying the level of significance necessary for entry as p=0.25 and that for staying in the model as p=0.05 so that a tighter fit could be obtained.

Results from the correlation analyses and multiple regression analyses were used in creating a model for hierarchical regression to predict BMI z score in the children. In a hierarchical multiple regression, the researcher decides not only how many predictors that enter but also the order in which they enter. Usually, the order of entry is based on logical or theoretical considerations, beginning with the main effects and then the interactions. This allows the researcher the flexibility to assign the relative importance to the predictors entering the model at various levels.

The key variables entered in the Hierarchical Regression Model were gender, child taster status, child perceived weight, energy intake, Pressure to Eat, Perceived Responsibility, Food Reactivity, Maternal Restraint, Disinhibition, Interaction between child taster status and maternal restraint. The outcome variable was the BMI z-score of the children.

CHAPTER 4: RESULTS

4.1 Subject Characteristics and Weight status

4.1 a. Child Weight Status

About two thirds of the children enrolled in the Program participated (82 out of 120). Table 4.1 shows the demographic data of the participants. 69% of the children were of Hispanic origin, mostly from the Dominican Republic and Puerto Rico while 31% were of Non Hispanic, mostly African American, White, Asian or mixed ethnicities (white/Hispanic, Black/Hispanic or Hispanic/Hispanic). One child exceeded the 100% weight for age and had hypertension, hence, was not included in the study. Fifty five percent of children overall, 44% of the girls and 66% of the boys were above the BMI percentile considered normal (85 percentile). Boys had a significantly higher BMIZ (1.55) than girls (1.08) (p=0.04). A higher number of overweight children were boys (62%) while more numbers of girls were normal weight (60%) (χ^2=0.04).

4.1. b. Maternal Weight Status

72 mothers participated in the study (table 4.1.1). Mean BMI of the mothers was in the overweight range (27 ± 0.6 kg/m^2). The mothers had an average of a high school education. Only 36% mothers had an education beyond a high school diploma. Mothers with higher education gave higher ‘Perceived Responsibility’ score (t value=0.008) and higher ‘child activity’ score (t value=0.002). Since wages and income information was not collected in this study, further analyses could not be conducted. Also overweight mothers had significantly higher restraint (p=0.009) and higher disinhibition (p=0.03).

The relationship between maternal BMI and child’s BMIZ modestly trended in the same direction but missed statistical significance (r=0.19, p=0.09).

Correlations showed that mothers with higher BMI tended to give higher PROP scores (r=0.27, p=0.01). No correlation between child's BMIZ with child's PROP status was noted. There was a trend of mothers of boys to have a higher BMI than the mothers of girls. Correlations between maternal and child BMIZ with other factors is shown in Table 4.6.1.

Table 4. 1.1 DEMOGRAPHIC DATA OF THE STUDY POPULATION

	CATEGORY	OVERALL	BOYS	GIRLS
		CHILDREN		
TOTAL NUMBER	**N**	78	41	37
MEAN AGE	**MONTHS**		51.27 ± 0.9	52.51±1.2
MEAN BMI p=0.05	**PERCENTILE**	82 ± 2.0	85 ± 2.7 a	79± 3.0 b
WEIGHT	**NORMAL**	45%	34%	56%
	RISK OF OVERWEIGHT	27%	32%	22%
	OVERWEIGHT	28%	34%	22%
		MOTHERS		
TOTAL NUMBER	**N**	72	40	32
MEAN AGE OF MOTHERS	**YEARS**	30.10± 0.8	26.86± 1.4	28.53± 0.9
MEAN BMI	**kg/m^2**	27.2 ± 0.6	28.75± 0.8	26.57± 0.7
WEIGHT	**NORMAL**	46%	37.5%	56%
	OVERWEIGHT	29%	32.5%	25%
	OBESE	25%	30%	19%

4.2 Child and Maternal Taster Status

4.2 a. Child Taster Status

Overall, 75% of the children were tasters and 25% were non-tasters. There were no significant differences in the prevalence of tasters and non tasters among boys and girls. As has been reported previously from studies in this lab [81], the trend of non taster boys to be heavier than taster boys and the opposite relationship for taster girls (to be heavier than non taster girls) was seen in this study. However, it did not reach statistical significance. ANOVA ($F=1.49, df=1, p=0.23$) showed that the mean BMIZ of non taster boys ($n=11$) was 1.91 ± 0.34 while that of taster boys ($n=30$) was 1.42 ± 0.42.

Fig 4.2.1 and Table 4.2.1 show mean BMI percentile of children based on their taster status. It is interesting to note that non taster girls were normal weight while non taster boys did trend towards being having a higher BMIZ score than taster boys. Seven of the 11 non taster boys were overweight while only 2 of the 9 non taster girls were overweight. Yet, these differences did not reach significance.

Table 4.2.1 Mean BMI Percentile of Children based on Taster Status				
`1	Taster Status	N	% by Taster Status	Mean BMI percentile
OVERALL	NON TASTER	20	26	81.0 ± 4.0
	TASTER	58	74	82.0 ± 2.3
GIRLS	NON TASTER	9	24	72.0 ± 6.3
	TASTER	28	76	80.8 ± 3.3
BOYS	NON TASTER	11	27	90.0 ± 3.0
	TASTER	30	73	83.0 ± 3.5

4.2 b. Maternal Taster Status

Mothers used the Paper disc method to rate intensity of PROP. Among the mothers, 83% were tasters and 17% were non tasters. This taster to non taster ratio is close to values previously reported by Goldstein et al [115]. However, 66% of the taster mothers were medium tasters. Only 16% tasters made up the super taster category.

Scatter-plot for mean levels of sodium chloride and PROP is shown in (Fig 4.2.2). Figure 4.2.3 shows that there is no difference in mean sodium chloride rating in the three taster groups. ANOVA showed that there was significant difference in PROP ratings between the three groups as expected ($F=84.9$, $df=2$, $p<0.0001$).

Also, Spearman's correlations showed a weak negative relationship between child taster status and maternal taster status. No other relationships based only on child and maternal taster status was discernable.

4.2 c. Taster Status and Weight Status

Spearman's correlations revealed that both child and maternal taster status had no significant correlation with the child's gender, BMI z scores, child food consumption (nutrients and food group-wise), child eating behaviors or child temperament and maternal disinhibition with the exception of maternal restraint. No differences in maternal BMI based on maternal taster status existed.

4.3 a. Maternal Cognitive Factors with Maternal Weight Status

4.3 a.1. Maternal Weight Status with Maternal Restraint

There were more mothers who were restrained and overweight (χ^2 p=0.01). Restraint scores are reported in Table 4.3.1. Overall, mean BMI of restrained mothers (29.7± 0.94 kg/m ^{2}) was significantly higher than those with less restraint (26.41±0.74 kg/m^2) (F=5.34,df=1,p=0.02) indicating that over weight mothers reported making efforts to restrict their eating but showed the opposite results in terms of BMI. This phenomenon was seen mostly in mothers of boys and not in mothers of girls. Mothers of boys with high restraint had significantly higher BMI than mothers of boys with low restraint (30.5 ±1.14 versus 26.5±1.26 kg/m^2) (F=5.31,df=1,p=0.02). This trend was not noted in the mothers of girls. This is probably why the overall correlation was only modest (r=0.20, p=0.08) (Table 4.3.2). Yet, both restrained and unrestrained mothers were in the overweight category. There were no differences in restraint between overweight and obese mothers. The reason as to why this observed relationship of high maternal restraint with higher maternal BMI was restricted to mothers of boys only and not the girls, is not understood at this time.

4.3 a.2. Maternal Weight Status and Maternal Disinhibition

Pearson’s correlation showed disinhibition had a significant correlation (r=0.43, p=0.0001) with maternal BMI (Table 4.3.2) as has been seen in other studies (52, 54). Mothers who were disinhibited were overweight and had approximately 3 units higher

BMI (27.73 ±0.99 kg/m ^{2}) than mothers who were not disinhibited, and normal weight (24.67 ±0.64 kg/m ^{2}) (t value=0.002). The emotional eating subscale was significant correlated (r=0.49, p≤0.0001) with maternal BMI and it was seen that overweight mothers had a significantly higher score (2.14) than normal weight mothers (1.72) (t value=0.01). Emotional eating seemed to be a stronger contributor to disinhibition scores than external eating. Girls' mothers with high disinhibition had significantly higher BMI than the girls' mothers with low disinhibition (F=7.04,df=1,p=0.01) (29.0 ±1.11 versus 25.0±1.01 kg/m^2). This trend was also noted in the mothers of boys, but missed significance (F=3.25, df=1, p=0.07).

Hence, overall, mothers with high restraint and disinhibition, had a significantly higher BMI (F=4.79,df=3,p=0.004). However, disinhibition and not restraint had a higher influence on maternal BMI (fig 4.3.1). Disinhibition in mothers of both the boys and girls had a positive relationship with higher maternal BMI whereas restraint in the mothers of only boys had a positive relationship with higher maternal BMI.

As understanding relationships with taster status were important to the study, interactions between maternal taster status and maternal cognitive factors for predicting maternal weight were explored. It was found that after adjusting for disinhibition (ANCOVA), which had a strong main effect on maternal BMI, no interaction effects between maternal taster status and maternal restraint was seen overall or gender specifically on maternal BMI of boys and girls. ANCOVA data is not shown here.

Hence, it appears that mothers of boys seemed to have a higher BMI that was related to higher restraint and disinhibition while the mothers of girls seemed to have a higher BMI that was related to higher disinhibition. As other maternal psychological factors were not assessed, it could be possible that these mothers had other emotional issues related to lower esteem, low socioeconomic status or binging as has been suggested by the authors of the DEBQ [43] and others [42]. Also, maternal weight was not the focus of the study, so, it was not possible to make conclusions regarding this issue.

4.3 b. Maternal Cognitive Factors with Child Weight Status

Table 4.3.1 shows that no statistical differences in the mean scores of maternal cognitive factors and child temperament scores based on child taster status, gender and body weights was present.

4.3 b.1. Child Weight Status with Maternal Restraint

Spearman's correlations failed to show a strong relationship between maternal restraint and BMIZ of boys and girls (Table 4.3.2). However, one way ANOVA analyses showed that children who had restrained mothers had a trend towards higher BMIZ ($F=2.93$, $df=1$, $p=0.09$). This trend of a higher BMIZ was specifically seen in boys with restrained mothers (1.81 versus 1.23) ($F=2.65$, $df=1$, $p=0.11$). In the girls with restrained mothers, this relationship was modest. Hence, overall, maternal restraint as a main effect had a moderate relationship with child weight and was not a significant main effect in the Hierarchical model.

4.3 b.2. Child Weight Status with Maternal Disinhibition

Spearman's correlations did not show any relationship between maternal disinhibition and BMIZ of boys and girls (Table 4.3.2). Further analyses did not yield statistically significant relationships between maternal disinhibition and child weight status. This was evidenced in the Hierarchical Regression Models where disinhibition did not enter the model that predicted child weight.

However, high maternal disinhibition had a direct positive relationship with high BMI in the mothers of both boys and girls. With regard to the child BMIZ, the relationship of maternal disinhibition was split; a relationship of high BMIZ in boys but low BMIZ in girls with higher disinhibition was seen; thus its effect on child weight was negated.

Table 4 .3.1 **MEAN MATERNAL COGNITIVE FACTOR SCORES, CHILD FEEDING SUBSCALES AND CHILD TEMPERAMENT SUBSCALES**

BY TASTER STATUS AND CHILD WEIGHTS

	Restraint **REST**	**Disinhibition** **DISIN**	**Responsibility** **PR**	**Pressure** **PE**	**Restriction** **RS**	**Monitor** **MS**	**Concern** **CC**	**Reaction** **REACT**	**Activity** **ACT**	**Social** **SOCIAL**
Overall	2.9	4.7	4.5	3.4	3.4	4.2	3.2	3.2	3.9	3.4
By Child Taster Status										
Overall NT	2.8	4.7	4.5	3.1	3.2	4.3	3.4	3.1	4.0	3.4
Overall T	2.8	4.7	4.5	3.5	3.4	4.1	3.1	3.2	3.8	3.4
By Child Weight Status										
Overall Normal weight	2.9	4.8	**4.2 a**	3.6	3.2	4.0	3.0	3.4	3.6	3.2
Overall Overweight a vs b p≤0.001	2.8	4.6	**4.7 b**	3.2	3.4	4.2	3.3	3.0	4.0	3.5
Boys Normal Weight	3.1	3.8	3.9	3.6	3.3	4.0	2.7	3.7	3.7	3.2
Boys Overweight	2.85	4.2	4.6	3.2	3.4	4.3	3.1	3.1	4.0	3.4
Girls Normal Weight	2.8	4.9	**4.1 c**	3.6	3.2	4.1	3.3	3.2	3.6	3.3
Girls Overweight c vs d p≤0.001	2.7	4.5	**4.8 d**	3.4	3.6	4.2	3.5	3.8	3.9	3.7

Table 4.3.2 CORRELATIONS BETWEEN MATERNAL AND CHILD FACTORS

		BMIZ	Maternal BMI	Responsibility	Pressure	Restriction	Monitor	Concern	Activity	Social	Reactivity
Restraint	**Disinhibition**										
Overall	0.17	0.02	0.20	0.1	0.10	0.23	0.19	-0.13	0.02	-0.07	0.03
Boys	0.13	-0.12	0.25	0.19	0.03	0.15	0.29	-0.23	0.18	-0.06	0.04
Girls	0.18	0.16	0.10	0.07	0.18	0.32	0.04	0.05	-0.15	-0.06	0.005
Disinhibition	**Restraint**										
Overall	0.17	0.10	**0.43*** **	-0.25	-0.03	-0.10	-0.19	-0.09	-0.15	**-0.30*** **	-0.11
Boys	0.13	0.03	**0.42*** **	0.03	0.06	0.008	-0.11	-0.02	-0.23	-0.25	-0.18
Girls	0.02	0.07	0.008	0.04	-0.47	-0.09	-0.08	0.17	-0.01	-0.36	0.01

*****p≤0.001**

PR=Perceived Responsibility Scale PE=Pressure to Eat Scale RS=Restriction Scale MS=Monitoring Scale CC=Concern about Child Weight Scale

ACT= Child Activity Score SOCIAL= Child Socialization Score FOOD REACT= Child Food Reactivity Score

4.3 d. Maternal Cognitive Factors and Child Nutrient Intakes

Maternal restraint and disinhibition were not significantly correlated as was the expected relationship between these two constructs using the DEBQ [43]. Though maternal disinhibition seemed to play a stronger role in maternal BMI, no direct relationships between maternal disinhibition and child nutrient intakes was present. However, maternal restraint mediated child energy consumption. Overall, children with restrained mothers consumed significantly higher energy (269 kcal ± 18.49) than those who had unrestrained mothers (210 kcal ± 18.49) (F=4.38, df=1, p=0.02). There was a trend for a higher fat consumption in children of restrained mothers compared to those with unrestrained mothers (11g versus 8g) (F=2.82, df=1, p=0.09). There were no interactions in these relationships.

Also, overweight children consumed more energy than normal weight children (this will be discussed in the next section). Two way ANOVA showed that overweight children with restrained mothers consumed significantly higher quantities of food (F=3.77, df =3, p=0.01) and energy (F=5.47, df =3, p=0.001) at the school lunch, when compared to the normal weight children despite the absence of mothers at lunch times (Figure 4.3.2). This relationship between overweight and high maternal restraint with respect to energy intakes was significant in the girls (F=3.44,df=3,p=0.02) but missed significance in the boys (F=2.65,df=3,p=0.06) but trended in the same direction as that of the girls.

Considering the fact that BMIZ, maternal restraint and energy had independent positive relationships with child nutrient intakes, ANCOVA was done to control each of these factors and to assess the effect on the interactions between taster status with restraint (controlling for child weight), taster status with child weight (controlling for restraint) and taster status with restraint (controlling for energy intakes). It was found that no significant interactions existed between these factors overall and gender-wise.

4.4 Weight Status, Taster Status and Food Data

4.4 a. Taster Status and Foods at Home

Non taster over weight mothers reported a higher number of total types of drinks available in the house in the past week when compared to the overweight taster mothers (p=0.009). These drinks included diet and regular sodas, artificially flavored diet and regular drinks, milk based drinks (milk, shakes, smoothies) and fruit drinks. No differences were found based on taster groups or weight in the consumption based on drink groupings. No other foods at home records were related to taster status of children or mothers.

4.4 b. **Weight Status, Child Nutrient Intakes**

There were no differences in consumption of nutrients based on taster status (Table 4.4.1) or gender (Table 4.4.2) or gender by taster interaction in children. Though no main effects or interactions were significant, a trend for non taster overweight children with restrained mothers to have the highest total fat intakes (11.09g) when compared to the others was seen (6.7-10.6g, p=0.34). These data are not shown.

Nutrient intakes were significantly higher in overweight children than in the normal weight children (Table 4.4.2). As BMIZ scores were significantly correlated with nutrient intakes, higher energy consumption was expected. When BMIZ scores were controlled using ANCOVA, no differences were seen in any nutrients consumed based on child taster status and gender, indicating a strong relationship consistent with body size and nutrient consumption.

No significant differences could be detected by ‘percent nutrient’ or energy density (kcal/gram of food) consumption. Relationships of energy intake with other factors are shown in the correlation (Table 4.4.3). Two way ANOVA between maternal and child weight for energy ($F=8.78, df=3, p<0.0001$), total proteins ($F=7.47, df=3, p=0.0002$) and total fats ($F=7.95, df=3, p=0.0001$) showed that there was a significant interaction (energy $p=0.002$, total proteins $p=0.01$, total fat $p=0.001$) (Figure 4.4.1). Post hoc tests showed that overweight children with overweight mothers consumed significantly more energy (125 kcal more), protein (6g) and fat (7g) than overweight children with normal weight mothers. However, there were no differences in the above mentioned nutrient consumption in normal weight children with either normal or overweight mothers. The higher energy, protein and fat consumption by overweight children existed in both genders (Table 4.4.2), however the interaction effect ($p=0.01$) of maternal weight and child weight on energy consumption was significant mainly in the boys ($F=7.59, df=3, p=0.0006$) and not in the girls ($F=1.80, df=3, p=0.16$). The interaction between maternal weight and child weight seemed to influence intakes of energy, proteins and fats in boys but, not in the girls. These data are not shown.

Also, the correlation between maternal weight and nutrient intakes was positively significant for boys but in girls, it was in the negative direction and not significant (Table 4.4.3). That is possibly the reason why, energy intake did not enter the Stepwise Regression model predicting body weights in girls.

The menus were planned and executed using the USDA Child and Adult Care Food Program meal pattern (Appendix 1). One third of the nutrients needed for the day should be met at school per requirements; out of which two thirds could be approximately derived from the lunch provided (330 kcal, 28g carbohydrates, 4.8g fiber, 4 g proteins, 9-13g fat). These two third values were not mandated but considered appropriate for calculation purposes in this study as full day nutrient consumption information collection was not feasible and could not be collected. It was seen that at lunch, in normal weight children, 50% of calories and 80% of carbohydrates were met while among overweight children, 79% of energy and100% of carbohydrates were met. Protein consumption was over 100% in both normal and overweight children when compared to the USDA standards. Ratio of fat and saturated fat energy recommended per day could be extended to the lunch consumed at school. Amount of fat was within the allowed limits (<35% of energy). In overweight children saturated fat at lunch exceeded recommendations, especially in boys (<10% of total energy). Total sugars were not part of the total carbohydrates count and contributed separately to the energy intakes. Sugar intake was derived mainly from canned fruit in light syrup and was not different between groups and was lower than the recommended range.

Total fiber intake was low (2g). However, it was slightly higher in boys than girls and among the overweight than normal weight children but no statistical differences based on taster groups, gender or weight status was apparent. The fiber intake was lower probably due to lack of fruit and vegetables offered in the meal.

Table 4. 4.1 MEAN NUTRIENT INTAKES BASED ON TASTER STATUS

Means ± SE	NON TASTERS	TASTERS	PVALUE
ENERGY (KCAL)	215.2±16	248.8±15	0.27
ENERGY DENSITY (KCAL/G)	1.08± 0.04	1.06 ± 0.09	0.84
TOTAL PROTEINS (GRAMS)	10.2±1.2	12.8± 0.8	0.12
TOTAL CARBOHYDRATES (GRAMS)	24.7±2.1	28.0±1.6	0.28
TOTAL FAT (GRAMS)	8.46± 1.5	9.69± 0.9	0.50
TOTAL SATURATED FAT (GRAMS)	2.8±0.4	3..9±0.4	0.21
TOTAL SUGAR (GRAMS)	13.2±0.9	12.5± 0.7	0.11
TOTAL FIBER (GRAMS)	1.37±0.1	1.67±0.1	0.33
PERCENT ENERGY FROM PROTEINS	18.6±1.1	20.0±0.6	0.09
PERCENT ENERGY FROM CARBOHYDRATES	52.2±1.9	48.5 ±3.7	0.37
PERCENT ENERGY FROM FAT	29.9±2.0	32.0±1.2	0.23
PERCENT ENERGY FROM SATURATED FAT	11.1±1.2	13.4±0.7	0.12

4-8 yr old Daily Recommended Intakes:

1500kcal, 130g carbohydrates, 22g fiber, 16g proteins/day

Fat (25-35% energy): 41-51g/day

Saturated Fat (10-14% of energy): 21-23g/day

Added Sugars: <25% of total energy: <90g/day

Table 4. 4.2 MEAN NUTRIENT INTAKES BASED ON GENDER AND CHILD WEIGHT STATUS

	BOYS			GIRLS			OVERALL –BY GENDER		
Means ± SE	**NORMAL WEIGHT**	**OVER WEIGHT**	**P VALUE**	**NORMAL WEIGHT**	**OVER WEIGHT**	**P VALUE**	**BOYS**	**GIRLS**	**P VALUE**
ENERGY (KCAL)	187±16.6	274±28.3	**0.01**	202±18.01	278±29.4	**0.02**	244±20.4	234±17.3	0.71
ENERGY DENSITY (KCAL/G)	0.9± 0.0	1.1 ± 1.1	0.06	1.0 ±0.1	1.3 ± 0.1	**0.03**	1.0±0.1	1.1±0.1	0.30
TOTAL PROTEINS (GRAMS)	8.6±1.0	13.6±1.5	**0.01**	10.4±0.8	14.71±1.7	**0.03**	12.0±1.1	12.3±0.9	0.83
TOTAL CARBOHYDRATES (GRAMS)	25.7±2.6	30.3±2.8	0.31	22.7±1.9	28.94±2.2	**0.05**	28.7±2.1	25.4±1.6	0.20
TOTAL FAT (GRAMS)	5.6±0.8	11.2±1.7	**0.005**	7.7±1.0	11.55±1.9	0.09	9.3±0.5	9.4±1.0	0.96
TOTAL SATURATED FAT (GRAMS)	2.0±0.2	4.3±0.7	**0.004**	2.7±0.3	5.03±01.2	0.09	3.5±0.5	3.7±0.6	0.83
TOTAL SUGAR (GRAMS)	13.2±1.8	12.5±1.0	0.73	9.6±0.7	11.75±1.2	0.16	12.7±0.9	10.5±0.7	0.07
PERCENT ENERGY FROM PROTEINS	19.5±1.5	19.9±1.3	0.84	21.0±0.8	21.0±0.9	0.98	19.0±1.0	21.0±0.6	0.31
PERCENT ENERGY FROM CARBOHYDRATES	55.0±4.2	50.8±3.5	0.45	48.1±2.3	45.20±1.8	0.35	51.3±2.7	46.9±1.5	0.09
PERCENT ENERGY FROM FAT	26.2±3.0	34.2±1.9	**0.03**	31.6±1.7	34.16±1.3	0.98	30.2±1.7	32.7±1.2	0.61
PERCENT ENERGY FROM SATURATED FAT	10.3±1.5	13.9±1.2	0.07	12.1±0.9	12.91±1.3	0.25	12.7±1.0	12.9±0.8	0.86

Table 4.4.3 CORRELATIONS BETWEEN CHILD NUTRIENT CONSUMPTION WITH CHILD AND MATERNAL FACTORS

	BMIZ	MBMI	Disinhibition	Restraint	Responsibility	Pressure	Monitor	Restriction	Concern	Reactivity	Activity	Social
KCAL												
OVERALL	**0.48*** **	0.16	-0.03	0.15	0.20	-0.20	0.19	0.01	-0.12	-0.13	0.09	0.14
BOYS	**0.52*** **	0.30	-0.01	0.005	0.09	-0.20	0.14	-0.19	-0.26	-0.27	0.03	-0.07
GIRLS	0.41	-0.09	-0.10	0.34	0.30	-0.20	0.26	0.27	0.17	0.05	0.15	0.39
TPROT												
OVERALL	**0.40*** **	0.18	-0.05	0.18	0.22	-0.20	0.17	-0.003	-0.07	-0.15	0.10	0.16
BOYS	**0.43*** **	0.35	-0.05	0.06	0.10	-0.19	0.14	-0.18	-0.16	-0.26	0.05	-0.05
GIRLS	0.40	-0.07	-0.01	0.34	0.36	-0.24	0.23	0.21	0.09	0.06	0.17	0.40
TFAT												
OVERALL	**0.43*** **	0.10	0.0009	0.12	0.21	-0.15	0.12	-0.009	-0.09	-0.12	0.08	0.10
BOYS	**0.49*** **	0.18	-0.01	-0.04	0.20	-0.12	0.05	-0.19	-0.21	-0.27	0.05	-0.05
GIRLS	0.37	-0.04	0.07	0.35	0.25	-0.19	0.25	0.20	0.13	0.09	0.14	0.31
GRAMS												
OVERALL	**0.33*** **	**0.33*** **	-0.004	0.15	0.02	-0.17	0.28	0.06	-0.19	-0.09	0.11	0.07
BOYS	0.37	**0.41*** **	0.04	0.09	-0.04	-0.23	0.22	-0.07	-0.22	-0.17	0.11	0.07
GIRLS	0.20	0.12	-0.21	0.21	0.05	-0.04	0.39	0.27	-0.07	-0.03	0.08	0.11

*****p≤0.001**

PR=Perceived Responsibility Scale PE=Pressure to Eat Scale RS=Restriction Scale MS=Monitoring Scale CC=Concern about Child Weight Scale

ACT= Child Activity Score SOCIAL= Child Sociability Score FOOD REACT= Child Food Reactivity Score

4.5 Weight Status, Taster Status and Child Food Group Intakes

There were no differences in consumption of food groups based on taster status and gender. The Food groupings (Table 4.5.1) included milk, meat, grain, added fat, added sugar, condiments, fruits and vegetables from the NDSR categories based on USDA guidelines.

The Milk group foods mainly included milk most of the time as children were offered only 2% milk as a drink during lunch. The condiment group included gravy and sauces (regular or fat free) and salad dressings (regular). Salad dressings would have normally been categorized under fat group, but, considering that it was consumed sparingly by children, it was included under condiments for calculation purposes. The Grain group included breads (whole wheat and refined), rolls, buns, pasta, rice, macaroni, taco/tortilla (soft and hard). Legumes, starchy vegetables and potatoes were categorized separately as 'Other starches' as they were consumed in very small amounts and they did not differ substantially between groups. 'Added sugars' group included honey, syrups and sugar, which was consumed in negligible amounts.

Overall, overweight children consumed significantly higher amounts from the milk group ($F=4.93, df=1, p=0.02$). Overweight girls had significantly higher consumption from the grain group ($F=6.48, df=1, p=0.01$) and more milk group consumption ($F=4.14, df=1, p=0.04$). On average, overweight girls consumed 0.44 servings (approximately half a slice of bread) more from grain group per lunch day. No other group differences were observed.

The actual consumption is shown in Table 4.5.1; these were calculated based on standard USDA servings used by NDSR Output. However, Head Start standard lunch rules require that children be served the amounts according to USDA Child and Adult Care Meal Program patterns which were based on the USDA servings (Appendix 1). Child and Adult Care Meal Program patterns do not seem all inclusive and need to be revised.

By comparing, it was seen that on average most food groups did not fulfill the guidelines except for the grain group. Child and Adult Care Meal Program patterns average consumption patterns were compared to guidelines. ¾ cup of milk should be consumed, but children consumed a fourth of a cup less milk; meat group consumption should be about 1 $^{1/2}$ ounces but was short by 2/3- 3/4 serving, but grain group consumption exceeded standards by 1/3rd serving. The Child and Adult Care Meal Program pattern was less stringent about the servings of fruits and vegetables in this age group. While 2 servings of USDA fruit or vegetable or one each was expected at lunch, most centers chose to serve one fruit cup or serve cut slices of fruits like apples, oranges, pears. Half a fruit cup is one serving, so the Center met the USDA Meal Program pattern by serving two servings of fruit, and by-passed the vegetables but still stayed within the guidelines. Even with the fruit servings met, the actual consumption was slightly short of meeting guidelines (Table 4.5.1). The Perth Amboy center served one cup of cooked vegetable for each classroom which was often forgotten, neglected by teachers as historically it wasn’t consumed. Lettuce and tomato were served with entrees like taco, sandwiches or burgers but consumption was optional, so again, it was by-passed and intake was never encouraged or discussed with the children. It was returned back to the kitchen or thrown in the garbage.

It is interesting to note that despite lower consumption of meat and milk groups, which were important sources of proteins for the children, the DRI for proteins based on approximate consumption requirements for lunch was exceeded. This was probably due to the fact that grain group consumption exceeded requirements and was a potential source of proteins for the children. Energy density was on average 1kcal/gram of food which is slightly below the normal levels recommended (normal is 1.36-1.82kcal/g with higher amounts of food intake) [114]. Total energy intake did not meet calculated requirements for both normal weight and over weight children for lunch time only, perhaps due to the complete lack of vegetables and fruit servings and controlled total sugar consumption at school. The energy sources were mainly from the grain group and fat inherent in foods provided at the school (regular full fat cheeses, regular fatty meats, eggs) and not from added discretionary fats (margarine, oils or butter).

Table 4. 5.1

FOOD GROUP SERVINGS CONSUMED BASED ON GENDER AND CHILD WEIGHT STATUS IN COMPARISON TO HEAD START SERVING RULES

	Mean Serving ± SE By gender			Mean Serving ± SE By child weight		
	Boys	**Girls**	**Meets Head Start Lunch Servings [1]**	**Overweight**	**Normal weight**	**Meets Head Start Lunch Servings [2]**
Milk group	0.4 ± 0.0	0.5± 0.0	No	0.6± 0.0	0.4± 0.0	No
Meat group	0.5± 0.0	0.8± 0.1	No	0.7± 0.1	0.6± 0.1	No
Grain group	0.8± 0.0	0.8± 0.0	Yes, exceeded	0.9± 0.0	0.7± 0.1	Yes, exceeded
Added Fat group	0.2± 0.0	0.2± 0.0	-	0.2± 0.0	0.2± 0.0	-
Added Sugar group	0.0± 0.0	0.0± 0.0	-	0.0± 0.0	0.0± 0.0	-
Fruit group	0.4±0.0	0.3± 0.0	No	0.3± 0.0	0.3± 0.0	No
Vegetable group	0.1± 0.0	0.1± 0.0	No	0.1± 0.0	0.1± 0.0	No
Condiment group	0.1± 0.0	0.1± 0.0	-	0.1± 0.0	0.0± 0.0	-

1 Head Start Lunch serving comparison for boys and girls combined (as no statistical difference seen)

2 Head Start Lunch serving comparison for normal and overweight children combined (as same trend seen for both normal and overweight children)

4.6 Child Factors and Weight Status

4.6 a. Perceived Weight Scores (PWM) (PWC)

Correlations showed that BMIZ score was correlated to the 'Perceived Weight of Child' score (r= 0.36, p=0.001) while maternal self reported BMI was strongly correlated to the 'Perceived Weight of Mother' (PWM) score (r= 0.6, p<0.001) indicating accurate judgment of self weight and child weight by mothers when filling out the Child Feeding Questionnaire. It is interesting to note that PWC scores in boys was not strongly correlated to actual BMIZ (r=0.26, p=0.09) while PWC scores in girls was strongly correlated to their actual BMIZ (r=0.63, p<0.0001) indicating that mothers of girls were more acutely aware of their daughters weights than the mothers of boys. This is reflected in the stepwise regression models run independently for boys and girls (next section). In the Infant Growth Study conducted among mostly Caucasian British children, perceived child weight predicted increased child BMI z scores among high-risk families [37].

Also, there was a trend for PWC to be positively correlated with maternal disinhibition in the girls (r=0.31, p=0.07); this relationship was negative and significant in the boys (r=-0.31,p=0.04). However, as disinhibition and BMIZ were not significantly correlated in both boys and girls, the results could not be extended to the actual weight status.

Table 4.6.1 shows the relationship of child BMIZ and maternal BMI with other child factors. Table 4.6.2 shows that both maternal and child weight were strongly negatively correlated with Pressure to Eat scores. Perceived Responsibility score and Restriction Score were strongly positively correlated with the Monitoring Scale. The Restriction Scale was also strongly positively correlated with Concern about Child scores. In this study, Cronbach's Alpha test shows a range of 0.65-0.80 between subscales of each CFQ Factor indicating high test-retest reliability within each subscale. These data are not shown.

Table 4.6.1

CORRELATIONS BETWEEN MATERNAL AND CHILD WEIGHT WITH MATERNAL AND CHILD FACTORS

	Disinhibition DISIN	Restraint REST	Responsibility PR	Pressure PE	Monitor MS	Restriction RS	Concern CC	Activity ACT	Social SOCIAL	Reaction REACT
BMIZ										
Overall	0.04	0.02	0.21	**-0.33*** **	0.03	0.05	0.09	0.14	0.12	-0.22
Girls	0.07	0.16	0.22	-0.30	-0.02	0.19	0.12	0.11	0.21	-0.33
Boys	0.03	-0.12	0.17	-0.34	0.04	-0.04	0.14	0.14	0.08	-0.22
BMI										
Overall Mothers	**0.43*** **	0.20	-0.11	-0.34	0.01	-0.11	-0.12	0.03	-0.13	-0.07
Girls' Mothers	**0.48** **	0.10	-0.30	-0.42	0.02	-0.11	-0.14	-0.0007	-0.17	-0.05
Boys' Mothers	**0.42** **	0.25	-0.005	0.26	0.001	-0.11	-0.06	-0.02	-0.07	-0.14

*****p≤0.001**

PR=Perceived Responsibility Scale PE=Pressure to Eat Scale RS=Restriction Scale MS=Monitoring Scale CC=Concern about Child Weight Scale ACT= Child Activity Score SOCIAL= Child Sociability Score REACT= Child Food Reactivity Score

Table 4.6.2 CORRELATIONS BETWEEN CFQ FACTORS AND TEMPERAMENT FACTORS WITH CHILD AND MATERNAL WEIGHT

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**Social**
1. BMIZ		0.1	0.2	**-0.3*** **	0.0	0.0	0.0	-0.2	0.1	0.1
2. MBMI			-0.1	**-0.3*** **	-0.1	-0.0	-0.1	-0.0	0.0	-0.1
3. Responsibility				-0.0	0.0	**0.4*** **	0.0	0.0	**0.4*** **	0.1
4. Pressure					0.2	-0.0	0.1	0.2	-0.0	-0.0
5. Restriction						**0.4*** **	**0.3*** **	0.0	-0.0	0.1
6. Monitoring							-0.0	-0.0	0.2	-0.0
7. Concern								-0.1	-0.1	0.3
8. Reactivity									0.0	0.0
9. Activity										0.2

*****p<0.001**

Responsibility=Perceived Responsibility Scale Pressure=Pressure to Eat Scale Restriction=Restriction Scale Monitoring=Monitoring Scale Concern=Concern about Child Weight Scale Activity= Child Activity Score Sociability= Child Sociability Score Reactivity= Child Food Reactivity Score

4.6 b. Perceived Responsibility Scale (PR)

As the Responsibility Scale had several questions related to maternal food portioning and responsibility of serving food to the child, it was hypothesized that higher scores might be the link that connected overweight mothers to over weight children. Two way ANOVA ($F=4.37$, $df=3$, $p=0.007$) showed that higher responsibility was reported by mothers of overweight children, both boys and girls, regardless of her own weight (Figure 4.6.1).

Conclusions could not be extended to actual weight status as maternal BMI was not significantly correlated with Perceived Responsibility. Also, no significant differences in nutrient consumption patterns could be distinguished based on Responsibility scores.

Responsibility scale was also significantly correlated to Monitoring Scale (r=0.37, p=0.008). Mothers who gave high Responsibility scores also scored high on Monitoring Scores (ttest=0.05). No differences gender-wise, in energy intake or child weights based on PR and MS were observed.

4.6 c. Sociability Scale (SOCIAL)

Overall, sociability did not vary significantly in normal and overweight children. Disinhibition was significantly negatively correlated to child's sociability overall (r=-0.30, p=0.008) and in girls (r=-0.36, p=0.03) (Table 4.3.2). Further analyzes showed that overall, disinhibited mothers with normal weight children, reported a lower sociability of score (ttest=0.02). Normal weight girls with high sociability scores consumed significantly more energy (F=6.07,df =1, p=0.02),and protein (F=5.34,df =1, p=0.02) and trended towards higher total fat intake (F=3.40,df=1,p=0.07) than normal weight less sociable girls. This trend was similar in overweight girls also. However, the trend was reversed in the boys for energy and fat intake (the data were not significant and not shown here). As child nutrient intakes were negatively yet, not significantly correlated to disinihibition, it is difficult to further interpret these findings.

4.6 d. Restriction Scale (RS)

No difference in energy consumption was seen on the basis of restriction score as a main effect. Two way ANOVA (F=5.11, df =3, p=0.02) revealed the presence of a significant interaction (p=0.02) between RS and child weight (Figure 4.6.2) for energy intakes. Overweight children who had less restriction consumed significantly higher energy than overweight children who had more restriction. The reverse trend was noted with the normal weight children, but the results were not significant.

Also, as seen before, overweight children with restrained mothers consumed more calories than overweight children with unrestrained mothers (Figure 4.3.2). However, from comparing figures (4.3.2) and (4.6.2), it was clear that overweight children with high maternal restraint and low restriction had the highest energy consumption (Figure 4.6.2). ANOVA confirmed this relationship overall and in the boys. However, in the girls, a significant interaction was seen (p=0.03) wherein among overweight girls, the same relationship of higher weight with lower restriction was associated with higher energy intakes existed. Yet, in the normal weight girls, a reverse relationship of higher restriction and higher energy intake was noted (F=3.88,df=3,p=0.01).

As BMIZ in both genders was also significantly correlated with energy intakes, it was controlled and the relationship between restraint and restriction was studied. The same trends seen earlier continued to be present in the boys. Boys with high maternal restraint and low restriction consumed the most energy (F=4.2,df=4, p=0.006). But, the opposite effect (trend only) was seen in the girls with a high maternal restraint and high restriction to have the highest energy consumption (F=2.47,df=3,p=0.06) . This was similar to what was seen in the normal weight girls' consumption patterns (discussed in the previous paragraph). No interaction effects were significant.

Thus, low restriction and high restraint seemed to be consistently associated with higher energy intakes in the overweight children of both genders while in the normal weight children, the relationship of high energy consumption seemed to be related to high restraint and high restriction in the girls and not in the boys.

4.6 e. Pressure to Eat Score (PE)

PE scores were not related to maternal restraint or disinhibition scores. 'Pressure to Eat' score was negatively correlated to both maternal and child weight which meant that mothers with higher BMI put less pressure to eat on their children (Table 4.6.1). Also, children who were overweight felt less pressure to eat. ANOVA showed that children with lower Pressure to Eat had significantly higher BMIZ than those who did not have lower pressure to eat (F=7.18,df=1, p=0.009). PE scores were significantly negatively correlated to BMIZ in boys (r= -0.34, p=0.02) and not in girls. PE missed entering the stepwise regression model that predicted BMIZ of the boys. Yet, this association of PE and BMIZ in the boys, a negative parameter, was strong enough to enter the Regression Models as will be seen a little later. However, overall, overweight children with a low PE consumed the highest energy (F=4.39, df=3, p=0.006).

4.6 f. Food Reactivity Score (REACT)

Food reactivity scores were not related to maternal BMI, restraint or disinhibition scores. Taster mothers gave significantly higher reactivity scores to their children than non taster mothers (ttest=0.04). Though not significant, non-taster mothers reported that their child is overly reactive to food if the child is a taster and vice versa showing that children and mothers could be living in two different sensory worlds.

Food reactivity was overall negatively correlated to child BMIZ (r=-0.22, p=0.05). However, correlations in the girls showed a stronger relationship to BMIZ (r= -0.33, p=0.04) than in the boys. This was reflected in the results which showed that overweight children had significantly lower food reactivity scores than normal weight children, especially girls (ttest=0.04). ANOVA showed that BMIZ of girls who were less reactive to food was 1.37 versus the BMIZ of the girls who were more reactive to food (0.70) (F=5.52, df=1,p=0.02). The Food Reactivity factor was strong enough to enter the Stepwise and Hierarchical Regression Models predicting BMIZ specifically in the girls.

There was a trend for overweight children in both genders with low reactivity to consume higher energy and proteins. In normal weight children, the trend was the opposite but inconsequential.

Also, the ‘Pressure to Eat’ scores were significantly lower in children with low food reactivity indicating that children who reacted less to food were less pressured to eat (ttest=0.007). It can be concluded that children with lower pressure and lower food reactivity had a higher BMIZ and consumed higher energy and proteins.

4.6 Interaction of Child Taster Status and Maternal Cognitive Factors that Predicted Child BMIZ

4.7 a. Child Taster Status and Maternal Restraint

Though not apparent in correlations and significant in the ANOVA model (F=2.01, df=3, p=0.11), the relationships between maternal restraint and child taster status predicting child weight was worth noting. It was seen (Figure 4.7.1) that a trend of Non Taster children with restrained mothers to have a highest BMIZ (2.02, n=8) existed when compared to the others i.e. Non taster children with unrestrained mother (0.97, n=12), taster children with restrained mothers (1.31, n=31) and taster children with unrestrained mothers (1.19, n=27) was seen. There was no interaction. Among the two relationships considered, the relationship between restraint and weight status in children was comparatively stronger than the relationship between restraint and child taster status. This relationship, however, could not be further extended to nutrient intakes. Instead, maternal restraint worked with child weight to define nutrient consumption as was seen earlier (Figure 4.3.2). Further analyses showed that there were 7 NT boys with restrained mothers and only 1NT girl with restrained mother. Hence, the observed effect of NT boys with restrained mothers as having a high BMIZ was predominantly due to the effect seen in boys. However, this effect was strong enough to enter the Hierarchical model predicting boys' BMIZ and overall BMIZ (discussed in the next section). Overall, as energy intakes were consistent with the body weights, ANCOVA was used to understand the relationships. It was seen that the interaction term between taster status and maternal restraint was not significant, yet, the same pattern seen in the ANOVA persisted. The BMIZ of the non-taster boys with restrained mothers was the highest compared to the other three groups, but missed significance.

Thus, taster status had a modest, yet important mediating effect in predicting body weight, especially in the boys. Despite the lack of other relationships coming to the fore based on this finding, the interaction between child taster status and maternal restraint was significantly negative in the Hierarchical Regression Model but, missed significance in the Stepwise Regression Model indicating a subtle impact on the boys' weight status. Thus, taster status in children seemed to have a relationship albeit modest, with BMIZ of children and maternal restraint scores in the current study.

4.8 Stepwise Regression to Predict Child Weight Status

Two types of regression models were used to predict child weight status based on the maternal and child factors that affect current child BMIZ scores. Stepwise regression was used to predict BMIZ as most factors showed some degree of correlation with each other (Table 4.8.1). Factors eligible to enter the model met the criterion of $p \leq 0.25$ while the factors that stayed within the model was restricted to those that met the $p \leq 0.05$ criterion. It was attempted to predict BMIZ of both boys and girls separately and together in different models as described below.

4.8 a. Stepwise Regression (Table 4.8.1): Boys

Energy intake was positively related to BMIZ of boys. Overweight boys consumed more energy, protein and fat as seen before in the study, hence entered the model. The combined effect of taster status with maternal restraint showed a negative relationship to weight status of boys. The fact that higher number of NT children with high maternal restraint in the study were boys (7 out of 8), was perhaps the driving force for seeing the entry of this interaction term in the model that predicted boys' weight. The Pressure to Eat factor (CFQ) was negative in the model indicating that overweight children with higher BMI had lower Pressure to Eat. However, it did not meet the statistical significance criterion ($p \leq 0.05$) and hence, was removed from the model.

Table 4.8.1 STEPWISE REGRESSION MODEL TO PREDICT BOYS BMIZ

Adjusted R^2 =0.36, $p<0.0008$

Variable	Parameter Estimate	p value
Intercept	0.97	0.02
CHILD TASTER STATUS * MATERNAL RESTRAINT (continuous)	-0.24	**0.03**
ENERGY CONSUMPTION	0.004	**0.0008**
REMOVED PRESSURE TO EAT	-0.27	0.10

Gender coded as 0=boy, 1=girl
Pressure to Eat=score from CFQ
Energy Consumption = from lunch intake data
Taster Status coded as 0 = non taster, 1= taster
Maternal Restraint =score from DEBQ

4.8 b. Stepwise Regression (Table 4.8.2): Girls

Energy intake also had a positive relation to BMIZ of girls. Overweight girls consumed more energy, protein and fat as seen before in the study, hence entered the girls' BMIZ predictor model as well. Perceived Weight of Child score which assessed the mothers' perception of the child's weight status, entered the stepwise model due to a strong correlation noted in the accuracy in assessment of daughters' weights by mothers in predicting girls' weight. Food Reactivity, a CCTI factor showed a significant negative association in this model, which indicated that mothers who assessed their daughters being less food reactive tended to have a higher BMIZ. Energy intakes missed statistical significance as it was slightly above $p \le 0.05$ (the significance set to stay in the model).

Table 4.8.2 STEPWISE REGRESSION MODEL TO PREDICT GIRLS BMIZ Model R^2 =0.53, p<0.0001		
Variable	**Parameter Estimate**	**p value**
Intercept	-4.42	0.001
PERCEIVED WEIGHT OF CHILD	239	**<0.0001**
FOOD REACTIVITY	-0.42	**0.01**
REMOVED **ENERGY CONSUMPTION**	-0.002	0.057
Perceived Weight of Child= score from CFQ **Energy Consumption = from lunch intake data** **Food Reactivity = score from CCTI**		

4.8 c. Stepwise Regression (Table 4.8.3): Both Genders

Factors that had a positive relation to BMIZ of the child were: Male gender, higher energy consumption and Perceived Weight of Child Score. Pressure to Eat Score was negatively associated with BMIZ and improved the predictability of BMIZ of the child. Though maternal BMI was closely positively associated with child BMIZ, it was not highly correlated with most other child factors and hence, did not aid in the model's prediction value. However, the interaction of child taster status and maternal restraint was negative and missed staying in the model (p=0.08) as this term was significant in predicting BMIZ only in the boys and not in the girls.

Table 4.8.3 STEPWISE REGRESSION MODEL TO PREDICT CHILD BMIZ Adjusted R^2 =0.44, p<0.0001		
Variable	**Parameter Estimate**	**p value**
Intercept	-0.99	0.36
GENDER	-0.52	**0.01**
PERCEIVED WEIGHT OF CHILD	0.93	**0.008**
PRESSURE TO EAT	-0.27	**0.007**
ENERGY CONSUMPTION	0.003	**0.0008**
REMOVED CHILD TASTER STATUS * MATERNAL RESTRAINT	-0.12	0.08
Gender coded as 0=boy, 1=girl **Perceived Weight of child =score from CFQ** **Pressure to Eat=score from CFQ** **Energy Consumption = from lunch intake data** **Taster Status coded as 0 = non taster, 1= taster** **Maternal Restraint =score from DEBQ**		

4.8 b. Hierarchical Regression (Table 4.8.2)

Hierarchical Regression typically involves entering groups of related variables that are the main effects first, followed by the interactions. Through various steps, factors or groups of factors were included or removed based on their contribution to improvement in model. The variables known not to be related to child weight were not entered in the model. The restraint factor is entered as a dichotomous variable (median split) in this model.

Step 1 Gender, Taster status of child and Perceived Weight of Child (PWC) were added. Taster status didn't meet cutoff of <0.05 initially yet it was left in the model as it was of interest (variance was 18%).

Step 2 included the addition of energy intake which increased the variance by 15.74%.

In Step 3, Child Feeding subscales 'Perceived Responsibility' (PR) and 'Pressure to Eat' and Temperament subscale of 'Food Reactivity' (REACT) were added, which increased the variance by 3.38% PR and REACT did not meet the cutoff of <0.05.

Step 4 included the addition of maternal restraint and disinhibition; this did not change the variance at all and did not meet the cutoff of <0.05.

In Step 5 interaction between taster and maternal restraint was introduced. An increase in variance of 5.84% was noted which improved the final model where adjusted r^2 was 0.4173, which meant that this model accounted for 41.73% final variance in predicting child's BMIZ score.

Hence, in children, the taster status and restraint interaction had a negative parameter estimate due to the fact that non tasters (negative term) with high maternal restraint (positive term) had a significantly higher BMIZ.

Table 4.8.4 HIERARCHICAL REGRESSION MODELTO PREDICT CHILD BMIZ

R^2 =0.4994 **Adj R^2=0.4273**

Steps and Variable Entered	Parameter Estimate	p value
Step 1: 18%		0.0009
Gender	- 0.35	0.09
Child Taster Status	0.42	0.19
Perceived Wt of Child	1.16	**0.001**
Step 2: 15.74%		<0.0001
Energy Intake at Lunch	0.002	**0.003**
Step 3: 3.38%		<0.0001
Perceived Responsibility	0.12	0.43
Pressure to Eat	-0.2	0.07
Food Reactivity	-0.23	0.11
Step 4: NSD		
Maternal Restraint	1.08	**0.01**
Maternal Disinhibition	0.08	0.34
Step 5: 5.84%		<0.0001
Child Taster Status * Maternal Restraint (categorical)	-1.31	**0.009**
	Total 41.73%	

Gender coded as 0=boy, 1=girl
Perceived Weight of child ,Pressure to Eat =score from CFQ
Food Reactivity =score from CCTI
Energy Consumption = from lunch intake data
Taster Status coded as 0 = non taster, 1= taster
Maternal Restraint, Disinhibition =scores from DEBQ

4.9 Results Summary

The present study was conducted among preschool aged (4-5 years) children attending the government Head Start Program in Perth Amboy, NJ. The objective was to investigate the relationship of children's taste sensitivity, child and maternal variables on nutrient intakes and body weight.

Overall, as hypothesized, a trend was observed for non taster boys to be heavier than taster boys and non taster girls to be heavier than taster girls. It is interesting to note that though not statistically significant, this trend was present in the same direction as reported by Keller and coworkers (81) yet at a higher level of BMI owing to higher prevalence of overweight among children in the current study. Though taster girls were heavier than non taster girls, it must be noted that the mean weight of non taster and taster girls fell within the normal ranges unlike the trend seen in the boys, wherein, non taster boys were in the overweight range and taster boys were not. This difference in weight ranges at the start of the study could perhaps have muted the larger differences that could have been noted otherwise.

As expected, overweight children consumed significantly higher amounts of food, energy, protein and fat when compared to the normal weight children of both genders. When child weight was controlled, no differences in these nutrients were seen indicating nutrient consumption was consistent with body size. However, there was interaction between maternal weight and child weight for energy, protein and fat intakes wherein over weight boys with overweight mothers consumed significantly higher energy, protein and fat when compared to the other groups of boys. This interaction was not seen in the girls possibly due to the negligible correlation of maternal weight with daughters' weights. However, this weight interaction indicated a possible link to overeating in overweight boys that was both habitual and hereditary.

Results showed that children's nutrient intakes had modest or no relationship with their taster status, gender and maternal disinhibition but was influenced by maternal restraint. This trend though present in both genders, did not reach significance when analyzed separately for energy and food amounts consumed in the boys and in the girls' with restrained mothers. However, the restraint effect only continued to exacerbate the issue of higher nutrient intakes that was noted with higher child weights.

Summing up, from the maternal point of view, it was found that maternal BMI was positively correlated with maternal disinhibition regardless of child gender. However, maternal weight was positively associated with maternal restraint only in the mothers of boys.

Likewise, from the child point of view, it was found that BMIZ of both boys and girls were not correlated to maternal disinhibition. In terms of restraint, only the boys' weight was positively related to maternal restraint. Thus, the difference in short term nutrient intakes and long term weight in the context of a high maternal restraint was in the same direction for the boys but, in the girls, only nutrient intakes was in the same direction as a high maternal restraint but not the weight. Maternal restraint seemed to reliably predict short-term food intake and weight status in boys. However, in girls, maternal restraint predicted short-term food intake but not the weight. There may be more complex interactions occurring in girls or factors that couldn't be measured that contributed to the weight status in the girls.

ANOVA revealed the presence of a significant interaction between the Restriction scale and child weight for energy intakes. Overweight children who had less restriction consumed significantly higher energy than overweight children who had more restriction. The reverse trend was noted with the normal weight children, but the results were not significant. This relationship was confirmed overall and in the boys. In the girls, at first, a reverse trend of girls with high maternal restraint and high restriction to have the highest energy consumption was noted. But, as BMIZ in both genders was also significantly correlated with energy intakes, it was controlled and the relationship between restraint and restriction was studied. The same trends seen earlier continued to be present in the boys. Boys with high maternal restraint and low restriction consumed the highest energy. But, the opposite trend of girls with high maternal restraint and high restriction had the highest energy consumption as was seen in normal weight girls consumption patterns was seen. Thus, higher restraint and a low restriction seemed to be consistently associated with higher energy intakes in the overweight children of both genders while in the normal weight children, the relationship of high energy seemed to be just moderately related to high restraint and high restriction in the girls and not in the boys. However, the restriction factor was not strong enough to enter the Hierarchical Models that predicted either the boys or girls weights.

Among the child feeding factors, ‘perceived responsibility’ scores were significantly higher in overweight children of both genders regardless of the maternal weight status.

Taster status did not have a main effect in predicting child weight. Yet, non taster boys, with restrained mothers, had the highest BMIZ as compared to the other groups.

although the interaction between PROP status and restraint was not significant in the ANOVA model, the interactive term enhanced the prediction of the Hierarchical Model by 5.84 %.

Stepwise Regression model (R^2 =44%) to predict child weight revealed that male gender along with CFQ factors of Perceived weight of child and energy consumption were positive predictors. Negative parameters, Pressure to Eat (low pressure to eat predicted high child weight) and the interaction of taster status and maternal restraint (non tasters with high maternal restraint) predicted higher child weight.

The same factors were also seen in the Hierarchical Model with 41.73% variance predicting child weight. Apart from the factors that were present in the Stepwise model, others that also contributed positively were Perceived Responsibility. Maternal restraint and disinhibition were also positive estimates but didn't improve the predictive value of the model. The interaction of taster status with restraint, a negative estimate, contributed 5.84% increase to the Hierarchical model. Stepwise Regression model results of individual genders showed that in boys, the combined effect of non-taster status with restrained mothers negatively predicted BMIZ, while energy intake was a positive predictor. The Pressure to Eat score though significant in the overall model, missed significance in this model predicting boys' weight. However, the overall stepwise model only modestly predicted BMIZ in boys (r^2=0.36).

In the girls, the Perceived Weight of Child was a positive predictor while food reactivity was a negative predictor that contributed significantly to the model. Energy intake just missed significance (0.08) in predicting the BMIZ of girls.

CHAPTER 5: DISCUSSION

The aims of this study were two fold: Firstly, to understand the relationship of PROP taster status and its relationship to food consumption patterns and body weight in children. Secondly, to explore the extent of influence of maternal taster status, feeding styles, her cognitive factors and weight on the child's food intakes and body weights.

5.1 PROP status in the Children and their Mothers

5.1 a Children

Overall, 75% of the children were tasters and 25% were non-tasters. This ratio reflects a slightly lower trend than that reported from other studies done among Caucasian children in studies within the lab [75,81,88,40]. Bell et al found among Caucasian preschool children (4-5 year olds) that 37% were non-tasters while 63% were tasters [75]. In the same preschool population, Keller et al found an average of 66% tasters and 34% non tasters [81]. In school age children (7-11 years), Goldstein et al found 69% tasters and 31% non tasters [115]. Similar lower prevalence of non tasters has been noted in the predominantly non Hispanic children but, in another preschool population of Head Start (MI) [60] it was found that 78% were tasters and 22% were non tasters.

5.1 b Mothers

Among the mothers, 83% were tasters and 17% were non tasters. The difference in prevalence of taster to non taster ratio is lower than that reported by Tepper and Ullrich among Caucasian middle aged women (73% tasters) [98] and that of a mixed cohort in Carlantino, Italy (62% tasters) [97]. It is however, close to values previously reported by

Goldstein et al in a Caucasian population (80% tasters) [115]. Drewnowski et al reportedly classified 18% middle aged breast cancer patients as non tasters while 82% were tasters using the PROP threshold detection method for classification [89]. In the current study, 66% of the taster mothers were medium tasters. Only 16% taster mothers made up the super taster category. The number of super taster mothers in this study is lower than some previously reported values in female adults; 35% was reported by some lab studies which mostly consisted of Caucasian populations [115,112].. The current population was mostly from the Dominican Republic and Puerto Rico. The prevalence of non tasters in the Hispanic populations has been reported to be less than 20% [79]: 10% in Puerto Ricans, 10% in Mexicans, 4-7% in Peruvians, 9% in Jamaicans and 17% in Chileans [79]. Hence, the current data agree with the lower prevalence of non tasters in the Hispanic populations that has been reported.

5.2 Prevalence of Overweight and Body Weight Status

5.2 a Mothers

Mean BMI of the mothers was in the overweight range (27 ± 0.6 kg/m^2). Fifty four percent of the mothers had above normal weights (BMI >25), 29% of the mothers were overweight (BMI = 25-29.9) and 25% were obese (BMI≥30). Such a high prevalence of obesity in this Hispanic population is worrisome, yet it is similar to another study done in 2003 among low- income Hispanic, mostly Dominican Republic immigrants of NYC, where 58% had above normal weights, 40% were overweight and 18% were obese [72]. However, the mean age of the mothers of preschool aged children in the NYC population was slightly higher (33 years) as compared to the current study's maternal age (27 years) which could be the reason seen in the weight shifts.

5.2 b Children

The increased in prevalence of overweight noted in the children in this study mirrored similar trends of increased overweight in the adults [28,10]. The relationship between maternal BMI and child's BMIZ modestly trended in the same direction but missed statistical significance (r=0.19, p=0.09) possibly because mothers' BMI was self reported and was not actually measured during the study. However, there was a trend for overweight mothers to have overweight children.

In the current study, 55% of all children and, 44% of the girls and 66% of the boys were above the 85th percentile of weight-for-age. In 2004, Worobey et al [126] noted that the BMI of 48% of children exceeded the 85th percentile) and 25% of children exceed the 95th percentile) among primarily Hispanic and Black preschoolers attending Head Start in NJ. In the current study, boys had a significantly higher BMIZ (1.55) than the girls (1.08) (p=0.04). A higher number of overweight children were boys (62%) while more numbers of girls were normal weight (60%) (χ^2=0.04).

5.3 PROP status and Body Weight

The first objective of the study was to establish the role of taster status of children in body weight patterns among preschool children.

The hypothesis that non taster boys will be heavier than taster boys and non taster girls will be less heavy than taster girls stemmed from the empirical findings by Keller et al [81]. Who reported this effect among preschool aged children who were predominantly Caucasian with a low prevalence of overweight (>85th percentile weight for height), The prevalence of obesity was higher (30%) in current study population as compared to other population of children studied in our lab[75,81,88]. It is interesting to note that although not statistically significant, this trend was also present in the same direction yet at a higher level of BMI.

No differences in maternal BMI based on maternal taster status alone existed in this study which was similar to other results reported in women [113, 89] in mixed populations [77,117] and children [40] perhaps due to the subtle, indirect effects of taster status on body weights as noted in these studies. As other maternal intakes and related parameters were not measured in this study, meaningful associations could not be established. Also, maternal and child PROP status were not significantly correlated, However, fathers' taster status was not measured and the paternal contribution to the children's PROP status was unknown.

5.4 PROP taster status and Lunch Intakes

The second objective of the study was to establish the role of taster status of the children in their food consumption patterns.

Earlier studies have reported that tasters in general showed lower acceptance of bitter foods (raw broccoli /American cheese) and girls gave lower hedonic ratings to full fat milk [88]. Other studies from the our lab have shown that non taster children consumed a higher percentage of protein (cheese and meats) than tasters [81], had a higher tendency for snack consumption [113] and had higher energy consumption (293kcal/day) as compared to super taster children [40]. In the present study, no significant relationships between child and maternal PROP status with child nutrient and food group intake were observed. However, mean energy intakes from the lunch were low making differentiation difficult. It was also possible that no actual differences existed in nutrient intakes based on PROP status in this population. Lumeng et al too reported no significant differences in nutrient intakes based on PROP status in Head Start children of MI [60].

Vegetable consumption was also of interest in the current study, as studies have shown bitter vegetable consumption was significantly lower in tasters when compared to non tasters [75, 77]. However, there were practical constraints on being able to show this in the current study because of the way the meals were served to the children. It was interesting to note that the USDA Child and Adult Care Food Program meal pattern for lunch (Appendix) does not mandate vegetable consumption. The pattern allows for '2 fruits/vegetables juice or 2 fruit and/or vegetable' serving combinations at the lunch served at Head Start. Due to this option, the Head Start center served 2 servings of fruit in the form of one fruit cup and served vegetables in bowls for children, to taste. With only display of these vegetables and almost no encouragement through discussion or teaching during meal times, the vegetables were easily by-passed or neglected by teachers and students. Hence, vegetable and fruit consumption was low and statistical differences were not discernable. However, this data does not capture vegetable and fruit intakes at home. This pattern though discouraging, has been documented and linked to acculturation, lack of exposure, and poverty in some ethnic Hispanic populations that have immigrated to the US [22, 33].

Despite the lack of data needed to associate vegetable and fruit intakes with PROP status in the current study, the lunch intake data was still useful as it represented approximately two-thirds of the children's daily recommended nutrient intakes. This information helped us to understand the eating patterns in the Hispanic preschool population and explore other dominant relationships around the eating habits of children as discussed below. The unique approach of actually measuring what the children ate as compared to self-reports has been a powerful tool in this study that helped make other useful associations.

The third objective of the study was to determine the roles and interactions between PROP taster status, maternal cognitive and family environment factors in weight status of preschool children.

Previous studies suggest that maternal cognitive factors along with maternal weight have the potential to influence disregulation of energy intake in children [26]. Mothers exert influence over the food consumption, eating habits and portion sizes of young children [28, 7]. Maternal control in the form of attempts to restrict their daughters' intake are related to cognitive factors like restraint and disinhibition that direct self eating behaviors, food choices, amounts, child's feeding styles and weight concern for her child [28]. Hence, it is important to understand the role of maternal cognitive factors in maternal weight and then, with child weight and associated child factors.

5.5 Cognitive Factors and Weight Status

5.5 a Cognitive Factors and Maternal Weight

Eating in response to emotional or external signals like sight and smell of food leads to higher disinhibited eating. Consistent with several other studies [28, 115, 98], this study showed that maternal disinhibition was an independent positive predictor of maternal overweight. In the current study, mothers reporting emotional eating had higher BMI than mothers who did not report emotional eating. The current study suggests that emotional triggers for disinhibition are strongly related to the development of obesity and are perhaps of greater importance than external cues.

Dieting or dietary restraint is defined as the intentional efforts to achieve or maintain desired weight through reduced caloric intake [53]. However, studies have shown that individuals with elevated scores on dieting scales are at increased risk for future onset of obesity and weight gain. This was explained by the restraint theory that associated higher obesity risk in restrained eaters due to probable over-reliance on cognitive control of over eating rather than physiological cues that may leave dieters vulnerable to overeating when these cognitive controls are disrupted by emotions or by the intake of forbidden food. Studies show that only restrained eaters with high disinhibition scores showed overeating after an experimentally induced preload [122]. Similarly, when the variable attributed to overeating was removed, restrained eating no longer predicted food consumption [123]. Another theory suggests that disinhibition may be dependent on a ‘rigid-type’ of restraint which is the “all or nothing” approach to eating and food, avoidance of liked foods that give pleasure as opposed to the more flexible control of eating exhibited by long-term, successful restrained eaters [54].

In support of the postulations above, there have been mixed reports of both high [46, 47, 71, 72] and low [45, 52] weight with highly restrained eaters depending on success or failure of restraint practiced. It could be possible that failure could also result from intent to restrain and higher body weight. In contrast, success could reflect actual changes in eating behaviors and lower body weight. Previous studies done in the lab have been ambiguous about the main effects of restraint on maternal weight due to variability in ‘intent versus behavior’, ‘flexible versus inflexible’ restraint and difference in mean maternal weight of study populations [115, 98]. In previous studies from our lab, dietary restraint was positively associated with weight status in the mothers but the subjects were not all in the overweight range [113,115]. In the current study, the presence of high disinhibition (emotional states or stimulating food) along with high restraint in the mothers could be counteracting their dieting behavior, leaving them vulnerable to higher intakes and subsequently to higher body weights. Or it is also possible that the inflexible, rigid type of restraint with little room to improvise and maintain a healthy diet caused abandonment of dieting leading to higher BMI as a consequence. As the data collected is cross-sectional, it is difficult to generalize or speculate the exact role of high restraint in shaping maternal eating habits and weight. As other maternal psychological factors were not assessed, it could be possible that these mothers had other emotional issues related to lower esteem, low socioeconomic status or binging as has been suggested by the authors of the DEBQ [43] and others [42]. Also, maternal weight was not the focus of the study, so, it was not possible to draw conclusions regarding this issue. The authors of the DEBQ further suggest a psychological exam before strategies to tackle weight issues are initiated in circumstances when both maternal restraint and disinhibition were linked to overweight mothers [43].

The first part of the third hypothesis was that maternal restraint and disinhibition will be positively correlated to child weight status (3a).

5.5 b Cognitive Factors and Child Weight

The influence of cognitive factors has been shown in girls as young as 5 years of age [126]. A majority of the 5-year- olds indicated that they sometimes ate in response to external cues, such as the sight and presence of palatable food, even when they weren't hungry. Further, about 30% of girls reported at least moderate levels of dietary restraint, about 25% of the sample showed evidence of emotional disinhibition, and nearly 75% reported externally disinhibited eating in the presence of palatable foods. Daughters' dietary restraint and emotional disinhibition were positively related to their perceptions of parental pressure to eat more, while their external disinhibition was related to their perceptions of having restrictions placed on their eating [126]. This research reveals that pressure in child feeding is associated with the emergence of dietary restraint and disinhibition among young girls, eating styles characterized by a lack of responsiveness to internal hunger and satiety cues. In the study, young girls' perceptions of parental pressure to eat more food, rather than parents' own reports of pressuring daughters to eat, related to girls' reports of dietary restraint and disinhibition. Taken together, mothers played a central role in transmitting cultural values, impressions of body size, weight and body image to their daughters. Daughters also gathered information about their mothers' own regulation of food intake through observations [126]. However, the relationship of maternal cognitive factors with child body weights was not studied, but has been difficult to establish in other studies [28,72, 81] due to the complex inter-relationships between environmental and cognitive/hereditary factors and the mostly cross sectional approach of most studies.

Unlike the results found by Carper et al [126], in the current study, maternal restraint had a significant positive main effect on child weight, especially in the boys. Other studies from our lab also support the correlation of higher maternal restraint with higher child weight [113]. In the current study, overweight boys had mothers with significantly higher maternal restraint but not the overweight girls. However, as the children were of preschool age, cognitive factors could not be reported by them. Maternal measures of their cognitive factors were reported and correlated to child weight. Hence, overall, maternal restraint had a moderate relationship with child weight and was not a significant main effect in the Hierarchical model during the primary steps but, it attained strength in its relationship with child taster status when the interaction term was later entered in the model.

In contrast, in the current study, maternal disinhibition was not directly correlated to child weight in either boys or girls. Further analyses did not yield statistically significant relationships between maternal disinhibition and child weight status. The relationships were probably nullified overall perhaps due to the opposite relationships seen between disinhibition and weights in boys and girls. Hence, maternal disinhibition did not show any strong directional main effect in determining child body weight. This was evidenced in the Hierarchical Regression Models where disinhibition did not enter the model that predicted child weight. Yet, this finding is in agreement with the study in the NYC Hispanic study where higher maternal disinhibition was found to be associated with higher weight in boys but not in the girls [72]. The difference in maternal disinhibitory effects on weights of boys and girls could not be understood completely and cannot be considered reliable as only weak associations were noted to begin with.

In summary, high maternal disinhibition was positively related to high BMI in mothers of both boys and girls. With regard to the child BMIZ, the relationship of maternal disinhibition was oppose in boys and girls; higher disinhibition was related to higher BMIZ in boys but to lower BMIZ in girls; thus its overall effect on child weight was negated. Unlike the current study, in the study by Goldstein et. al, the evidence of a direct relationship of maternal disinhibition and higher child energy intake was present but disinhibition was not included in the regression model that predicted child weight as it was co-linear with maternal BMI which was a positive predictor [40].

In relation to restraint, it is interesting to note that a trickle down effect existed where overall, high maternal restraint was related to significantly higher BMI of mothers of boys and trended towards a higher BMIZ in the boys themselves whereas no difference was noted among the girls' mothers or the girls' weights. In the current study, these cognitive factors only modestly predicted child weight as main effects in the Hierarchical Regression Model. Their effect in the model was subtle and comparable to other studies where also only modest effects were seen [113, 81]. Some possible explanations for varied strength of maternal cognitive factors as the main effects in predicting child weight in the current study could be the complex and the indirect nature of these relationships with child weight and the lack of large sample sizes and thereby, statistical significance. However, not much is known about how cognitive factors in minority mothers influence their child feeding practices and weight.

The third hypothesis (3b) of study was that maternal child feeding practices and child temperament influence child weight status and food consumption. Before the effects of these factors are discussed, it is important to understand the relationship of weight status and food consumption.

5.6 Factors Influencing Lunch Intakes

5.6 Maternal Overweight and Child Overweight Status

In the current study, it was found that an interaction between the maternal weight and child weight influenced the energy and total amount of food consumption at the school lunch. Wardle et al found that children from obese/overweight families showed higher preference for fatty foods in a taste test and a lower liking for vegetables [14]. In a study by Birch et al, 3-5 year old children indicating strong preferences for high-fat foods had high total fat intakes. Their fat preferences were also related to their triceps skinfold measurements. Finally, those children with the strongest preferences for high-fat foods and the highest total fat intakes (Food Frequency Questionnaire) had heavier parents than did children with low scores [127]. These results were echoed in the actual consumption data recorded in the current study as described below.

5.6 a. Weight Status and Lunch Intakes

Body weight was found to be strongly correlated with lunchtime nutrient intakes (energy, total proteins and total fat) of children in this study. Overweight boys consumed significantly higher percentage of fat energy than normal weight boys. The trend though present in girls, was not significant. When child weight was controlled, no differences in intakes were seen based on gender or taster status, confirming a consistent strong relationship between body size and nutrient intakes. Though no main effects were seen when adjusted for body weight, there was a strong positive interaction between maternal and child weight for consumption of energy, total fat and total protein. Overweight children with overweight mothers consumed significantly more energy (125 kcal more), protein (6g) and fat (7g) than overweight children with normal weight mothers. These data imply that maternal obesity plays a key role in excessive nutrient consumption in over weight children even in meal settings where mothers are absent. This finding was worrisome yet similar to the reports from Birch et al studies [26, 127] where overweight children who were already susceptible to nutrient intake disregulation, were affected by maternal weight.

5.6 b. Maternal Cognitive Factors and Child Nutrient Intakes

Direct evidence associating maternal restraint with child nutrient intakes has been reported frequently [26, 59, 72, 81, 127], yet, the direction of association between maternal cognitive factors and nutrient intakes has been inconclusive from our lab studies. In preschool children, maternal restraint correlated with consumption of higher amounts of discretionary fats, yet no differences were seen in the consumption of total energy [81] between children whose mothers scored high or low on dietary restraint. Also, maternal restraint waswas positively associated with child fat intake as percentage of calories among 3-5 year olds [127] but not among the 7-11 year olds [40]. In the current study, maternal restraint showed positive correlations with child nutrient intakes. There was a trend for higher fat consumption in children of restrained mothers when compared to those with unrestrained mothers (11g versus 8g). Furthermore, children of restrained mothers consumed significantly more energy, which is similar to the results from our lab by Keller et al., who also found among Caucasian preschool children, a correlation between maternal restraint and child consumption of discretionary fats [81]. Yet, current study results were not supported by the finding from Contento et al's study among Hispanic 5-7 year old children of NYC [72]. In that study however, actual intakes were not measured and restraint was in fact, associated with positive healthful choices in the mothers and hence, in the children. The clinical significance of the positive association of maternal restraint with a trend towards higher fat consumption is not completely understood and is open to future research. In the mothers, the presence of high emotional eating and/or the excessive rigidity in control of restraint might render the mothers susceptible to overeating, which might, in turn, through yet unexplained ways trickle down to the feeding habits in their young children. It is speculated that mothers who practiced greater cognitive control over their own food intake had children who were less likely to show precise regulation of energy intake which could possibly contribute to child overweight [127].

In the current study, results showed that children's nutrient intakes had modest or no relationship with their taster status, gender and maternal disinhibition, but was influenced by maternal restraint. The relationship between energy intake and maternal restraint was stronger with respect to consumption of energy in girls with restrained mothers than boys with restrained mothers. Also, when body weight was considered, a similar positive direction in the results was noted. It was seen that overweight children with restrained mothers consumed higher amounts of food and energy than overweight children of unrestrained mothers. This relationship was significant in the girls but missed significance in the boys.

Thus high maternal restraint seemed to link moderately with higher energy intakes in both boys and girls. However, the association of high maternal restraint with higher weight seemed to be a common thread that linked mothers and sons but not mother and daughters.

5.7 Child Feeding Practices, Temperament Factors, Weight Status and Child Nutrient Intakes

The third hypothesis (3b) of study was that maternal child feeding practices (CFQ subscales) and child temperament (CCTI subscales) influence child weight status and food consumption.

Factors in the CFQ are known to influence child weight [40, 39]. In one study, ‘Concern about Child Weight’ [40] was a positive predictor while in other studies ‘Pressure to Eat’ score [39, 40] was a negative predictor of child weight in the Regression model. In the present study, the regression models for body weight showed positive correlation with the ‘perceived weight of child’ and the ‘perceived responsibility’ factors and as found before, a negative relation with the ‘pressure to eat’ factor.

Overweight children of both genders had mothers with higher ‘perceived responsibility’ scores regardless of maternal weight. This indicated the strong influence of maternal perception of ‘responsibility’ that perhaps influenced control of portion sizes and types of food served. No differences gender-wise, in energy intake or child weights based on ‘perceived responsibility’ scores were observed. However, this perception or actual serving of larger portions by mothers could not be confirmed as food intake behavior data at home was not collected. Yet, the fact that perceived responsibility scores were related to higher weight in children and that these scores included questions related to portion size suggests that this scale is a potentially robust tool that can be explored to understand etiologies of obesity in children. In the Infant Growth Study conducted among mostly Caucasian British children, it has been noted that Perceived Responsibility at age 5, was linked with predicting reduced child BMI z scores at age 7 among families at low risk for overweight [37]. However, the children in the current study had the opposite finding wherein a higher PR score was linked with higher child weight. This difference could perhaps be explained by the varying demographics, ethnicities, feeding habits and occurrence of overweight in the two populations. This trend supports the idea that Hispanic parenting styles were less restrictive and the overweight issue was often not taken seriously due to lack of education and awareness [33]. With a more flexible feeding approach noted among Hispanic mothers, and in this study, the fact that they were aware of their child's overweight status perhaps meant that they tended to perceive a higher need for food for their overweight child as being appropriate.

The Pressure to Eat' factor (CFQ subscale) has almost always shown to be a strong negative predictor of child weight [37, 39, 40]. This factor showed a similar strong negative correlation and entered both the regression models in the current study. The negative correlation of the 'pressure to eat' factor observed previously in Caucasian populations was also seen in the Hispanic population studied here. This could also be linked to a flexible, less authoritarian feeding style adopted by mothers who were less restrictive of the eating habits of their children. A trend for overweight children with low 'pressure to eat' scores to consume high energy and protein was seen in both genders.

5.8 PROP taster status, Cognitive Factors, Weight Status

The third hypothesis (3c) was that maternal factors and family environmental factors interact with child taster status and weight.

Clear relationships between PROP taste sensitivity and body weight or energy intakes in adults has been hard to demonstrate due to mediating effects of cognitive factors [98, 97]. A study done by Tepper and Ullrich among middle aged predominantly

Caucasian women, showed that when disinhibition, was controlled for in the statistical analysis, restrained eating masked the relationship of PROP status and BMI [98]. In the low restraint group, the non taster women had significantly higher BMI than the super taster women. In the high restraint group however, no differences in body weight were found. Similarly, in a study done in an Italian cohort, it was found especially among women, that a significant interaction between dietary restraint and PROP phenotype on BMI existed. Among unrestrained females, non tasters had higher BMI and waist circumference than the other groups [97]. Nolen et al found a small positive influence of maternal restraint on weights of preadolescents [81]. Among preschool children, however, our lab studies failed to show significant relationships between maternal restraint and child weight [40,81].

Hence, maternal cognitive factors have the potential to mediate not only the effects of the mothers' taster status and weight but also, to interact with the child taster status and weight that could possibly extend to nutrient intakes.

Keller et al from our lab found that non taster boys had a significantly higher BMI than taster boys [88]. Although the interaction between PROP status and restraint was not significant in the ANOVA model in the present study, the interactive term enhanced the predictive value of the regression model for boys as well as the Hierarchical Model (for both genders) by 5.84%. Thus, taster status in young children seemed to have a modest yet important relationship with maternal restraint scores that predicts BMIZ .

Our data disagree with the findings of Lumeng et al. [60] who also tested the relationship between PROP taster status and body weight children in Head Start children (MI), and didn't find supporting data. They suggested that an increased propensity to consume cheap, energy dense, unhealthy food when the child was not in school might have overwhelmed the effect of PROP status on body weight in their study. However, a critical difference between our study and the study by Lumeng et al, is that Lumeng and coworkers did not include cognitive variables in their study which we have shown repeatedly to mediate the relationship between PROP status and body weight (refs). . The current study had limitations. The lack of statistical power due to smaller sample sizes, especially in the numbers of non tasters reduced the ability to make extensive conclusions. Secondly, the presence of many mediating variables especially when the interaction among the variables (each one separately or in combination with others) was not completely understood. Self reporting of maternal weights and self administration of the PROP sensitivity tests at home, in the absence of the investigator, could have potentially risked gathering of accurate data in the mothers. Also, the inability to include food intake data from the home needs to be addressed when the study is repeated.

Future studies need to include an equal mix of children by economic status, taster status, body weight, gender and set hypotheses based on available subject population demographics so that statistical power is not compromised.

5.9 Conclusions

Childhood overweight has seen an exponential rise in the past few decades despite the consistent hereditary factor that determines obesity. This rising trend could partially be explained by changes in the food environment, eating habits and physical activity levels. Food environment is often the primary factor that dictates the eating habits of young children and maternal eating style is influential to young children who see and learn eating behaviors from their mothers. Maternal emotional eating and restraint, and their attitudes towards diet and dieting direct their own food choices and hence, potentially trickle down to the feeding styles they employ with their children. Also, a surprising finding was that a lower restriction seemed to be associated with higher energy intakes in the overweight children of both genders indicating that among this ethnic Hispanic population, a flexible feeding style was practiced. The link of other key factors like a lower pressure to eat, lower reactivity to food, and higher perceived responsibility with higher child weight sheds light on important relationships that determine child weight in this population. The focus of weight management programs should not only include nutrition education to mothers and children but, also include assessment of maternal restraint and its effect on the child's feeding practices and nutrient intakes. A better understanding of these factors could lead to higher effectiveness of the intervention and improve the efficacy of programs that address childhood obesity in ethnic and low-income populations.

The role of PROP taste sensitivity in guiding food choices, eating behaviors and actual intakes could be further explored to design multiple approaches to weight management.. A unique finding in the present study was that non taster boys with restrained mothers had the highest BMIZ as compared to the other groups. This relationship should be further characterized in a larger study population to confirm this finding and to determine the relative importance of this relationship to eating behavior and body weight in minority children.

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FIGURES

Figure 4.2.1

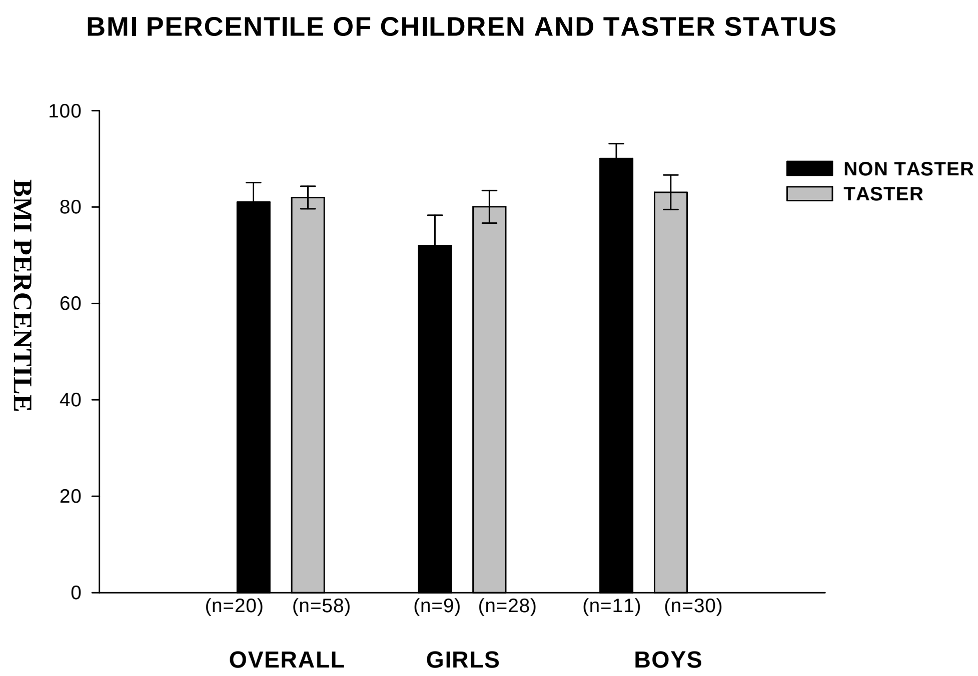
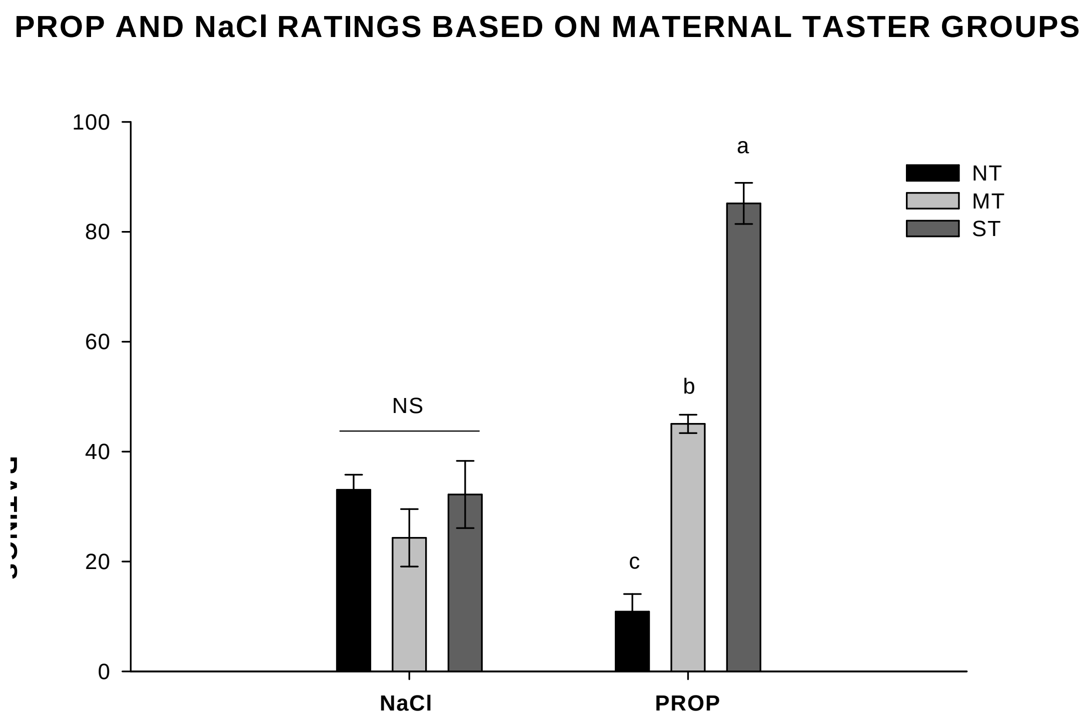


Figure 4.2.2



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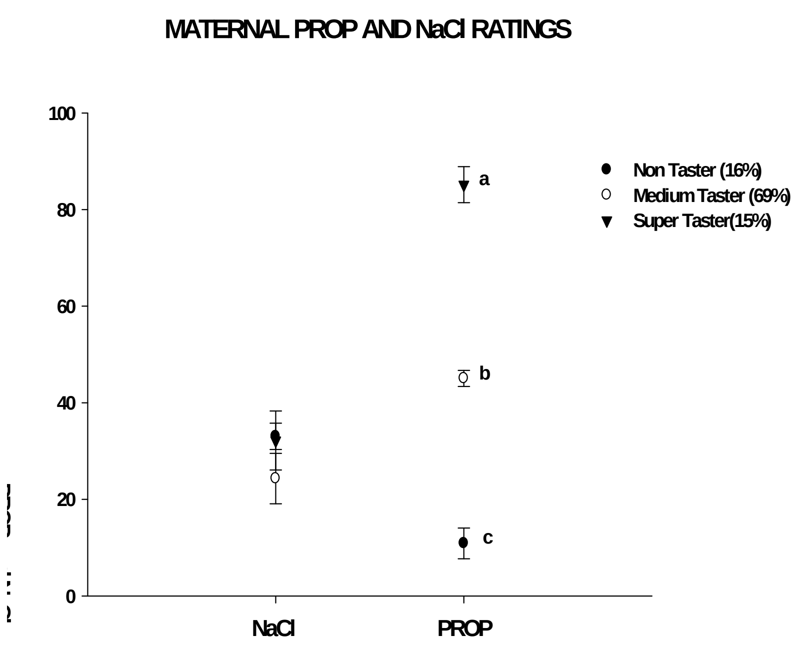
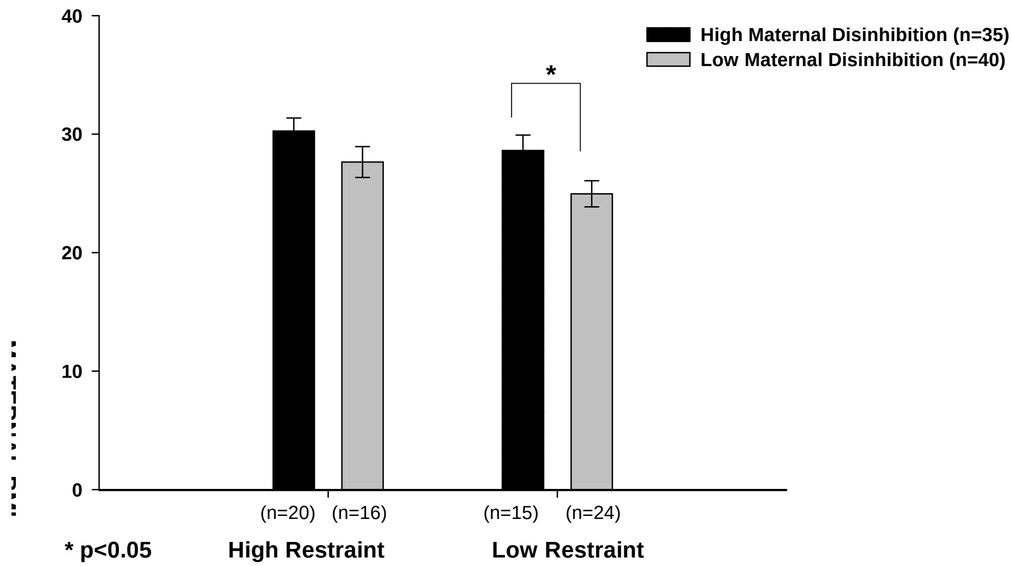


Figure 4.3.1

RELATIONSHIP OF MATERNAL RESTRAINT AND DISINHIBITION

WITH MATERNAL BMI



MATERNAL RESTRAINT

Figure 4.3.2

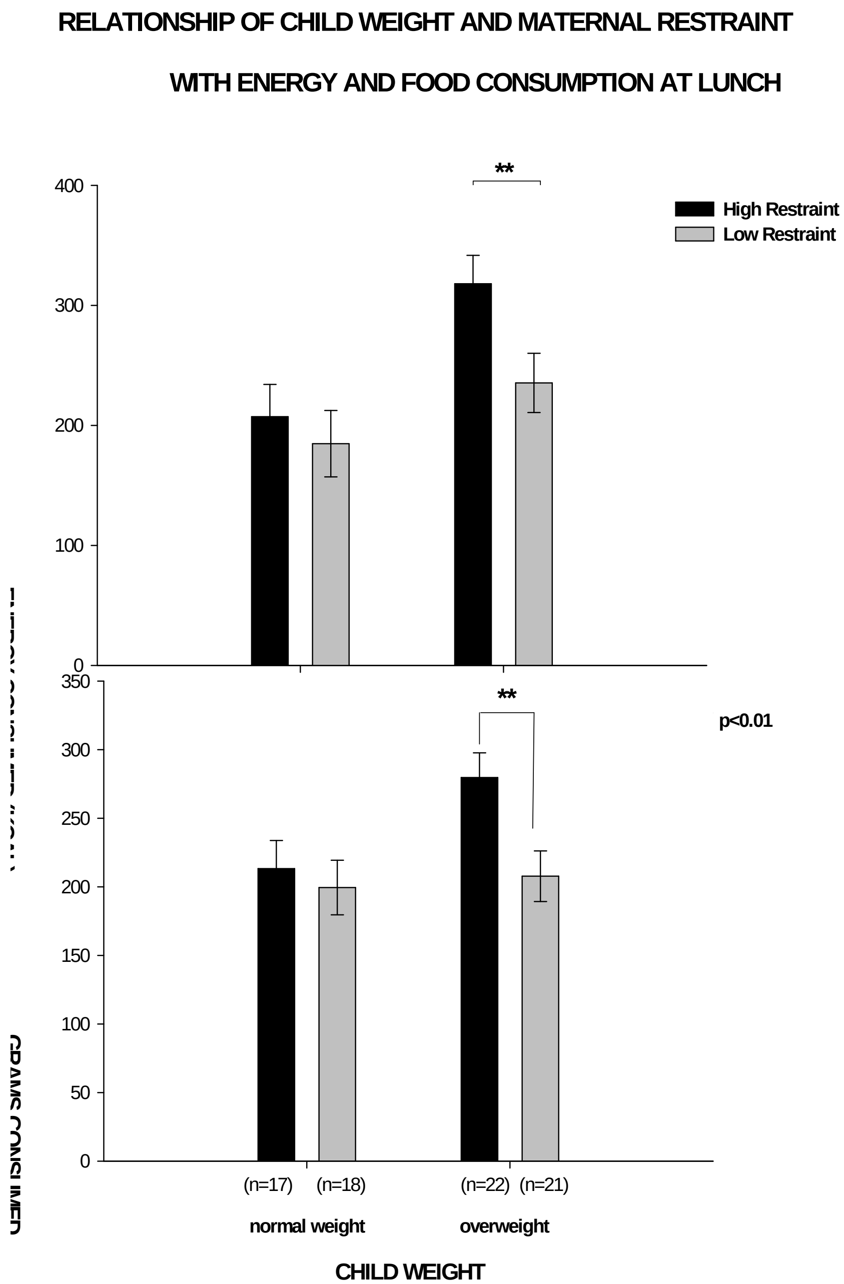

RELATIONSHIP OF CHILD WEIGHT AND MATERNAL RESTRAINT
WITH ENERGY AND FOOD CONSUMPTION AT LUNCH
High Restraint
Low Restraint
**
400
300
200
100
0
350
300
250
200
150
100
50
0
p<0.01
(n=17)
(n=18)
(n=22)
(n=21)
normal weight
overweight
CHILD WEIGHT

Figure 4.4.1

RELATIONSHIP OF CHILD ENERGY, FAT AND PROTEIN CONSUMPTION AT LUNCH WITH MATERNAL WEIGHT AND CHILD WEIGHT

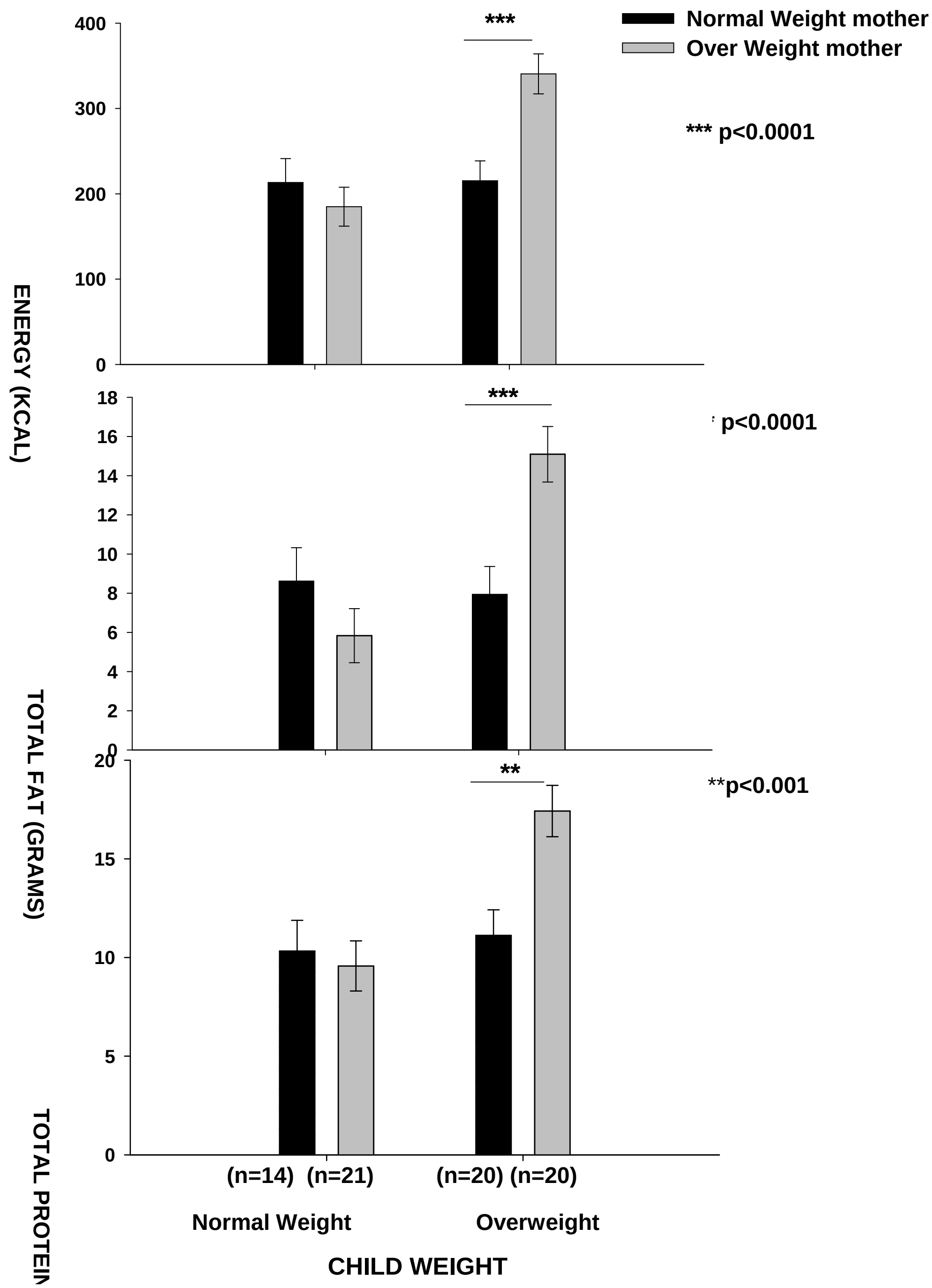


Figure 4.6.1

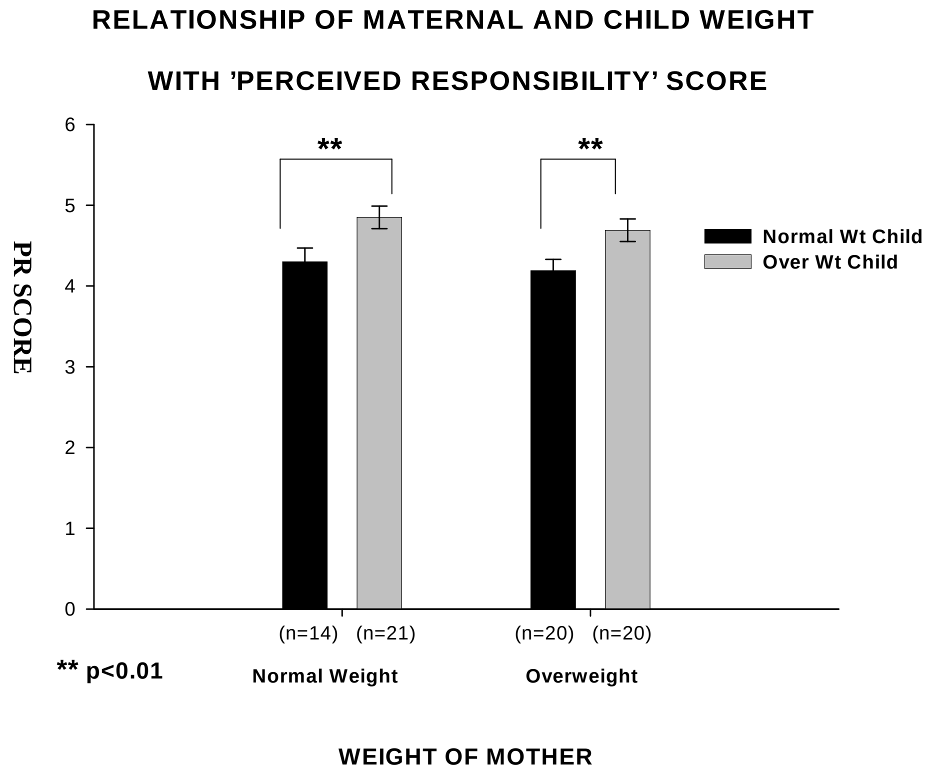


Figure 4.6.2

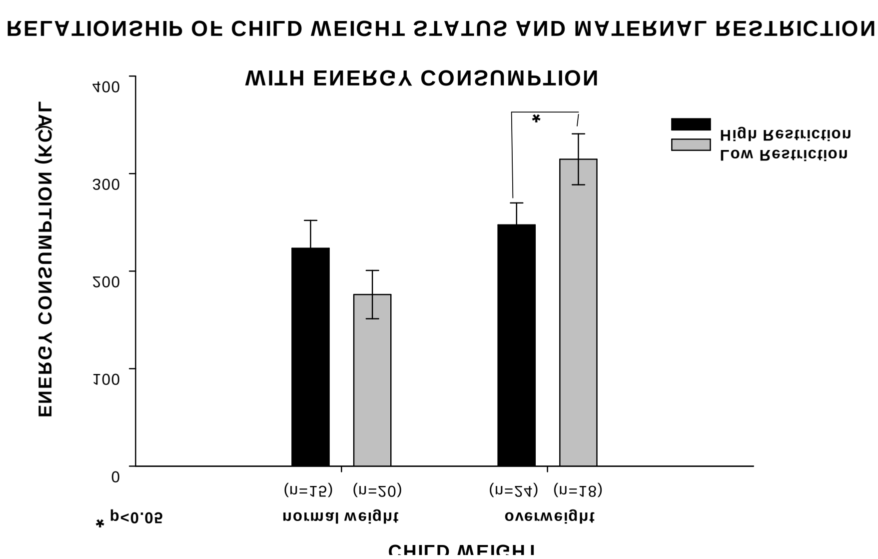
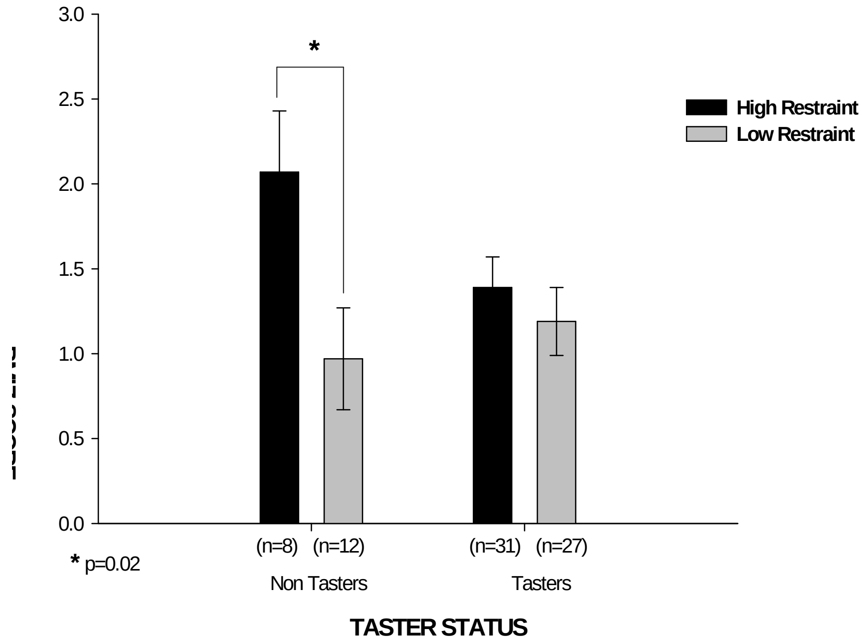


Figure 4.7.1

RELATIONSHIP OF TASTER STATUS AND MATERNAL RESTRAINT

FOR CHILD BMIZ SCORE



APPENDICES

Appendix 1 USDA Child and Adult Care Food Program Meal Pattern

Child Meal Pattern
Lunch or Supper

Food Components	Ages 1-2	Ages 3-5	Ages 6-12[1]
1 milk fluid milk	1/2 cup	3/4 cup	1 cup
2 fruits/vegetables juice,[2] fruit and/or vegetable	1/4 cup	1/2 cup	3/4 cup
1 grains/bread[3] bread or	1/2 slice	1/2 slice	1 slice
cornbread or biscuit or roll or muffin or	1/2 serving	1/2 serving	1 serving
cold dry cereal or	1/4 cup	1/3 cup	3/4 cup
hot cooked cereal or	1/4 cup	1/4 cup	1/2 cup
pasta or noodles or grains	1/4 cup	1/4 cup	1/2 cup
1 meat/meat alternate meat or poultry or fish[4] or alternate protein product or	1 ounce	1 1/2 ounces	2 ounces
cheese or	1 ounce	1 1/2 ounces	2 ounces
egg or	1/2 egg	3/4 egg	1 egg
cooked dry beans or peas or	1/4 cup	3/8 cup	1/2 cup
peanut or other nut or seed butters or	2 Tbsp.	3 Tbsp.	4 Tbsp.
nuts and/or seeds[5] or	1/2 ounce	3/4 ounce	1 ounce
yogurt[6]	4 ounces	6 ounces	8 ounces

[1] Children age 12 and older may be served larger portions based on their greater food needs. They may not be served less than the minimum quantities listed in this column.
[2] Fruit or vegetable juice must be full-strength.
[3] Breads and grains must be made from whole-grain or enriched meal or flour. Cereal must be whole-grain or enriched or fortified.
[4] A serving consists of the edible portion of cooked lean meat or poultry or fish.
[5] Nuts and seeds may meet only one-half of the total meat/meat alternate serving and must be combined with another meat/meat alternate to fulfill the lunch or supper requirement.
[6] Yogurt may be plain or flavored, unsweetened or sweetened.

Appendix 2

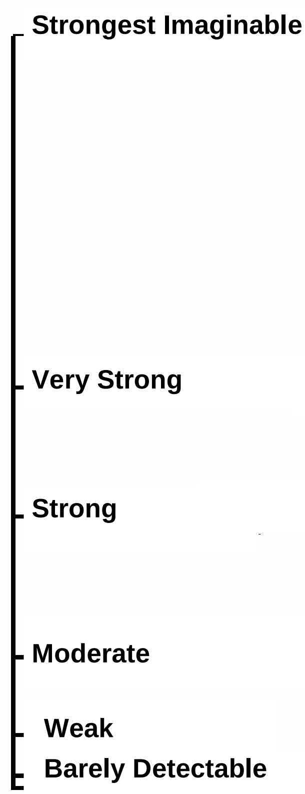
Appendix 2 USDA Recommendations for Dietary Intakes by Food Groups for 2-3 year old and 4-5 year old children (preschool age) Per Day

Food Group	**Amounts** **2-3 year olds** **4-8 year olds**	**Serving Amount Equivalents**
Grains	3 oz equivalents 4-5 oz equivalents	1 oz equivalent = 1 slice bread, 1 cup cereal, ½ cup cooked, rice, pasta
Vegetables includes potatoes, corn	1 cup equivalents 1 1/2 cup equivalents	1 cup equivalent = 1 cup raw vegetables/cooked or juice 2 cups leafy vegetables
Fruits	1 cup equivalents 1 1/2 cup equivalents	1 cup equivalent= 1 cup fruit or 100% juice ½ cup dried fruits
Milk	2 cups equivalents 2 cups equivalents	1 cup equivalent= 1 cup milk or yogurt 1 1/2 oz cheese, 2 oz processed cheese
Meat and Beans	2 oz equivalents 3-4 oz equivalents	1oz equivalent = 1 oz meat/poultry/fish ¼ cup cooked dry beans 1 egg, 1tbsp peanut butter ½ oz nuts/seeds

Appendix 3 PROP TASTER STATUS BALLOT FOR MOTHERS

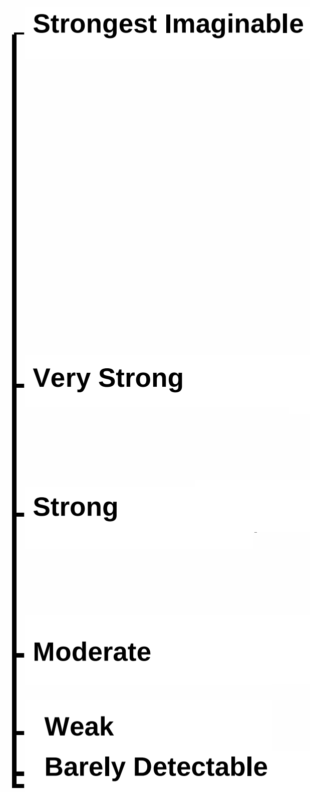
Instructions:

- Rinse your mouth thoroughly with water before you begin.
- Place the disk from the bag with the **BLUE** dot on the tip of the tongue for 30 seconds or until it is wet.
- Rate the intensity of the taste of the paper disk by drawing a mark on the scale for your answer.
- You can draw your mark on any place on the scale.
- For the next sample, go to the next page.



Instructions:

- Please rinse your mouth with water, and wait for 45 seconds before you begin.
- Taste the disk from the bag with the **RED** dot and draw a mark on the scale for the intensity of the taste.



Form Complete

Please return the form to Head Start

Appendix 4

<u>Caregiver</u> - Demographic and Health Information

Please answer these questions about <u>yourself</u> to the best of your knowledge and make sure you answer every question.

Is the caregiver filling out this form, the child's mother?

☐1 YES ☐2 NO

If not, what is your relationship to the child? ________________________

INFORMATION ABOUT CHILD'S CAREGIVER / MOTHER

Who does the cooking for the child most of the time?

Please specify:

____

1. What is the <u>highest</u> education level completed by the child's mother/ caregiver? *(Please check only one answer).*

☐1 6th grade or less
☐2 8th grade or less
☐3 Attended some High School
☐4 High School Graduate or GED
☐5 Technical School
☐6 Some College or more

If you are not the mother, you may stop here and return the form to Head Start. Thank you.

If you are the mother, please continue to fill out the form.

Continued on next page

PLEASE ANSWER THESE QUESTIONS IF YOU ARE THE CHILD'S MOTHER

2. Does the mother has a history of or is currently being treated for any medical conditions?

☐ 1 YES ☐ 2 NO

If Yes, then please check all that apply?

☐ 1 Diabetes (Type I or Type II)

☐ 2 Heart problems

☐ 3 Blood problems (hemophilia)

☐ 4 Kidney problems

☐ 5 Hypertension

☐ 6 Stroke

☐ 7 Thyroid Problems

☐ 8 Otitis Media (chronic ear infection, when you were younger)

☐ 9 Severe hay fever or allergies

☐ 10 Asthma

☐ 11 Cancer

☐ 12 Sinus infection

☐ 13 Other ***(specify)***:__________________

3. Mother's current height: ☐ ft ☐ in OR ☐ meter

4. Mother's current weight: ☐ lb OR ☐ kg

5. Mother's highest weight in the last 5 years (not pregnant) ☐ lb OR ☐ kg

6. Mother's lowest weight in the last 5 years (not pregnant) ☐ lb OR ☐ kg

7. Did you ever breast feed this child? ☐ 1 YES ☐ 2 NO

***If Yes, for how long? Please specify*:**

____

Appendix 5

Child - Demographic and Health Information

Please answer these questions about your child to the best of your knowledge and make sure you answer every question.

A. GENERAL INFORMATION ABOUT YOur CHILD

Please provide the following information:

1. Child's Name: ______________________

2. Child's Date of birth: ☐☐ month ☐☐ day ☐☐☐☐ year

3. Child's Gender: ☐ Male ☐ female

4. Child's current height: ☐ ft ☐ in OR ☐ meters

5. Child's current weight: ☐ lb OR ☐ kg

6. Child's birth weight: ☐ lb OR ☐ kg

7. Contact Telephone Number: ______________________

8. Was your child born in the United States? Yes ☐1 No ☐2

***If "No,"* Please write in the country of birth:** ______________________

9. What is the race of your child? Please choose all that apply.

- ☐1 Black or African-American
- ☐2 White
- ☐3 American Indian or Alaska native
- ☐4 Asian or Pacific islander
- ☐5 Hispanic or Latino
- ☐6 Other ***(specify):*** ______________________

Continued on next page

10. What is the ethnicity of your child? Please choose all that apply.

- ☐ 1 African ***(specify):*** ______________________
- ☐ 2 West Indian / Caribbean ***(specify)****:* ______________________
- ☐ 3 Mexican / Mexican-American
- ☐ 4 Puerto Rican
- ☐ 5 Cuban
- ☐ 6 Central American
- ☐ 7 Other Latino/Hispanic **(*specify):*** ______________________
- ☐ 8 South Asian ______________________
- ☐ 9 Middle Eastern
- ☐ 10 South East Asian ***(specify)***: ______________________
- ☐ 11 None of the above. ***(specify)***: ______________________

B. HEALTH INFORMATION ABOUT YOUR CHILD

11. Does your child have a history of OR is s/he currently being treated for any medical conditions*?*

☐ 1 YES ☐ 2 NO

***If Yes, then please check all that apply*.**

- ☐ 1 Diabetes (Type I or Type II)
- ☐ 2 Heart problems
- ☐ 3 Blood problems (hemophilia)
- ☐ 4 Kidney problems
- ☐ 5 Hypertension
- ☐ 6 Stroke
- ☐ 7 Thyroid Problems
- ☐ 8 Otitis Media (chronic ear infection, especially when younger)
- ☐ 9 Severe hay fever or allergies
- ☐ 10 Asthma
- ☐ 11 Cancer
- ☐ 12 Sinus infections
- ☐ 13 Other ***(specify)***:______________

12. Has your child had a cold/flu or ear infection in the past 2 weeks? *(check one)*

☐1 YES ☐2 NO

***If yes, please explain:*______________________________________**

13. Has your child visited the dentist in the past two weeks? *(check one)*

☐1 YES ☐2 NO

14. Has your child had hay fever/ nasal allergies in the past two weeks? (check one)

☐1 YES ☐2 NO

15. Does your child have any food allergies? *(check one)*

☐1 YES ☐2 NO

If yes, please explain

____

16. Are there any foods that you do not feed your child because of other health reasons? *(check one)*

☐1 YES ☐2 NO

***If yes please explain*____**

Form Complete.

Thank you for your time. Please return form to Head Start.

Appendix 6 ***What Foods Do You Have at Home?***

Did you have the following foods in your home in the last week? Please check the "YES" or "NO" box for each food.

100% Fruit Juices and Fruit					
1.100% Orange Juice	Yes ☐	No ☐	15. Grapes	Yes ☐	No ☐
2. 100% Apple Juice	Yes ☐	No ☐	16. Mango	Yes ☐	No ☐
3. 100% Grape Juice	Yes ☐	No ☐	17. Oranges, Tangerines, Clementines	Yes ☐	No ☐
4. Other 100% Juice	Yes ☐	No ☐	18. Papaya	Yes ☐	No ☐
5. Apples	Yes ☐	No ☐	19. Pineapple	Yes ☐	No ☐
6. Applesauce	Yes ☐	No ☐	20. Pears	Yes ☐	No ☐
7. Apricots	Yes ☐	No ☐	21. Peaches, Nectarines	Yes ☐	No ☐
8. Bananas	Yes ☐	No ☐	22. Plums	Yes ☐	No ☐
9. Blueberries	Yes ☐	No ☐	23. Strawberries	Yes ☐	No ☐
10. Melon (cantaloupe, honeydew, Musk melon)	Yes ☐	No ☐	24.Raspberries, Blackberries	Yes ☐	No ☐
11. Watermelon	Yes ☐	No ☐	25. Kiwi	Yes ☐	No ☐
12. Coconut	Yes ☐	No ☐	26. Grapefruit	Yes ☐	No ☐
13. Dried Fruit	Yes ☐	No ☐	27. Guava	Yes ☐	No ☐
14. Fruit Salad or Fruit Cocktail	Yes ☐	No ☐	28.Other ____________	Yes ☐	No ☐

Continued on the next page

Did you have the following foods or drinks in your home <u>in the last week</u>? Please check the "YES" or "NO" box for each food.

Vegetables					
1. Carrots	Yes ☐	No ☐	14. Eggplant	Yes ☐	No ☐
2. Celery	Yes ☐	No ☐	15 . Onions	Yes ☐	No ☐
3. Cucumber	Yes ☐	No ☐	15. Beets	Yes ☐	No ☐
4. Corn	Yes ☐	No ☐	16. Radish	Yes ☐	No ☐
5. Potato salad/Other white potatoes	Yes ☐	No ☐	17. Broccoli	Yes ☐	No ☐
6. Greens (Spinach, Collard, Turnip, Kale)	Yes ☐	No ☐	18. Lettuce	Yes ☐	No ☐
7. French fries	Yes ☐	No ☐	19. Green beans	Yes ☐	No ☐
8. Green peas	Yes ☐	No ☐	20. Cole slaw	Yes ☐	No ☐
9. Squash (pumpkin, winter, summer, butternut, zucchini)	Yes ☐	No ☐	22. Cooked beans (pinto, black-eyed peas, lentil)	Yes ☐	No ☐
10. Green Peppers	Yes ☐	No ☐	23. Sweet potatoes/ Yams	Yes ☐	No ☐
11. Other Peppers (yellow, red, orange)	Yes ☐	No ☐	24. Okra	Yes ☐	No ☐
12. Cauliflower	Yes ☐	No ☐	25. Tomatoes	Yes ☐	No ☐
13. Cabbage	Yes ☐	No ☐	26. Other ***Specify*__________	Yes ☐	No ☐

Continued on next page

Did you have the following foods in your home <u>in the last week</u>? Please check the "YES" or "NO" box for each food.

Drinks					
1. Soft drinks, regular	Yes ☐	No ☐	13. Ice tea, unsweetened	Yes ☐	No ☐
2. Soft drinks, diet	Yes ☐	No ☐	14. Fruitopia	Yes ☐	No ☐
3. Koolaid, regular	Yes ☐	No ☐	15. Sunny Delight	Yes ☐	No ☐
4. Koolaid, diet	Yes ☐	No ☐	16. Capri Sun	Yes ☐	No ☐
5. Fruit drinks, regular	Yes ☐	No ☐	17. Bottled Water	Yes ☐	No ☐
6. Fruit drinks, diet	Yes ☐	No ☐	18. Water from the faucet	Yes ☐	No ☐
7. Punches, regular	Yes ☐	No ☐	19. Milk, Whole	Yes ☐	No ☐
8. Punches, diet	Yes ☐	No ☐	20. Milk (1%, 2% or skim)	Yes ☐	No ☐
9. Powerade/Gatorade	Yes ☐	No ☐	21. Flavored Milks	Yes ☐	No ☐
10. Snapple, regular	Yes ☐	No ☐	22. Milk Shakes	Yes ☐	No ☐
11. Snapple, diet	Yes ☐	No ☐	23. Smoothies	Yes ☐	No ☐
12. Ice tea, sweetened	Yes ☐	No ☐			

Form complete.
Thank you for your time and prompt reply.
Please return form to Head Start.

Appendix 7

Child Feeding Questionnaire

	NEVER	RAREL Y	SOME -	MOST OF THE TIME	ALWAYS
1. When your child is at home, how often are you responsible for feeding?	□	□	□	□	□
2. How often are you responsible for deciding what your child's portion sizes are?	□	□	□	□	□
3. How often are you responsible for deciding if your child has eaten the right kind of foods?	□	□	□	□	□
	NEVER	**RAREL Y**	**SOME - TIME**	**MOSTL Y**	**ALWAYS**
4. How much do you keep track of the sweets (candy, cake, ice cream, pies) that	□	□	□	□	□
5. How much do you keep track of the snack food (chips, Doritos, cheese puffs)	□	□	□	□	□
6. How much do you keep track of the high-Fat foods that your child eats?	□	□	□	□	□
7. I have to be sure that my child does not eat too many sweets	□	□	□	□	□
8. I have to be sure that my child does not eat too many high-fat foods	□	□	□	□	□
9. I have to be sure that my child does not eat too much of his/her favorite	□	□	□	□	□
10. I intentionally keep some foods out of my child's reach	□	□	□	□	□
11. I offer sweets to my child as a reward for good behavior	□	□	□	□	□
12. I offer my child his/her favorite foods in exchange for good behavior	□	□	□	□	□

Continued on next page

	DISAGREE	SLIGHTLY DISAGRE E	NEUTRA L	SLIGHT-LY AGREE	AGR EE
13. If I did not guide or regulate my child's eating s/he would eat too many junk foods	☐	☐	☐	☐	☐
14. If I did not guide or regulate my child's eating, s/he would eat too much of his/her favorite	☐	☐	☐	☐	☐
15. My child should always eat all of the food On his/her plate	☐	☐	☐	☐	☐
16. I have to be especially careful to make sure my child eats enough	☐	☐	☐	☐	☐
17. If my child says "I'm not hungry", I try to get him/her to eat anyway	☐	☐	☐	☐	☐
18. If I did not guide or regulate my child's eating s/he would eat much less than s/he should	☐	☐	☐	☐	☐

	REALLY UNDER WEIGHT	UNDER WEIGH T	NORMA L	OVER WEIGH T	REAL LY
19. During YOUR childhood, (5-10 years old) you were	☐	☐	☐	☐	☐
20. During YOUR teenage years, you were	☐	☐	☐	☐	☐
21. During YOUR 20's you were	☐	☐	☐	☐	☐
22. At present, YOU are	☐	☐	☐	☐	☐
23. During the first year of life your CHILD was	☐	☐	☐	☐	☐
24. As a toddler your CHILD was	☐	☐	☐	☐	☐
25. As a pre-schooler, your CHILD is	☐	☐	☐	☐	☐

	NOT AT ALL	A LITTLE	CONCERN ED	FAIRLY	VE RY
27. How concerned are you about your child eating too much when you are not around?	☐	☐	☐	☐	☐
27. How concerned are you about your child having to diet to maintain a desirable	☐	☐	☐	☐	☐
28. How concerned are you about your child?	☐	☐	☐	☐	☐

Appendix 8 **<u>Colorado Child Temperament Inventory</u>**

Please answer each of the following on a scale of 1 (not typical of my child) to5 (typical of my child). Check ONLY one box for each characteristic.

Child's Characteristic	Not Typical 1	2	3	4	Typical 5
1. When my child moves about, s/he usually moves slowly	☐	☐	☐	☐	☐
2. My child makes friends easily	☐	☐	☐	☐	☐
3. My child prefers quiet, inactive games to more active ones	☐	☐	☐	☐	☐
4. My child consistently dislikes many kinds of foods	☐	☐	☐	☐	☐
5. My child is energetic	☐	☐	☐	☐	☐
6. My child rarely takes a new food without Fussing	☐	☐	☐	☐	☐
7. My child is off and running as soon as s/he gets up in the morning	☐	☐	☐	☐	☐
8. My child takes a long time to warm up to Strangers	☐	☐	☐	☐	☐
9. Once my child decides s/he doesn't like a food, there is no getting him to like it	☐	☐	☐	☐	☐
10. My child tends to be shy	☐	☐	☐	☐	☐
11. My child is always on the go	☐	☐	☐	☐	☐
12. My child is very friendly with strangers	☐	☐	☐	☐	☐
13. My child has strong likes and dislikes in Food	☐	☐	☐	☐	☐
14. My child makes faces at new foods	☐	☐	☐	☐	☐
15. My child is very sociable	☐	☐	☐	☐	☐

Appendix 9 **Dutch Eating Behavior Questionnaire**

Please read each question and than decide whether each item is true in relation to you, using the following rating scale: never; rarely; sometimes; often; very often. Check the box that corresponds to your rating. Please respond to all items, making sure that you check the box for the rating that is true about you. If you make a mistake or need to change an answer, change the check to a cross and then check the correct box

1. Do you have the desire to eat when you are irritated?	Never ☐	Rarely ☐	Sometimes ☐	Often ☐	Very Often ☐
2. If food tastes good to you, do you eat more that usual?	Never ☐	Rarely ☐	Sometimes ☐	Often ☐	Very Often ☐
3. Do you have a desire to eat when you have nothing to do?	Never ☐	Rarely ☐	Sometimes ☐	Often ☐	Very Often ☐
4. If you have put on weight, do you eat less than you usually do?	Never ☐	Rarely ☐	Sometimes ☐	Often ☐	Very Often ☐
5. Do you have a desire to eat when you are depressed or discouraged?	Never ☐	Rarely ☐	Sometimes ☐	Often ☐	Very Often ☐
6. If food smells and looks good, do you eat more than usual?	Never ☐	Rarely ☐	Sometimes ☐	Often ☐	Very Often ☐
7. How often do you refuse food or drink offered because you are concerned about your weight?	Never ☐	Rarely ☐	Sometimes ☐	Often ☐	Very Often ☐
8. Do you have a desire to eat when you are feeling lonely?	Never ☐	Rarely ☐	Sometimes ☐	Often ☐	Very Often ☐
9. If you see or smell something delicious, do you have a desire to eat it?	Never ☐	Rarely ☐	Sometimes ☐	Often ☐	Very Often ☐
10. Do you have a desire to eat when somebody lets you down?	Never ☐	Rarely ☐	Sometimes ☐	Often ☐	Very Often ☐
11. Do you try to eat less at mealtimes than you would like to eat?	Never ☐	Rarely ☐	Sometimes ☐	Often ☐	Very Often ☐
12. If you have something delicious to eat, do you eat it straight away?	Never ☐	Rarely ☐	Sometimes ☐	Often ☐	Very Often ☐
13. Do you have a desire to eat when you are angry?	Never ☐	Rarely ☐	Sometimes ☐	Often ☐	Very Often ☐
14. Do you watch exactly what you	Never	Rarely	Sometime	Often	Very

	eat?	☐	☐	s ☐	☐	Often ☐
15.	If you walk past the baker do you have the desire to buy something delicious?	Never ☐	Rarely ☐	Sometimes ☐	Often ☐	Very Often ☐
16.	Do you have a desire to eat when you are approaching something unpleasant to happen?	Never ☐	Rarely ☐	Sometimes ☐	Often ☐	Very Often ☐
17.	Do you deliberately eat foods that are slimming?	Never ☐	Rarely ☐	Sometimes ☐	Often ☐	Very Often ☐
18.	If you see others eating, do you also have the desire to eat?	Never ☐	Rarely ☐	Sometimes ☐	Often ☐	Very Often ☐
19.	When you have eaten too much, do you eat less than usual the following days?	Never ☐	Rarely ☐	Sometimes ☐	Often ☐	Very Often ☐
20.	Do you get the desire to eat when you are anxious, worried to tense?	Never ☐	Rarely ☐	Sometimes ☐	Often ☐	Very Often ☐
21.	Do you find it hard to resist eating delicious foods?	Never ☐	Rarely ☐	Sometimes ☐	Often ☐	Very Often ☐
22.	Do you deliberately eat less in order not to become heavier?	Never ☐	Rarely ☐	Sometimes ☐	Often ☐	Very Often ☐
23.	Do you have a desire to eat when things are going against you or when things have gone wrong?	Never ☐	Rarely ☐	Sometimes ☐	Often ☐	Very Often ☐
24.	If you walk past a snack bar or a café, do you have the desire to buy something delicious?	Never ☐	Rarely ☐	Sometimes ☐	Often ☐	Very Often ☐
25.	Do you have the desire to eat when you are emotionally upset?	Never ☐	Rarely ☐	Sometimes ☐	Often ☐	Very Often ☐
26.	How often do you try not to eat between meals because you are watching your weight?	Never ☐	Rarely ☐	Sometimes ☐	Often ☐	Very Often ☐
27.	Do you eat more than usual, when you see others eating?	Never ☐	Rarely ☐	Sometimes ☐	Often ☐	Very Often ☐
28.	Do you have a desire to eat when you are bored or restless?	Never ☐	Rarely ☐	Sometimes ☐	Often ☐	Very Often ☐
29.	How often in the evening do you try not to eat because you	Never	Rarely ☐	Sometimes	Often ☐	Very Often

are watching your weight?	☐		☐		☐
30. Do you have a desire to eat when you re frightened?	Never ☐	Rarely ☐	Sometimes ☐	Often ☐	Very Often ☐
31. Do you take into account your weight with what you eat?	Never ☐	Rarely ☐	Sometimes ☐	Often ☐	Very Often ☐
32. Do you have a desire to eat when you are disappointed?	Never ☐	Rarely ☐	Sometimes ☐	Often ☐	Very Often ☐
33. When you are preparing a meal are you inclined to eat something?	Never ☐	Rarely ☐	Sometimes ☐	Often ☐	Very Often ☐
34. How often do you try unfamiliar foods?	Never ☐	Rarely ☐	Sometimes ☐	Often ☐	Very Often ☐