Effect of Food Advertisements on Satiety and Meal-Time Food Intake in 9-14 y old Boys and Girls

by

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A thesis submitted in conformity with the requirements for the degree of Masters of Science

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Abstract

The effect of meal-time exposure to food advertisements (FA) on food intake, subjective appetite and caloric compensation was investigated in overweight/obese (OW/OB) and normal weight (NW) boys (study 1) and girls (study 2). In random order, each participant watched either FA or non-food advertisements (NFA) 30 min after consumption of either a non-caloric sweetened control (CON) or a glucose (GLU) drink. Food advertisements increased food intake only in OW/OB girls. The GLU drink reduced food intake in both girls and boys despite no changes in subjective appetite. Food advertisements did not modify the response to the GLU drink in girls and contrary to the hypothesis they magnified the reduction in energy intake following the GLU drink in boys. In conclusion, FA in a TV program during consumption of a pizza meal by NW and OW/OB boys and girls increased food intake only in OW/OB girls and increased caloric compensation for the GLU drink at meal time in boys but not in girls.
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# Table of Contents

Abstract ........................................................................................................................................... ii

Table of Contents .................................................................................................................................. v

List of Tables ......................................................................................................................................... ix

List of Figures ....................................................................................................................................... xi

List of Equations .................................................................................................................................. xii

List of Appendices ................................................................................................................................. xiii

List of Abbreviations ............................................................................................................................. xiv

1 Introduction ......................................................................................................................................... 1

2 Literature review ............................................................................................................................... 3

2.1 Introduction ..................................................................................................................................... 3

2.2 Obesity and overweight .................................................................................................................. 3

2.3 Factors associated with childhood obesity ................................................................................... 4

2.3.1 Increased energy intake ............................................................................................................. 4

2.3.1.1 Physiology of food intake control ......................................................................................... 4

2.3.1.2 Effect of environmental factors on food intake ................................................................. 5

2.3.1.3 Effect of food-related environmental factors on food intake ............................................. 6

2.3.2 Reduced energy expenditure ..................................................................................................... 7

2.3.2.1 Physical activity .................................................................................................................... 7

2.3.2.2 Sedentary behavior .............................................................................................................. 9

2.4 Television viewing as a factor associated with obesity .............................................................. 10

2.4.1 Television viewing and energy expenditure ............................................................................ 11

2.4.1.1 Effect of TVV on physical activity ..................................................................................... 11

2.4.2 Television viewing as a sedentary behaviour: ......................................................................... 12

2.4.3 Effect of TVV on resting energy expenditure ......................................................................... 13

2.4.4 Television viewing and energy intake ...................................................................................... 14
2.4.4.1. Non-food related effect of television viewing on energy intake ........................................ 14
2.4.4.2. Food related effect of TVV on energy intake by food advertisements ......................... 16
2.4.4.2.1. Effect of food advertisements on food choices .................................................. 17
2.4.4.2.2. Effect of food advertisements on energy intake ............................................... 18
2.4.5. Effect of weight status on response to TVV and food advertisements .......................... 20
2.5. Measurements of subjective appetite, food intake and assessment of eating behavior ...... 21
2.5.1. Measurements of subjective appetite ........................................................................... 21
2.5.2. Measurements of short term food intake ...................................................................... 21
2.5.3. Assessment of eating behavior .................................................................................... 22
2.6. Summary and study rationale ......................................................................................... 23
3 Hypothesis and objectives ................................................................................................. 24
3.1. Hypothesis ...................................................................................................................... 24
3.2. Objective ....................................................................................................................... 24
4 Materials and Methods ...................................................................................................... 25
4.1. Experimental design ...................................................................................................... 25
4.2. Participants ..................................................................................................................... 25
4.3. Experimental procedure ............................................................................................... 26
4.3.1. Television viewing protocol ..................................................................................... 29
4.3.2. Advertisements protocol ......................................................................................... 29
4.4. Measures and Data analysis .......................................................................................... 31
4.4.1. Preload treatment ...................................................................................................... 31
4.4.2. Food Intake ............................................................................................................... 32
4.4.3. Subjective appetite .................................................................................................... 33
4.4.4. Subjective Physical Comfort ..................................................................................... 34
4.4.5. Subjective Palatability ............................................................................................... 34
4.4.6. Subjective Sweetness ................................................................................................. 34
4.4.7. Subjective Acceptance ........................................................................................................... 34
4.4.8. Estimate of body fat mass ....................................................................................................... 35
4.4.9. Eating behavior Assessment ................................................................................................. 36
4.4.9.1. Emotional eating behavior ............................................................................................... 36
4.4.9.2. External eating behavior .................................................................................................. 36
4.4.9.3. Restraint eating behavior ............................................................................................... 36
4.5. Data analysis ............................................................................................................................... 38
5 Results ........................................................................................................................................... 39
5.1. Participants .................................................................................................................................. 39
5.2. Food intake .................................................................................................................................. 41
5.3. Cumulative energy intake .......................................................................................................... 43
5.4. Caloric compensation .................................................................................................................. 45
5.5. Water intake ............................................................................................................................... 48
5.6. Subjective appetite ...................................................................................................................... 50
5.7. Physical comfort .......................................................................................................................... 58
5.8. Drink sweetness and palatability ............................................................................................... 62
5.9. Food palatability and TV program acceptability ....................................................................... 64
5.10. Correlations ............................................................................................................................... 66
5.10.2. Associations between food intake and each of weight, age, BMI percentile, percent FM, water intake and behavioral factors ............................................................................... 67
5.10.3. Visual analog scores and food intake .................................................................................... 69
5.10.4. Thirst and water intake ......................................................................................................... 73
5.10.5. Drink palatability and weight .............................................................................................. 73
5.10.6. Restraint and caloric compensation ..................................................................................... 73
6 Discussion......................................................................................................................................... 75
8 Reference List..................................................................................................................................... 84
9 Appendices....................................................................................................................................... 92
9.1. Appendix I- Nutritional Composition of the Pizza Served at Test Meals ...................... 108
9.2. Appendix II- Recruitment Material ................................................................................. 92
9.2.1. Metro ads .................................................................................................................. 92
9.2.2. Recruitment slip ....................................................................................................... 93
9.2.3. Recruitment letter for parents .................................................................................. 94
9.3. Appendix III- Screening Questionnaires ....................................................................... 95
9.3.1. Telephone screening questionnaire .......................................................................... 95
9.3.4. Background information .......................................................................................... 103
9.3.5. Contact information ................................................................................................. 104
9.3.6. Food acceptability list .............................................................................................. 104
9.4. Appendix IV- Dutch Eating Behavior Questionnaire ................................................... 105
9.5. Appendix V- Study day questioners ............................................................................. 108
9.5.1. Feeding session cover sheet ..................................................................................... 108
9.5.2. VAS .......................................................................................................................... 109
9.5.2.1. Motivation to eat .................................................................................................. 109
9.5.2.2. Physical comfort .................................................................................................. 111
9.5.2.3. Drink sweetness ................................................................................................... 112
9.5.2.4. Drink palatability ................................................................................................. 113
9.5.2.5. Food palatability ................................................................................................. 114
9.5.2.6. TV program acceptability .................................................................................... 115
9.5.3. Food intake sheet ..................................................................................................... 116
9.5.4. Reminder slips ......................................................................................................... 117
9.6. Appendix VI- Sample size calculations ....................................................................... 118
List of Tables

Table 5-1 Baseline characteristics in boys ................................................................. 39
Table 5-2 Baseline characteristics in girls ........................................................................ 40
Table 5-3 Food Intake (kcal) in NW and OW/OB boys ..................................................... 41
Table 5-4 Food intake (kcal) in NW and OW/OB girls ..................................................... 42
Table 5-5 Cumulative energy intake (kcal) in NW and OW/OB boys ............................. 44
Table 5-6 Cumulative energy intake (kcal) in NW and OW/OB girls ............................. 45
Table 5-7 Meal-time caloric compensation (%; CC) for the glucose drink in NW and OW/OB boys ........................................................................................................ 46
Table 5-8 Meal-time caloric compensation (CC, %) for the glucose drink in NW and OW/OB girls ........................................................................................................ 47
Table 5-9 Water intake (ml) in NW and OW/OB boys ..................................................... 48
Table 5-10 Water intake (ml) in NW and OW/OB girls .................................................. 49
Table 5-11 Average change from baseline in pre-meal subjective appetite score (mm) in boys ........................................................................................................ 51
Table 5-12 Average change from baseline in pre-meal subjective appetite score (mm) in girls ........................................................................................................ 53
Table 5-13 Change in post-meal subjective appetite score (mm) in boys ....................... 55
Table 5-14 Change in post-meal subjective appetite score (mm) in girls: Effect of drink, ads and weight ........................................................................................................ 57
Table 5-15 Average change from baseline in pre-meal physical comfort (mm) in boys: Effect of drink, weight and time ..................................................................................... 58
Table 5-16 Average change from baseline in pre-meal physical comfort (mm) in girls... 59

Table 5-17 Change in post-meal physical comfort (mm) in boys ........................................... 60

Table 5-18 Change in post-meal physical comfort (mm) in girls ........................................... 61

Table 5-19 Drink palatability and drink sweetness (mm) in boys ........................................ 62

Table 5-20 Drink palatability and sweetness (mm) in girls .................................................... 63

Table 5-21 Food palatability and TV program acceptability in boys ..................................... 64

Table 5-22 Food palatability (mm) and TV program acceptability (mm) in girls ................. 65

Table 5-23 Association between food intake (kcal) and each of weight (kg), age, BMI percentile, fat mass (%) and water intake (ml), restraint, external and emotional eating scores in boys ........................................................................................................................................................................ 67

Table 5-24 Associations between food intake (kcal) and each of weight (kg), age, BMI percentile, fat mass (%) and water intake (ml), restraint, external and emotional eating scores in girls ........................................................................................................................................................................ 68

Table 5-25 Associations between food intake (kcal) and visual analog scores ................. 70

Table 5-26 Associations between food intake (kcal) and visual analog scores ............... 72
List of Figures

Figure 4-1 Study protocol ................................................................. 28

Figure 4-2 Advertisements protocol .................................................... 30

Figure 6-1 Interaction between drink composition and type of ads in boys............. 78

Figure 6-2 Association between drink palatability and glucose concentration in boys. . 80
List of Equations

Equation 4-1: Average appetite ................................................................. 33

Equation 4-2: Fat mass............................................................................... 35
List of Appendices

9.1. Appendix I- Recruitment Material ................................................................. 92

9.2. Appendix II- Screening Questionnaires .......................................................... 95

9.3. Appendix III- Dutch Eating Behavior Questionnaire .................................... 105

9.4. Appendix IV- Nutritional Composition of the Pizza Served at Test Meals ....... 108

9.5. Appendix V- Study day questioners ............................................................... 108

9.6. Appendix VI- Sample size calculations ......................................................... 118
### List of Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>ANOVA</td>
<td>Analysis of variance</td>
</tr>
<tr>
<td>BIA</td>
<td>Bioelectrical impedance analysis</td>
</tr>
<tr>
<td>BMI</td>
<td>Body mass index</td>
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<tr>
<td>CON</td>
<td>Control</td>
</tr>
<tr>
<td>CVD</td>
<td>Cardiovascular disease</td>
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<tr>
<td>DS</td>
<td>Drink sweetness</td>
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<td>DP</td>
<td>Drink palatability</td>
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<td>FA</td>
<td>Food advertisements</td>
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<tr>
<td>FP</td>
<td>Food palatability</td>
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<tr>
<td>GLP-1</td>
<td>Glucagon-like peptide-1</td>
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<tr>
<td>GLU</td>
<td>Glucose</td>
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<tr>
<td>Kcal</td>
<td>Kilocalories</td>
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<td>MetS</td>
<td>Metabolic Syndrome</td>
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<td>MTE</td>
<td>Motivation to eat</td>
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<td>MIN</td>
<td>Minute</td>
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<td>NW</td>
<td>Normal weight</td>
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<td>NFA</td>
<td>Non-food advertisements</td>
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<td>OB</td>
<td>Obese</td>
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<td>OW</td>
<td>Overweight</td>
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<tr>
<td>PA</td>
<td>Physical activity</td>
</tr>
<tr>
<td>PC</td>
<td>Physical comfort</td>
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<tr>
<td>SEM</td>
<td>Standard error of the mean</td>
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<tr>
<td>TEA</td>
<td>Thermic effect of activity</td>
</tr>
<tr>
<td>TEF</td>
<td>Thermic effect of food</td>
</tr>
<tr>
<td>TV</td>
<td>Television</td>
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<tr>
<td>Acronym</td>
<td>Description</td>
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<tr>
<td>TVA</td>
<td>Television program acceptability</td>
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<td>TVV</td>
<td>Television viewing</td>
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<tr>
<td>VAS</td>
<td>Visual analogue scale</td>
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1 Introduction

In 2004, based on data from Canadian Health Measures Survey, 26% of 2 to 17 y old Canadian children and adolescents were overweight (OW) or obese (OB), compared to 15% in 1978/79 and this rate is projected to continue rising [1]. At present, the literature indicates that OB children are at a higher risk of becoming OB adults [5] and suffering from associated conditions like type 2 diabetes [5]. In addition, childhood obesity has been associated with elevated cholesterol levels in adulthood [6]. As a result, OB children are at a higher risk of developing heart disease and atherosclerosis later in life independent of BMI in adulthood [7]. These data illustrate the critical need to identify factors that contribute to this problem and establish effective countermeasures against childhood obesity.

Several environmental factors have been associated with obesity. Accessibility of highly palatable food, large portion sizes and a diet high in fat and sugars are associates with obesity [2]. Because, FA mostly promote food products that are high in fat and sugar, as an attempt to fight childhood obesity, a ban on FA during children’s television (TV) programming has been proposed. Children are exposed to 5 food advertisements per hour and this is a concern because marketing is known to have a strong influence on children's food preferences, requests, and consumption [38]. However, obesity is a result of a chronic energy imbalance favouring higher energy intake and lower energy expenditure and the effect of FA on energy intake regulation in children is still unclear. In order to assess the impact of FA in increasing rates of obesity it is important to understand their effect on appetite and energy intake. This area of research on the effect of FA on food intake in adolescents and children is neglected.

We previously demonstrated that watching TV containing no food cues can override the physiological satiety signals arising from a GLU drink resulting in a significant increase in total energy intake compared to no TV, in 9 - 14 y old boys [30] and peri-pubertal girls[3]. However, it is not clear how this effect changes when food cues are incorporated in the TV programs as food commercials. Thus, the current research focuses to determine whether exposure to FA during a meal can increase energy intake in children and how they interact with physiological responses of satiety. Furthermore, this study will provide evidence to determine whether
OW/OB children are more responsive to FA compared to their NW counterparts and therefore are more at risk of higher food intake in response to FA. In addition, the effect of sex will be considered to identify possible differences between the boys and the girls.
2 Literature review

2.1 Introduction

The focus of the present research is on the role of FA in TV Viewing (TVV) on food intake in children. Therefore the literature review begins with a brief overview of childhood obesity, by describing the prevalence of obesity and its significance. Then, the factors contributing to obesity are discussed, followed by examination of the role of TV and more specifically food advertisements (FA) in more detail to provide background for the studies that have been conducted.

2.2 Obesity and overweight

Obesity is the result of an imbalance between energy intake and energy expenditure favoring excess adiposity. Specifically, fat accumulating near the viscera in the form of central adiposity is a significant risk factor for the Metabolic Syndrome (MetS). In addition to central obesity, MetS includes hyperglycemia and dyslipidemia, which are associated with the development of type 2 diabetes and cardiovascular disease (CVD), respectively [4, 5]. Furthermore, obesity has been associated with psychosocial problems, functional limitations and disabilities [6, 7]. In addition to the strain of these outcomes at an individual level, increased risk for chronic diseases leads to high economic burden at the national level. In Canada, in 2005, obesity-related chronic conditions were estimated to account for $4.3 billion in direct ($1.8 billion) and indirect ($2.5 billion) costs [8]. Therefore, adult obesity has received much attention given that nearly 60 % of Canadian adults are OW or OB [9]. But OW and obesity in children has only recently came to the forefront with the recognition that 25 to 30% of 6 to 17 y old children are OW or OB [10]. Currently, obesity affects about 8.6% of 6 to 17 y old Canadians [1] and this prevalence has increased 2.5 times in the past decade[10]. Childhood obesity is of concern because it can lead to early onset of chronic diseases such as dyslipidaemia, hypertension, abnormal GLU tolerance [11] and type 2 diabetes [12]. Without intervention, childhood obesity is highly predictive of adulthood obesity and may accelerate the disease processes and result in increased risk of early adult morbidity and mortality [13]. The consequences of childhood obesity have also been related to negative emotional states
such as sadness, loneliness, and nervousness, and increased likelihood of engagement in high-risk behaviors such as smoking and alcohol consumption [14].

2.3. Factors associated with childhood obesity

Obesity is a multi-factorial disease and cannot be solely attributed to genetic changes or one single lifestyle factor. Despite the efforts to combat this epidemic, obesity rates are still expected to rise, indicating the absence of an effective preventive strategy. Basically, any factor that results in an increase in energy intake over energy expenditure can contribute to obesity. Currently, the food rich environment and low cost of food promotes energy intake and lifestyles that reduce physical activity (PA) and promote sedentary behaviour lead to lower energy expenditure. Because TVV has been suggested to be a cause of both excess energy intake as well as decreased energy expenditure, these factors are reviewed first followed by a more in depth examination of the impact of TVV.

2.3.1. Increased energy intake

Excessive energy intake, more than what is needed to maintain energy balance, will lead to energy storage as fat and in long-term to obesity. Our bodies have several physiological negative feedback loops to maintain the balance between energy expenditure and energy intake. However, environmental factors such as a food rich environment and readily accessibility of highly palatable food along with other environmental factors associated with lifestyle conditions can override physiological signals of satiety and satiation and lead to excess energy intake.

2.3.1.1. Physiology of food intake control

Food intake is regulated by an integrated and complex system that drives hunger to increase intake or respond to signals of satiety and satiation to decrease food intake. Satiety refers to the decreased hunger and lasting post-prandial inhibition of further energy intake while satiation refers to the feeling of becoming full during food consumption and thus terminates energy intake at a meal. Food intake regulation has been divided into three stages: cephalic phase, pre- and post-absorptive responses. Cephalic phase includes the preparation of
the body and anticipation of food in response to environmental and hedonistic cues such as smell or sight of the food. Evidence has shown that food cues including smell, sight or even the thought of the food may stimulate the cephalic phase of digestion, which induces a simultaneous activation of gastrointestinal motility, saliva, gastric acid and pancreatic enzyme secretion, as well as release of the gastrointestinal hormones such as gastrin and pancreatic polypeptide [15]. Pre-absorptive responses involve hormonal responses to food in the stomach, gastric distension and presence of chyme in the small intestine and involves peptide hormones including Cholecystokinin, Peptide YY, Glucagon-like peptide-1 and others that act synergistically to quickly and effectively suppress postprandial hunger during and after a meal [16].

Post-absorptive regulation, involves responses to the absorbed nutrients. Two of the most potent determinants of post-absorptive satiety are insulin and GLU. Glucose absorption into the blood leads to increased blood GLU level which is associated with lower food intake [17, 18]. Higher blood GLU in response to direct peripheral infusion of glucose[19] or ingestion of carbohydrate drinks one hour before test meal [20] is associated with lower food intake. The effect of GLU on food intake could be in response to several factors including interactions with gut hormones [21] and insulin [22].

Insulin levels increases in response to increased blood GLU levels which leads to higher peripheral GLU uptake, fatty acid synthesis, glycogen storage and a shift from the fasting catabolic state to the fed anabolic state [23]. Insulin increases satiation in response to blood GLU via insulin sensitive GLU transporters in parts of the brain such as hypothalamus that are involved in food intake regulation [24]. Exogenous insulin has been shown effective in decreasing food intake and weight loss in both rats and humans [25-28].

2.3.1.2. Effect of environmental factors on food intake

It is generally agreed that physiological control system has developed to intentionally err on the side of the positive energy balance. Thus, environmental factors can override the physiological control of food intake and are the main factors in the continued rise in obesity. In the past decades the environment has become rich in highly palatable foods and the action of
eating has turned to pleasure and a socialising event. Environment can affect energy intake in two ways; first, non-food related factors such as presence of others, listening to music or watching TV without food cues can distract attention from sensing physiological signals. Second, food related environmental factors such as food availability, large portion sizes and FA may promote food intake via activation of the cephalic phase.

Non-food related environmental factors play a major role in determining energy intake [29-31]. For example, the presence of others during the meal affects energy intake depending on level of familiarity and sex of the companions. While, eating at a buffet, energy intake was 18% higher in presence of two friends of the same sex [29], it was not affected in presence of two strangers from the same sex [30] and was decreased in presence of strangers from a different sex [31]. Soft music and dimmed lighting as used in restaurants are other environmental factors shown to prolong eating time and increase food intake [29]. In laboratory conditions, energy intake from an ad libitum lunch was significantly higher in the presence of a distraction such as watching TV (with no food cues) or listening to a recorded story, compared to sitting with no distraction in 18 to 50 y old NW women [32]. Television viewing will be further discussed in depth in later sections.

2.3.1.3. Effect of food-related environmental factors on food intake

Food related environmental factors such as food palatability, proximity, visibility, variety and portion sizes contribute to increasing energy intake. Based on self-reported data, taste is rated most important factor in food choices in adults [33]. In adults, presence of a bowl of individually wrapped candies in participant’s proximity (i.e. desk) was associated with higher consumption (4.6 chocolates more on average) compared to when candies were placed 2 meters away from the participant’s desk and were not visible and participants had to stand up and walk to get them [34].

Food variety also increased energy intake in several clinical studies. In non-obese adults, consumption of a four course meal that contained different foods in each course increased energy intake by 60% compared to when only one type of food was offered [35]. Similar results were found in young men who ate a third more when they were offered sandwiches with four
different fillings compared to one filling [36]. In another study participants ate significantly more when three flavours of yogurt (hazelnut, blackcurrant, orange) which were distinctive in taste, texture and color were offered than when offered just one of the flavours, even if the flavour was the favourite [36].

Larger portion sizes offered in restaurants also contribute to increase in energy intake [37-39]. When adult men and women were served macaroni and cheese on different occasions, they consumed 30% more energy (162 kcal) when offered the largest portion (1000 g) than when offered the smallest portion size (500g) [37]. A similar effect was shown in children where doubling the portion sizes of 3 meals (breakfast, lunch and dinner) and the afternoon snack over 24 h, increased children’s energy intake by 23% compared to when they had their standard sized meal [40].

2.3.2. Reduced energy expenditure

Total daily energy expenditure includes three components; resting energy expenditure, thermic effect of food (TEF) and thermic effect of activity (TEA). Among these components, resting energy expenditure accounts for about 60-75% and TEF for about 10-15% of total daily energy expenditure[41]. The TEA is the most variable component and it can vary between 15 to 50% of total daily energy expenditure [41, 42] and it can be further divided to two components exercise and non-exercise related activities. Non-exercise related activities include incidental daily activities such as walking, standing and playing, making it the most modifiable component of energy expenditure. Physical activity includes both exercise and non-exercise activities. Due to life style changes, non-exercise PA has been replaced by sedentary activities.

2.3.2.1. Physical activity

Physical activity is defined as any bodily movement that results in energy expenditure which takes place as part of daily life [43]. It includes occupational, sports, conditioning, household and other activities. Several studies have shown that OW and OB children are less active and active at lower intensity than their healthy weight counterparts [44-46]. In 7 to 11 year old Canadians, higher organized and unorganized PA as reported by parents, were found associated with lower BMI in their children (10 – 43 % reduced risk of OW/OB) [47]. However,
using parents’ estimates of anthropometric measurements and time spent for PA is not very accurate. Therefore, a more recent study used accelerometers data to estimate daily energy expenditure and directly measured BMI in 8 to 11 y old children [46]. The accelerometers were worn for up to 4 non-consecutive days to minimise measurement errors. This study also found a negative association between BMI and daily energy expenditure [46]. However, an earlier study, using accelerometers to estimate PA found no association between PA and BMI [48]. Similarly, step count was not associated with BMI in children of south–eastern Sweden [49]. This lack of agreement among the studies perhaps can be explained by the fact that BMI may not be the best measure of obesity as it does not take in to account proportions of fat mass and lean mass. By looking at three different variables of body composition, BMI, waist circumference and fat mass, stronger associations was found between step counts and percent body fat mass than between step counts and BMI or waist circumference [50].

In addition to less body fat, regular PA is associated with several other health benefits such as reduced risk of CVD, some types of cancer, osteoporosis, diabetes, high blood pressure, depression, stress and anxiety in adults [51] and is an effective way to prevent the development of many features of MetS in children and adolescents, including obesity [52, 53], type 2 diabetes [54] and high blood pressure [55, 56]. In order to obtain these beneficial effects, it is recommended that adults aged 18 to 64 accumulate at least 150 min of moderate to vigorous intensity aerobic PA per week in bouts of 10 min or more and children are advised to accumulate at least 60 min of moderate to vigorous intensity PA every day [57]. Although internationally, Canada is consistently in the top quartile for average PA when compared to other countries [58] currently only 15% of adults [51] and only 7% of children and adolescents [59] meet the recommendations for PA.

There have been several interventions in place to promote PA in school aged children and a few have been shown effective in reducing BMI. In Ontario, Policy no. 138 is one example of a program which requires elementary schools, grades 1-8, to facilitate 20 min of daily PA into the curriculum [60]. In France, PA sessions of 1 h in length, twice a week, was implemented in the school program for 6 to 11 y old children. The intensity of the exercise was 70% of the theoretical maximal heart rate. After 6 month, students from the participating school decreased their BMI z-score. In girls the drop in BMI z-score was greater in OB vs. NW (-6.8 %
vs. -3.1%) [61]. In China, students in an intervention school exercised for 10 min per school day for the duration of two semesters while the control school did not participate in any intervention. At the end of the study daily energy expenditure increased by 3.1 Kcal/Kg per day in the intervention school compared to the control school in which total daily energy expenditure deceased. There was a significant decrease in weight gain and BMI in the girls in the intervention compared to the control school (2.4 kg vs. 4.6 kg; 0.47 kg m$^{-2}$ vs. 0.66 kg m$^{-2}$) [62].

2.3.2.2. Sedentary behavior

Canadian sedentary behaviour guidelines defines sedentary behaviour as a distinct class of behaviours characterized by little physical movement and low energy expenditure [63] including watching TV, playing passive video games, using the computer, prolonged sitting (e.g. at a desk) and motorized transportation. A study of a cohort of 17,013 Canadians adults aged 18 to 90 found time spend sitting (as a measure of sedentary level) was associated with higher mortality rate from all causes and CVD in 12 years follow up independent of leisure-time PA [64]. Several epidemiological studies that used TVV time as an estimate of sedentary behaviour have found that prolonged sedentary activity increases risk of obesity and type 2 diabetes independent of level of PA [65, 66]. In a clinical study, in pre-pubertal children time spent on sedentary activities as measured by Flex heart rate technique (including writing, reading, studying, TVV, sitting in the car or bus or cinema) was directly proportional to fat mass percentage [67].

Sedentary behaviour can reduce insulin sensitivity and GLU uptake. Several animal studies have shown that insulin mediated GLU uptake is significantly reduced due to muscular inactivity [68, 69]. Epidemiological studies have consistently reported that time spent in sedentary tasks that require little muscle activity (low accelerometry counts, self-reported television time or computer use) is inversely related to insulin action [70-72]. When healthy young men decreased their daily activity level from a mean of 10,501 to 1,344 steps/day for 2 weeks, their insulin sensitivity as measured by GLU infusion rate, declined by 17% [73]. However, higher inactivity reduces energy expenditure, if this reduction is not compensated for by a reduction in energy intake it will lead to energy surplus which is shown to increased insulin
resistance [74, 75]. Therefore, it is important to identify the difference between effect of inactivity and energy surplus.

In a clinical trial, in non-obese adults, only one day of inactivity, long hours of sitting and minimal walking or standing, decreased insulin sensitivity even when energy intake was reduced to maintain energy balance [76]. Participants participated in three study sessions, mostly sitting without matching energy intake (SIT), sitting with matching energy intake (SIT-BAL) and no sitting (NO-SIT). Three meals, breakfast, lunch and dinner were exactly the same between SIT and NO-SIT. However, the caloric content of the breakfast and lunch were reduced by about 1000 calories to match the reduction in energy expenditure in SIT-BAL. The next morning insulin action was tested. The results indicate that whole body insulin action was lower in SIT and SIT-BAL compared to NO-SIT (39% and 18% respectively). Therefore, both muscle inactivity and energy surplus contribute to the effect of prolonged sitting on insulin action.

Overall, changes in energy expenditure and energy intake have been attributed to many factors including changes in family dynamics and popular sedentary activities including using computers and TVV. More specifically long hours of screen-viewing time has become a concern in modern societies due to technological advancements that made TV a prominent fixture of the children’s lives. Although computers are replacing TVV time, TV remains the main leisure time activity of most children [77]. Therefore, in the following sections the role of TVV in obesity is elaborated.

2.4. **Television viewing as a factor associated with obesity**

Television viewing is one of the most frequent leisure-time activities and has been found associated with obesity in both adults and children [65, 78-81]. In adults, on average about 23 hours a week is spent watching TV [82] and several epidemiological studies have found a positive relationship between hours of TVV and the risk of OW and obesity [65, 78, 79]. The Nurses’ Health Study, a prospective cohort study, found a significant positive association between hours of TVV at baseline and the prevalence of obesity and type 2 diabetes, six years later, in non-obese female adults [65]. Two hours per day of TVV was associated with a 23% increased risk of obesity [65].
In youth, a longitudinal survey of 12 to 17 y old adolescents, in California, observed that two or more hours of TVV at baseline was associated with a doubled probability of being OW or OB at the follow up session three years later, independent of baseline BMI [80]. In this same age group, the UK’s National Health Examination survey indicated that each additional hour of TVV was associated with a 2% increase in the prevalence of obesity [81]. This study also found a significant association between hours of TVV and prevalence of OW and obesity in 6 to 11 y old children [81], further demonstrating that excessive TVV is a concern for youth of various ages. However, in these studies it is very hard to directly measure TVV time. Therefore, the data are derived from self-reports of children and their parents and are not precise. Furthermore, these findings only indicate associations and do not prove cause and effect relationships.

However, randomized controlled trials support the use of TVV as a modifiable risk factor for reducing childhood obesity [83]. In a clinical trial, third and fourth grade students from two schools were randomized into a control group that received no advice and an intervention group. The intervention included educating students and parents about limiting their TVV without promoting PA. Furthermore, the hours of TVV including video tapes and video games, was highly controlled by a device that budgeted the viewing time to 7 hours a week. BMI increase was lower in the intervention group compared to control (18.38 to 18.67 kg/m² vs. 18.10 to 18.81 kg/m²).

Although the association between TVV and obesity is clear, it is still unclear whether this effect is due to reduced PA or increased sedentary behaviour and food consumption. These factors are elaborated in the following sections.

### 2.4.1. Television viewing and energy expenditure

Television viewing can affect energy balance by decreasing energy expenditure through reducing PA and resting energy expenditure as well as increasing sedentary behaviour.

#### 2.4.1.1. Effect of TVV on physical activity

Television viewing has been suggested to reduce energy expenditure by replacing the time spent on energy-consuming activities and exercise required for preventing MetS, including
the incidence of obesity [52, 53], type 2 diabetes [54] and high blood pressure[55, 56] in children and adolescents. Reducing TVV time leads to an increase in PA in adults [84, 85]. In a randomized controlled trial, when TVV was reduced by 50% for 3 weeks in OB adults who self-reported three or more hours of TVV per day, a significant increase in energy expenditure was observed compared to the control group who continued their usual TVV habits [84]. Although in this study the TVV time was highly controlled using a monitor that would automatically shut down the TV when participants reached their limit for the week, energy expenditure was estimated from 24-hour activity recalls by telephone which was subject to recall bias. This limitation was accounted for in another study where PA was more accurately estimated by pedometers in adults from low-income housing in Boston. In support of the data from previous study, TVV was associated with decreased PA and each hour of weekday TVV resulted in 148 less steps [85].

In children, however, the relationship between TVV and PA is not well established. In both longitudinal and cross-sectional studies including 11 to 14 y old girls in California, only a non-significant, negative association was found between the hours of TVV and PA [86]. However, these studies only examined the after school hours of TVV and did not include weekend TVV while PA for the whole week was considered. Another longitudinal study that investigated changes in hours of TVV and PA, in one year, found no relation between the changes in TVV and leisure-time PA in adolescents [87]. However, these studies depend on self-reported PA which is subject to inaccuracy. In another study, an accelerometer was used to record children’s activity during the days that TVV time was recorded in frequent intervals by both parents and the child. Similarly, in this study no association was found between overall daily PA and hours of TVV in boys and girls [88]. However, an examination of specific time slots throughout the day showed that after school TVV was associated with lower after school PA in boys but not in girls [88]. This suggests the importance of the effect of leisure-time TVV on leisure-time PA.

### 2.4.2. Television viewing as a sedentary behaviour:

Television viewing is one of the most popular leisure-time sedentary activities. Research shows that sedentary activities such as non-active computer games and TVV are a major part of
daily activities in adults’ and children’s lives. In Canada, adults spend an average of 9.5 hours a day in sedentary pursuits, the equivalent of about 69% of their waking hours [89], and a third of those activities includes TVV [82]. For children and youth, 8.6 hours a day, or 62% of their waking hours, involve sedentary behaviours [89]. Similar trends are being reported in the U.S. where children and youth spend an average of 6-8 hours per day being sedentary [63]. While most of these hours are inevitable as children are seated during their classes at school and while doing their homework, it leaves few hours of modifiable leisure-time which is mostly occupied by TV (more than 2 h/day) and other screening activities (videogames and computer use) [77].

Television viewing requires minimal muscle activity and can have deleterious effects even if PA requirements are met. In adult men and women who met the guidelines for PA, TVV was associated with higher waist circumference, systolic blood pressure, and 2-h plasma glucose in men and women, and with fasting plasma GLU, triglycerides, and High-density lipoprotein concentrations in women [70].

2.4.3. Effect of TVV on resting energy expenditure

Television viewing may also affect energy expenditure by reducing resting energy expenditure which accounts for 50-60% of total daily energy expenditure. The effect of TVV on resting energy expenditure has been studied in a few randomized clinical trials, but results are not consistent. Only one study showed that TVV decreases resting energy expenditure in children but its results were not reproduced in the same lab when a larger sample size was recruited. In a laboratory setting, a within-subject comparison showed that, on average, watching a medium-paced, non-violent and age appropriate TV program (“Wonder Years”) decreased basal metabolic rate by 211 kcal/d in 8 to 12 y old pre-menarcheal girls [90]. However, these findings were not duplicated when a larger sample of 90 pre-menarcheal girls were tested [91]. In this study watching the same TV program (“Wonder Years”), using the same methods of resting energy expenditure measurements and the same procedures did not affect resting energy expenditure while compared to baseline nor did listening to a story or watching a more exciting show such as “Full house”, a family comedy [91]. More recently, in this same age group another study did not find any effect of TVV on resting energy expenditure
using different techniques (mouth piece or full mask calorimetry) and different positions while watching TV (sitting or standing) [92].

The content of the TV program might contribute to its effect on resting energy expenditure. If the program requires a lot of brain function or leads to emotional responses, it can affect resting energy expenditure. This is supported by a study where playing video games while sitting, increased resting energy expenditure compared to sitting relaxed [93]. However, this increased resting energy expenditure was then overcompensated for in the *ad libitum* meal of spaghetti Bolognese that followed the video game play, leading to total energy surplus of 60 kcal [93]. If this energy surplus is not compensated throughout the day it can lead to higher fat storage in long term.

2.4.4. Television viewing and energy intake

In addition to its effect on energy expenditure, TVV can alter the other side of energy balance by increasing energy intake. Epidemiological studies suggest a positive association between time of TVV and energy intake in adult women [94] and children [95]. However, the underlying mechanism of the effect of TVV on energy intake is still controversial. Television viewing during energy intake is a common occurrence and it accounts for about a quarter of total daily energy intake [96]. In adults, several clinical trials found that TVV that included no food cues increased energy intake from an *ad libitum* test meal [30, 32, 97]. In a physically active population of participants who participated in a summer camp and provided self-reported data on their TVV habits and nutrition, TVV during meals was widespread (38% breakfast, 31% lunch, 62% dinner, 18% every meal). The prevalence of OW or obesity was significantly higher among boys watching TV at dinner (58.5%) compared to the boys viewing TV only in the afternoon (35%) [98]. Furthermore, increased TVV time was associated with higher snacking and lower intake of fruits and vegetables [98]. However these data are based on self-reported data and direct measurements are required for more accurate findings.

2.4.4.1. Non-food related effect of television viewing on energy intake

Watching TV programs that contain no food cues during a meal or snack can affect the energy intake. Adults watching an interactive game show privately while eating from a buffet
meal increased their energy intake to a similar extent as eating with two friends compared to eating alone with no distraction [30]. Similarly, in another clinical study, when undergraduate students ate alone while watching the TV show of their choice, their intake of high fat food was significantly higher compared to when they were listening to a symphony that was chosen by the researchers [97].

In children and young adults, however, the effect of TVV on energy intake is not consistent and the results vary depending on age and sex of the participants, the source of the energy provided and previous exposure to TV. Pre-school children watching a TV show that contained no food messages decreased energy intake from both a buffet meal and snacks, while eating in a group of familiar children [99]. However, in this sample, higher daily TVV as well as higher occurrence of meal or snacking while watching TV was associated with higher energy intake at meal during the TVV condition [99], indicating the importance of previous exposure to TV and its effect on food intake.

In 15 to 16 y old, NW teenagers, when TV was present in the eating environment or when participants listened to their music of choice while eating, energy intake from a buffet meal was not affected but soda intake was increased compared to other conditions. However, due to the setting of the eating environment (eating in room where TV was present) the participants may not have paid attention to the TV program [100]. The effect of attention is shown in another study where 9 to 12 y old children’s intake from their favourite snack was higher while watching a continuous TV show compared to a repeated segment of a TV show [101]. This indicates the full TV show distracts attention from energy intake leading to higher energy intake while a repeated segment of a TV show that does not require a lot of attention did not have such effect. Therefore, in order to make sure children pay attention to the TV, in two clinical trials, the feeding environment was set up in a cubicle where participants were not distracted by their surroundings [3, 102]. Participants were seated in front of a TV set and wore headphones throughout the eating session. Intake from an ad libitum pizza meal was then measured. In this setting the energy intake was higher with TV compared to no TV in boys [102] but not girls [3] indicating between-sex differences in response to TV.
The effect of TVV on energy intake is not limited to its effect on satiation during a meal, but also on satiety from preload drinks. In children a sugar drink given 30 min before eating decreased their intake from the \textit{ad libitum} meal to compensate for the calories from the drink thus keeping the cumulative energy intake (drink plus meal) constant [3, 102, 103]. However, watching an age-appropriate non-food related TV show during the meal condition, distracted the participants from physiological signals of satiation and satiety from the sugar preload, which led to higher energy intake in 9 to 14 y old boys [102] and less compensation in boys [102] and peripubertal girls [3] but not post-pubertal girls[3].

Furthermore, mealtime TVV can continue to effect energy intake later in the day. To test the effect of TVV on second meal in a clinical study, NW adults were provided a fixed 400 kcal lunch consisting of a ham sandwich and crisps and 2.5 h later their intake from an \textit{ad libitum} snack (3 plates of cookies) without any distraction was measured. During the fixed lunch participants watched 10 min of a comedy show or ate without distraction. The results showed that TVV while eating lunch, led to higher snack intake (approximate average of 10g or 50 kcal increase). This effect could be in part due to effect of TVV on the memory of food consumed. Evidence has shown that doing several tasks together significantly decreases the memory of those tasks [104]. Therefore, mealtime TVV may reduce the memory formation from the concurrent meal. Furthermore, memory of the previous meal is shown to effect energy intake. Reminding participants about their previous meals caused significant reduction in subsequent snack intake [105]. As a result, reduced memory of previous meal, taken while watching TV, increases energy intake in following snack.

2.4.4.2. \textbf{Food related effect of TVV on energy intake by food advertisements}

In addition to non-food related effects of TV on energy intake, the content of the TV programs including FA has been suggested to contribute to obesity by promoting greater energy intake. Food ads account for one third of total commercials on TV and Canadian children on average are exposed to five FA per hour [106]. In a recent study, time-use diary data from the Panel Survey of Income Dynamics was used to estimate the time children spent in front of the TV, as well as the type of the program they watched [107]. In these time-use diaries, participants completed surveys about their activities during the day, on or around the day when
those activities have happened [107]. A significant association was found between hours of commercial TV viewed and BMI, while there was no association between BMI and non-commercial TVV time [107]. However, the non-commercial TV included educational programs that might promote healthy eating and therefore these studies do not separate the effect of FA and content of TV programs (educational vs. entertainment). However, a multinational study, comparing several countries, including US and Australia, found a significant association between the proportion of food commercials (especially those promoting energy dense foods) in children’s programs and proportion of OW children [108]. There are two proposed ways by which FA can increase risk of obesity; first, by increasing short-term energy intake, second by increasing energy intake from energy dense foods by influencing children’s food choices.

2.4.4.2.1. Effect of food advertisements on food choices

Marketing is known to have a strong influence on children's food preferences, requests, and consumption [38]. Children who watched the most hours of TV were found to be consumers of those foods mostly advertised on TV [109]. This is of concern because an analysis of FA during children’s programs, where programs were weighted by the TV rating data, revealed that 97.8% and 89.4% of FA viewed by children 2 to 11 y old and adolescents 12 to 17 y old respectively, were high in fat, sugar or sodium [110] indicating that FA promote consumption of a diet that associates with obesity [2].

In children, several clinical studies have examined the effect of FA on subjective measures of food choice and attitude by means of questionnaires. In grade 5 and 6 students, exposure to ads for food that are high in fat and sugar or consumed at fast food restaurants did not affect their attitude towards these foods [111]. In this study, attitude was regarded as children associating products with fun, their perception of the taste and their familiarity with the product [111]. However, in a more recent study, with a counterbalanced, within-subject design, in 6 to 13 y old children, exposure to FA resulted in an increase in selection of foods that were high in fat as well as foods that were high in carbohydrates, but not the foods high in protein [112]. In this study, participants were shown five minutes of either FA or NFA followed by 20 min of a cartoon (same episode of the “Scooby Doo”) [112] and were immediately given questionnaires regarding their food preferences and food choices from a selection of branded
and non-branded foods as well as their daily TVV habits [112]. However, these studies only measured subjective preference of children and did not provide them the actual food items to see if their intake of high fat and high sugar foods increased after FA.

Exposure to FA, prior to snacking affects children’s choices of snacks. In a clinical trial, a possible direct effect of food commercials on food choices was examined in 5 to 8 y old students in a summer camp where TVV and snacking was well controlled [113]. In this study children were divided in two groups where each group was exposed to a 30 min cartoon for 14 consecutive days, followed by a snack period when kids chose between fruits or sweetened snacks. The 30 min cartoon contained 4.5 min of commercials or no commercials. The commercial sessions were separated into 3 types; commercials promoting either candies, fruits or public service announcements promoting healthy eating and fruits and vegetables. Each commercial was approximately 30 seconds. At the end of the study, candy commercials significantly increased the choice of candies in subsequent snacking compared to no commercials. However, none of the fruit commercials or public service announcements increased fruit intake compared to no commercials [113]. The difference between the commercials might be explained by the children’s previous familiarity with the commercials showing candy, making them more appealing than the other commercials. This idea that familiarity can play a role in children’s responses to FA is supported by the study where children who watched more TV during the week (an indirect measure of exposure to FA) were more affected by FA and therefore chose more foods after FA compared to those who watched less TV [112]. Furthermore, children’s rejection of new foods peaks between the ages of 2 to 6 y old and therefore it is harder to promote healthy foods to this age group [114]. Similar results were found in older children. Nine to 11 y old students who were exposed to five minutes of FA followed by a cartoon increased their consecutive intake of high fat snacks over the low-fat options [115].

### 2.4.4.2.2. Effect of food advertisements on energy intake

In addition to their effect on food choices, FA may act as stimuli that induce energy intake. In a clinical trial, a within-subject, counter-balanced study, 9 to 11 y old children participated in 2 sessions where they watched 5 min of FA or ads for toys followed by 10 min of
cartoons with their classmates. Children were then divided into groups of 4-5 and were each given five plates of different snacks and their snack intake was measured. Children’s energy intake from snacks was higher after FA compared to NFA and this effect was greater in OB/OW compared to NW participants [116]. However, in this study children were eating in groups and presence of others is known to have an effect on energy intake. In an earlier study with a similar design, an ads recognition test was added to the protocol where children had to fill out forms regarding recognition of ads. This introduced a delay between exposure to ads and snack intake and there were no differences found between the responses of OW/OB and NW participants to FA. This indicates the importance of timing of the energy intake and exposure to FA [115]. Therefore, investigating energy intake while watching TV might serve as a better indicator of the direct effect of commercials rather than assessing energy intake after exposure to FA.

Several studies report an increase in concurrent energy intake from highly palatable snacks in response to FA. Two groups of 8 to 11 y old boys and girls watched TV alone and were provided M&M sweet snacks to eat while watching TV in a setting that was designed to mimic that of a living room. The TV program was 20 min and included 2 commercial breaks. One group watched only NFA while the other group watched a mixture of FA and NFA for a total of six FA. The results showed an interaction between the sex of the participants and their response to FA; while boys ate more after FA, girls energy intake was less after FA compared to NFA [117]. This was explained by the content of the FA as they were mainly directed to boys, had more boy characters than girls and the majority of the participants were NW [117]. Furthermore, the effect of sex was not confirmed in another study where 7 to 11 y old students watched 14 min of a cartoon with two commercial breaks including FA or NFA. Participants were tested alone and were given a bowl of fish crackers to consume ad libitum. The results showed that both boys and girls who watched FA ate 45% more than those who watched NFA [118]. The inconsistency between these 2 studies may also be attributed to the type of snack used as one study used sweet M&M chocolates [117] versus a more savoury fish crackers used in the later [118] because it is shown that when children are provided several types of snacks, the percentage of increase in intake is not similar between the types of snacks [116]. Furthermore, in these studies children’s food intake prior to study was not standardized.
Type of test food may be a contributing factor in the effect of FA on energy intake. In the above studies, only energy intake from high-fat and sweet snacks was measured which are known to be highly rewarding and treating, especially in young children [117]. Therefore they are not a good measure of energy intake in response to physiological responses in contrast with meals that are more often consumed in response to hunger and are eaten to satiation [119]. In adults, immediately after exposure to FA, intake of both healthy (vegetables) and unhealthy (mini chocolate chip cookies and cheesy snack mix) snack foods increased [118]. However, watching FA had no effect on concurrent intake from a buffet meal [120]. The effect of FA on energy intake from a concurrent meal has not been examined in children.

2.4.5. Effect of weight status on response to TVV and food advertisements

Higher responsiveness to food cues is hypothesized to contribute to the problem of obesity and OW. Several studies have suggested that OW and OB participants are more susceptible to external cues than NW participants [121-124] and thus, are more prone to overeat in a food-rich environment than NW participants. Analysis of survey results regarding meal cessation that asked the extent to which participants agreed with statements associated with internal cessation cues (emphasis on feeling of fullness and hunger) and external cessation cues (e.g. termination of the TV show, finishing specific amount of food or running out of beverage), showed NW participants were more likely to be influenced by internal cues of meal cessation, while OW participants were more influenced by external cues [121]. In addition, manipulation of portion sizes has significantly more effect on energy intake in OB compare to NW participants [122]. However, it is not clear if higher responsiveness to external cues is the cause of OW/OB or a result of OW/OB and a learned ability to be more responsive to food.

Furthermore, brain activity in response to food pictures is different in OB compared to NW women [123] and has been associated with waist circumference in children [124]. Unfortunately, these studies did not measure energy intake to examine whether the differences in brain activity actually translated to differences in energy intake. However, a more direct measure of the effect of food stimuli on energy intake in children showed higher increase in snack intake in response to FA in OB compared to NW participants [116]. This evidence
suggests the importance of weight status in participants’ responses to FA but does not determine cause and effect.

2.5. Measurements of subjective appetite, food intake and assessment of eating behavior

In this section the material and methods used in the literature to measure subjective appetite, short term food intake and body composition are explained.

2.5.1. Measurements of subjective appetite

The measurement of subjective feelings of appetite is conducted via Visual analog scales (VAS). A VAS consists of questions regarding subjective feelings of appetite proceeded by a 100 mm line with two opposite statements at either end of the spectrum. For example, the question, “How hungry do you feel right now?” is followed by the statements “Not hungry at all” on left side of the 100 mm line and the opposing statement, “As hungry as I have ever felt”, on the right. The participants would mark how they feel by placing an “X” anywhere along this 100 mm line. The VAS is later scored based on the distance between the left end of the line to the intersection of “X”, as measured in mm via a ruler. These VAS can be used to measure subjective ratings of individual’s desire to eat, hunger, fullness, prospective food consumption and thirst.

VAS have been used frequently in adult [125, 126] and adolescents [3, 102, 127] and are shown best used in within-subject, repeated-measures designs [128] where participants’ responses are only compared to themselves. Appetite ratings using VAS were found reproducible in adults and children [129-131]. Furthermore, in children, it was proven that children understand the VAS questions as evidenced by lowered rating of appetite post meal [3, 102, 131].

2.5.2. Measurements of short term food intake

Short term food intake is measured from food consumed during the test meal. However, the source of the meal differs between studies. Buffet type meals with different macronutrient composition are used [29-31, 99] especially when the effect of treatment on food choices is examined. However, variety in food is known to affect energy intake [35, 36] therefore single
food items are used in many studies [32, 37, 97]. When choosing a single food to measure *ad libitum* food intake it is important to choose a food that has consistency in its energy content so that every bite on average contains similar amount of calories and macronutrient composition. In our lab we have used frozen pizza as the test meal. Since, the type used has no outer crust it provides more uniform distribution of macronutrient and energy. The meal is *ad libitum* to make sure participants intake is not limited by the amount of food provided. Pizza is weighed before and after participant’s consumption and the weight consumed is calculated by subtracting the two values. The data provided by the supplier (McCain Foods Limited) is used to convert grams consumed to Kcal. This method has been used in several studies in children and adolescents [3, 102, 103, 127, 131]. Reproducibility of this method was also verified in boys [131].

### 2.5.3. Assessment of eating behavior

Eating behavior questionnaires have been used in adults and children to assess behavioral characteristics that are thought to be related to overeating, namely emotional eating, external eating and dietary restraint. There are many questionnaires developed, among them Dutch Eating Behavior Questionnaire (DEBQ) has been validated and has been translated to many languages [132]. All versions of DEBQ have high factorial validity and reliability. However, this questionnaire is made for adults and is found hard to understand by younger children [133]. Therefore, it was recently simplified to make it more understandable for children[132]. The DEBQ for children includes 20 questions in total. Seven questions assess emotional eating and focus on eating in response to feelings such as depression, loneliness, worriedness, restlessness, fright and sadness. Six questions examine characteristics of external eating and focus on eating in response to external cues such as sight or smell of food, passing by restaurants or candy shops, seeing someone else eat or cook. Another seven questions analyze restrained eating characteristic by focusing on if the child is cautious about their weight and deliberately control their eating to maintain or lose weight it asks about if they have tried diets to intentionally lose weight avoid eating between meals or after a meal or the next day and weather they think of foods being slimming/flattening. Children have three options to
respond to these questions: No, Sometimes or Yes. The DEBQ for children has been validated and used in previous studies to assess children’s eating behavior [3, 115, 132, 134, 135].

2.6. Summary and study rationale

In an attempt to fight increased obesity rates in children, a ban on FA during children’s TV programming has been proposed. However, the effect of FA on food intake remains unclear. There are a limited number of studies that have investigated the short-term effects of FA on energy intake from snacks in children; however, the effect of FA on intake from an actual meal has not been investigated. Furthermore, food intake regulation is primarily physiological and the interaction between the effect of FA and physiological signals of satiety and satiation has been ignored. Lastly, the effect of weight status in response to the effect of FA requires further investigation.
3 Hypothesis and objectives

3.1 Hypothesis

Food advertisements in a TV program watched during a meal block satiety responses to pre-meal energy consumption and delay satiation in OW/OB but not in NW boys (study 1) and girls (study 2).

3.2 Objective

To measure food intake during a meal while 9 – 14 y old OW/OB and NW boys (study 1) and girls (study 2) watch a program containing either FA or NFA, following either a calorie free (sweetened water) or caloric (GLU, 1g/kg body weight) beverage, consumed 30 min before the meal.
4 Materials and Methods

Experimental design and procedures were identical for the two studies, as explained in the following sections, unless otherwise mentioned.

4.1 Experimental design

The design was a 3 x 2 repeated measures randomized design with three treatments. Main factors were drink (CON or GLU), ads (FA or NFA), and body weight (NW or OW/OB). For each session, participants arrived 2 h after consuming a standard breakfast. The participants were then given 5 min to consume either a CON (non-caloric, sweetened) or GLU (Caloric) drink. Thirty min after the drink, they watched an episode of “The Simpsons” with or without FA while eating an ad libitum pizza meal for 30 min. Subjective appetite was measured at regular intervals during the study.

4.2 Participants

Normal weight and OW/OB boys (study 1) and girls (study 2) aged 9 – 14 were recruited. Those NW, OW and OB were within the 15th and 84th, 85th and 94th, and 95th and above percentile (inclusive) for BMI, respectively, based on the Centers for Disease Control growth charts for age and gender [136].

The participants were recruited by advertisements in the Metro newspaper and word of mouth. Recruitment materials are available in Appendix I. In addition, past participants of previous studies conducted by our lab were contacted. The Human Subjects Review Committee of the Ethics Review Office at the University of Toronto approved this study.

After a telephone screening, children and adolescents born at full-term and normal birth weight were asked to participate in an in-person screening session at the Department of Nutritional Sciences. Those taking medication which could interfere with appetite or food intake, significant learning, behavioral, or emotional difficulties, and those who disliked, or were not willing to consume, the standard breakfast, the preloads or pizza lunch were excluded. At the screening, the study was explained and informed written consent was obtained from the parent and written assent from their child. The children were asked to select
the type of pizza they would prefer to eat during the test visits. Physical measurements of height and weight were taken. Screening materials are available at Appendix II. The DEBQ for children was also administered at the screening to assess eating behavior (Appendix III). BIA measurements were taken before the start of one of the study sessions. All study sessions took place on weekend mornings and at least 7 days apart. Parents and participants chose a time for their session start time and a day based on the time the child normally consumes breakfast and was most convenient for them and were asked to arrive at the same time for each subsequent session (e.g. every Saturday at 10:00 am).

4.3. Experimental procedure

On separate mornings, at least 7 days apart, participants arrived at the Department of Nutritional Sciences, University of Toronto, two hours after the consumption of a standardized breakfast of Parmalat fat-free skim milk (250mL, 91 Kcal), Honey Nut Cheerios (26g, 103 Kcal), and Tropicana orange juice (236mL, 110 Kcal) at home. Prior to consuming the standardized breakfast, participants fasted for 10-12 h. Participants were also requested not to consume anything aside from the breakfast prior to arriving at the lab with the exception of water, which was allowed up until 1 h prior to arrival.

Upon arrival, the participants were asked if they had consumed the entire breakfast, if any other foods were consumed 12-14 h prior to arrival and if they were taking any medication (compliance survey). If the child was not sure about any of the above, their parents were contacted for confirmation. If they reported significant deviations from their usual patterns, they were asked to reschedule.

The study procedure is shown in Figure 4-1. Participants completed a baseline Motivation-To-Eat (MTE) VAS to measure appetite, thirst and a physical comfort (PC) VAS. After completion of baseline VAS, participants were provided with either the CON or GLU drink and were directed to drink it within 5 min. Upon completion of the preload, a VAS was given to measure sweetness of the preload as well as to measure PC. This was followed by 25 min of sedentary activities such as Sudoku, word puzzles, reading, Jenga, dominoes, and checkers. The topic of food and any related topic were avoided and if a participant inquired about any such
topic the topic was changed. Activities were interrupted at 15 min for another VAS to measure appetite, thirst and PC. At the end of this 30 min period, another VAS was given to assess appetite, thirst and PC. The participants were then exposed to either FA or NFA in the TV program for duration of 30 min while eating an ad libitum pizza meal and their food intake was measured. Upon completion of the test meal, participants filled out a final VAS to assess appetite, thirst, PC, the palatability of the pizza meal and the acceptability of the TV show.
Figure 4-0-1 Study protocol

Standard breakfast

CON/GLU\(^1\) preload

Pizza lunch\(^2\) and TVV\(^3\)

-120 min 0 min 5 min 15 min 30 min 60 min

MTE PC PC PC MTE PC MTE

PC DS DS PC PC PC

FP FP FP TVA TVA TVA

1 Control (non-caloric sweetener) or glucose (1 g/kg body weight) in 250 ml or water was given in an opaque covered mug with a straw and consumed within 5 min followed by 50 ml of water

2 A glass of filtered water was presented with the test meal and replaced with a new glass once emptied

3 Visual Analog Scale legend: MTE, Motivation To Eat; PC, Physical Comfort; DS, Drink Sweetness; DP, Drink Palatability; FP, Food Palatability; TVA, TV program Acceptability.
4.3.1. Television viewing protocol

In each cubicle there was a TV and DVD player set up before participants’ arrival in the feeding room. After the participants were provided with the first tray of pizza, they were asked to wear the headphones to prevent disturbing other participants in adjacent cubicles. Based on their treatment for that day, an episode of “the Simpsons” including either FA or NFA was played and the volume was adjusted to the participant’s preference. A 30 min countdown timer was started as soon as the episode was started. This timer was used to mark the end of the feeding session. Four different episodes were randomly assigned for each session to avoid boredom from the TV program.

4.3.2. Advertisements protocol

To assess the effect of FA, they were incorporated in a TV show to ensure the participants paid attention to the shows. Four episodes of “the Simpsons” were screened to ensure absence of food cues; any scene that contained food related topics were removed while keeping the storyline intact. For each participant, two episodes were randomly selected to include FA; the other two included NFA.

There were four commercial breaks in each episode and each commercial break was two min long. The first commercial break was incorporated right after the titles. The rest of the commercial breaks were incorporated in five minute intervals. The length of the episodes including the commercials was 30 min (Figure 4-2).

The commercials were recorded from the local TV from children’s programs played in Saturday morning shows or during weekday afternoons from animated programs such as “the Simpsons” and “Family guy”. The FA category contained 15 commercials including eight fast food restaurants, four candies, two breakfast cereals and one orange juice. The NFA category included 15 commercials that did not have food cues including ads for eight toys, three sneakers, two theme parks, one movie and one toy store. The FA were randomly sequenced to make a total of 8 min (four two min intervals) of advertisements. The same sequence was used for all the participants. Same procedure was used with NFA.
Random sequence of FA

An episode of the Simpsons

An episode including FA

**Figure 4-0-2 Advertisements protocol.** Food advertisements were randomly sequenced to make a total of 8 min of advertisements. These ads were incorporated in an episode of the Simpsons that contained no food cues to make a total of 30 min of a TV show. The same procedure was used with NFA.
4.4. Measures and Data analysis

4.4.1. Preload treatment

Energy intake after a caloric preload is commonly used as a measure of short term satiety signals after energy intake in adults [20, 126, 137] and children [3, 102, 103]. Children show excellent caloric compensation in response to sugar preloads by reducing their food intake 30 min later by an amount approximating the calories in the preload drinks. In this study, a similar approach was used to assess the effect of FA on short term satiety signals and food intake.

Over the course of the four sessions, each participant received two caloric and two non-caloric preloads such that one of each was consumed during each of the FA and NFA sessions. The caloric drink (GLU) contained 1.0 g/kg body weight GLU monohydrate (Grain Process Enterprises, Toronto, ON Canada) in 250 ml of water. The other was a non-caloric CON drink, which was matched for sweetness and flavor by addition of the high-intensity sweetener SPLENDÁ® Sucralose (donated by Tate and Lyle Sucralose, Inc. Deautur, IL) to 250 ml of water; this sweetener was used because it is not metabolized in the body and does not alter blood glucose or insulin secretion [138]. To each test preload, aspartame-sweetened, orange-flavored crystals (1.1 g, Sugar Free Kool-Aid, Kraft Canada Inc., Don Mills, ON Canada) was added to standardize flavor.

Test preloads were prepared on the Friday evening, before the weekend sessions and were stored in the refrigerator until 30 min before they were consumed in covered, opaque cups on the Saturday or Sunday morning. Preload treatments were administered in random and balanced order. Participants consumed the chilled drinks, in < 5 min, followed by 50 ml of water to minimize aftertaste. After consumption of the preloads, the participants were engaged in sedentary activities. The pizza lunch was served 30 min following the initiation of the preload.
4.4.2. Food Intake

Two varieties of five inch diameter pizza were offered for the test meal. The pizzas (Deep ‘N Delicious, McCain Canada Ltd., Florenceville, Canada) were selected due to their lack of outer crust and uniform composition. The participants had the options to choose between Three Cheese or Pepperoni; this choice was made during the screening session and was constant between sessions. The energy content of both types of pizza is listed 180 Kcal per pizza. The energy content and macronutrient information is provided by the manufacturer (Appendix IV). Thirty min after the beginning of the consumption of the CON or GLU drinks, the participant was escorted to a cubicle and seated in front of a TV. While watching the TV, the participants were served ad libitum pizza of a variety selected by the participant at the screening. Participants were instructed to eat until they were ‘comfortably full’. They were given a fresh hot tray of three pizzas at the start of the meal followed by trays served in regular 10 min intervals; if participants finished a tray before the 10 min mark, a new tray was offered as soon as available. The maximum number of trays served was 6 trays with a new tray provided every 6 min. A glass of filtered water was also provided for consumption with the lunch. More water was provided upon request.

The pizzas were cooked and cut into four equal pieces and weighed before they were served to the participants. Left over pizzas were weighed again and subtracted from the initial weight of the pizza to determine the net weight consumed in grams. Grams consumed were then converted to Kcal consumed using information provided by manufacturer. Five hundred milliliter of filtered water was also provided with the lunch. Grams of water consumed were measured by subtracting the weight of the leftover water from the initial weight of the water. Extra water was provided if requested.
4.4.3. Subjective appetite

Motivation- to -eat VAS was used to measure subjective appetite and thirst [102, 125, 127, 131, 139-141]. Four questions were asked to measure different dimensions of subjective appetite (Appendix V). 1) How strong is your desire to eat? (‘Very weak’ to ‘Very strong’), 2) How hungry do you feel? (‘Not hungry at all’ to ‘As hungry as I’ve ever felt’), 3) How full do you feel? (‘Not full at all’ to ‘Very full’), 4) How much food do you think you could eat? (‘Nothing at all’ to ‘A large amount’). To assess thirst, participants were asked: How thirsty do you feel? (‘Not thirsty at all’ to ‘As thirsty as I have ever felt’). This VAS was administered at baseline (0min) and in 15 min intervals pre-meal and immediately post-meal.

Each question was followed by a 100 mm line anchored with two opposing statements and participants marked an “X” anywhere on the line to indicate how they felt at the time. Scores were calculated by measuring the distance in mm from the left of the line to the “X”. To determine an average appetite score, desire to eat, hunger and PFC as well as 100 minus fullness are added and divided by 4 (Equation 4-1). This VAS, as well as the calculation for average appetite have been validated in adults [142] and have been used previously in children [3, 102, 125, 127, 131, 139-141].

Equation 4-1: Average appetite (mm) = [(desire to eat + hunger + (100 – fullness) + PFC)*1/4].

PFC, prospective food consumption.
4.4.4. Subjective Physical Comfort

The physical comfort VAS was used to assess the participant’s wellbeing by asking the participant ‘How well do you feel?’ with a range of ‘Not well at all’ to ‘Very well’ [102, 125, 127, 131, 139-141]. This VAS was provided at baseline (0 min), immediately after consumption of treatment drink, at 15 min, immediately before and after the pizza lunch (Appendix V).

4.4.5. Subjective Palatability

The VAS was used to assess the participant’s enjoyment of the meal and preload by asking the question ‘How pleasant have you found the food?’ with a range of ‘Very pleasant’ to ‘Not at all pleasant’ [102, 125, 127, 131, 139-141]. This VAS was administered immediately after treatment drink and pizza lunch (Appendix V).

4.4.6. Subjective Sweetness

The sweetness VAS was used to assess the participant’s perception of the sweetness of the treatment drink by asking the question ‘How sweet have you found the beverage?’ with a range of ‘Extremely sweet’ to ‘Not sweet at all’ [102, 125, 127, 131, 139, 141]. This VAS was administered immediately after treatment drink (Appendix V).

4.4.7. Subjective Acceptance

The acceptability VAS was used to assessed the participant’s enjoyment of the TV program by asking the question ‘How well did you enjoy the TV program?’ with a range of ‘Very well’ to ‘Not well at all’. This VAS was administered immediately post-meal (Appendix V).
4.4.8. Estimate of body fat mass

Bioelectrical Impedance Analysis (RJL Systems BIA 101Q, Detroit) was used to assess body composition as previously used in our lab [102, 127, 131, 139]. Prior to measurements, participants were taken to the washroom and where asked to empty their bladder. Then they were taken to the screening room where they were instructed to lay supine on a mat with the right shoe and sock removed. The instruction provided by the company was used for electrode placement on the body. The skin was first wiped with alcohol and then the signal electrode was placed on the first joint of the middle finger and another at the base of the second toe on the right side of the body. The reactance and resistance were recorded for each participants and were used to estimate percentage of body fat using Equation 4-2 [143]:

\[
\text{Equation 4-2: Fat mass} = \frac{W - (3.474 + 0.459*H^2/R + 0.064*W)}{0.769 - 0.009*A - 0.016*S}
\]

\(H= \text{Height (cm)}\)

\(R= \text{Resistance}\)

\(A= \text{Age}\)

\(W= \text{Weight (kg)}\)

\(S= \text{sex, 1 for male, 0 for female}\)
4.4.9. Eating behavior Assessment

In these studies, the DEBQ for children which was developed and validated by van Strien et al. [132] was used to assess restraint, emotional and external eating behavior.

4.4.9.1. Emotional eating behavior

Seven questions assess emotional eating by asking: “If you feel depressed do you get a desire for food?”, “If you feel lonely do you get a desire for food?”, “Does worrying make you feel like eating?”, “If things go wrong do you get a desire for food?”, “Do you have a desire to eat when you feel restless?”, “Do you have a desire for food when you are afraid?” and “If you feel sorry do you feel like eating?”. (Appendix IV). The participants have three options to answer these questions “yes”, “sometimes” or “no”. These answers are scored as “yes = 3”, “sometimes = 2” or “no = 1”. The average score for all 7 questions is considered as emotional eating score, with higher scores suggesting higher emotional eating behavior.

4.4.9.2. External eating behavior

Six questions examine characteristics of external eating by asking: “Do you feel like eating whenever you see or smell good food?”, “Does walking past a candy store make you feel like eating?”, “Does watching others eat make you feel like eating too?”, “Do you find it difficult to stay away from delicious food?”, “Do you feel like eating when you walk past a restaurant or fast food restaurant?” and “If somebody prepares food do you get an appetite?”. (Appendix VII). The participants have three options to answer these questions “yes”, “sometimes” or “no”. These answers are scored as “yes = 3”, “sometimes = 2” or “no = 1”. The average score for all 6 questions is considered as emotional eating score, with higher scores suggesting higher emotional eating behavior.

4.4.9.3. Restraint eating behavior

Seven questions analyze restrained eating characteristic by asking “Do you keep an eye on exactly what you eat?”, “Do you intentionally eat food that helps you lose weight?”, “If you have eaten too much do you eat less than usual on the next days?”, “Do you intentionally eat less to avoid gaining weight?”, “Have you ever tried not to eat in between meals to lost
weight?”, “Have you ever tried to avoid eating after your evening meal to lose weight?”, “Do you ever think that food will be flattening or slimming when you eat?” (Appendix VII). The participants have three options to answer these questions “yes”, “sometimes” or “no”. These answers are scored as “yes = 3”, “sometimes= 2” or “no = 1”. The average score for all 7 questions is considered as emotional eating score, with higher scores suggesting higher restraint.
4.5. Data analysis

Statistical analysis was done in each of study 1 and study 2, using SAS 9.2 (Statistical Analysis Systems, SAS Institute Inc., Carey, NC). A p-value less than 0.05 was used to determine significance. Values are presented as mean ± standard error of the mean (SEM). Tukey-Kramer post hoc test was used for mean comparisons if interactions occurred among main factors.

One-factor ANOVA was used to compare group (NW vs. OW/OB) characteristics including age, weight (kg), height (m), BMI percentile as well as restraint, external and emotional eating scores.

Three-factor ANOVA was used for analysis of the effect of weight status (NW vs. OW/OB), drink (CON vs. GLU) and ad type (FA vs. NFA) and their interaction on energy intake (kcal), cumulative energy intake, water intake as well as on VAS scores for drink sweetness and palatability, food palatability and TV program acceptability.

Three-factor ANOVA was used to assess the effect of weight status (NW vs. OW/OB), drink (CON vs. GLU), time and their interaction on pre-meal average appetite, desire-to-eat, hunger, fullness, PFC, thirst (Pre-meal VAS results from 15-30 min were expressed as change from baseline) and PC (Pre-meal VAS results from 5-30 min were expressed as change from baseline).

Three-factor ANOVA was used to assess the effect of weight status (NW vs. OW/OB), drink (CON vs. GLU), ad type (FA vs. NFA) and their interaction on post-meal average appetite, desire-to-eat, hunger, fullness, PFC, thirst and PC (Post-meal VAS result at 60 min was expressed as change from 30 min which represents the change from before and after food intake).

Pearson correlation coefficients were calculated to identify associations between BMI percentile and body FM as well as between food intake and each of weight, age, BMI percentile, percent FM, water intake, eating behavior scores and VAS scores. Pearson correlation coefficients were also calculated to identify associations between thirst and water intake, drink palatability and weight as well as restraint and caloric compensation.
5 Results

5.1 Participants

5.1.1 Study 1: Boys

Characteristics of the boys including age, weight, height, BMI percentile and cognitive restraint are presented in Table 5-1. Weight ($p = 0.004$), BMI percentile ($p < 0.001$), FM ($p < 0.001$) and the restraint scores ($p = 0.003$) but not height ($p = 0.677$), age ($p = 0.986$), external ($p = 0.412$) or emotional eating scores ($p = 0.897$) were lower and fat-free mass ($p < 0.001$) was higher in NW compared to OW/OB boys.

Table 5-1 Baseline characteristics in boys¹

<table>
<thead>
<tr>
<th></th>
<th>NW boys</th>
<th>OW/OB boys</th>
<th>p*</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>11</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>11.9 ± 0.2</td>
<td>11.7 ± 0.2</td>
<td>0.989</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>43.1 ± 1.3</td>
<td>64.6 ± 2.2</td>
<td>0.004</td>
</tr>
<tr>
<td>Height (m)</td>
<td>1.53 ± 0.01</td>
<td>1.57 ± 0.02</td>
<td>0.677</td>
</tr>
<tr>
<td>BMI percentile</td>
<td>54.4 ± 2.6</td>
<td>94.0 ± 0.5</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Fat mass (%)</td>
<td>14.8 ± 1.7</td>
<td>30.4 ± 1.7</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Fat-free mass (%)</td>
<td>85.2 ± 1.7</td>
<td>69.6 ± 1.7</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Restraint</td>
<td>1.4 ± 0.1</td>
<td>1.8 ± 0.1</td>
<td>0.003</td>
</tr>
<tr>
<td>External</td>
<td>1.9 ± 0.1</td>
<td>1.8 ± 0.1</td>
<td>0.412</td>
</tr>
<tr>
<td>Emotional</td>
<td>1.2 ± 0.1</td>
<td>1.2 ± 0.1</td>
<td>0.897</td>
</tr>
</tbody>
</table>

¹ Data are presented as Mean ± SEM. BMI, body mass index; NW, normal weight; OB, obese; OW, overweight.

* One-factor ANOVA with weight as the main factor.
5.1.2. Study 2: Girls

Baseline characteristics of the girls including age, weight, height, BMI percentile and cognitive restraint are presented in Table 5-2. Weight (p < 0.001), BMI percentile (p < 0.001), fat mass (p = 0.003) but not age (p = 0.973), height (p = 0.376), restraint (p = 0.182), external (p = 0.273) or emotional eating scores (p = 0.631) were lower and fat-free mass (p = 0.003) was higher in NW compared to OW/OB girls.

Table 5-2 Baseline characteristics in girls

<table>
<thead>
<tr>
<th></th>
<th>NW</th>
<th>OW/OB</th>
<th>p*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>girls</td>
<td>girls</td>
<td></td>
</tr>
<tr>
<td>n</td>
<td>14</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>11.8 ± 0.4</td>
<td>11.8 ± 0.6</td>
<td>0.973</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>43.0 ± 1.3</td>
<td>62.3 ± 1.7</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Height (m)</td>
<td>1.51 ± 0.03</td>
<td>1.54 ± 0.03</td>
<td>0.376</td>
</tr>
<tr>
<td>BMI percentile</td>
<td>55.2 ± 3.1</td>
<td>95.0 ± 0.4</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Fat mass (%)</td>
<td>24.6 ± 1.9</td>
<td>36.2 ± 3.2</td>
<td>0.003</td>
</tr>
<tr>
<td>Fat-free mass (%)</td>
<td>75.4 ± 1.9</td>
<td>63.8 ± 3.2</td>
<td>0.003</td>
</tr>
<tr>
<td>Restraint</td>
<td>1.6 ± 0.1</td>
<td>1.8 ± 0.1</td>
<td>0.182</td>
</tr>
<tr>
<td>External</td>
<td>1.8 ± 0.1</td>
<td>2.0 ± 0.1</td>
<td>0.273</td>
</tr>
<tr>
<td>Emotional</td>
<td>1.2 ± 0.1</td>
<td>1.3 ± 0.1</td>
<td>0.631</td>
</tr>
</tbody>
</table>

1 Data are presented as means ± SEM. BMI, body mass index; NW, normal weight; OB, obese; OW, overweight.

* One-factor ANOVA with weight as the main factor.
5.2. Food intake

5.2.1. Study 1: Boys

The treatment means for the effect of the main factors on food intake in boys are shown in Table 5-3. Drink (p < 0.001) but not ads (p = 0.397) nor weight (p = 0.123), affected food intake. Food intake was 18% lower after the GLU drink compared to CON. There was no drink by weight (p = 0.400) or ads by weight (p = 0.469) interactions. However, there was a drink by ads interaction (p = 0.042), explained by a 23% reduction in food intake after GLU drink while the children watched FA (p < 0.001) but only a reduction of 14% after NFA (p = 0.002), independent of weight. Furthermore, within each drink treatment, a post hoc analysis using a paired t-test shows a trend for the effect of ads on food intake (p = 0.062) indicating 7% higher food intake with FA compared to NFA after the CON drink but not after the GLU drink (p = 0.301).

Table 5-3 Food Intake (kcal) in NW and OW/OB boys.  

<table>
<thead>
<tr>
<th></th>
<th>NFA</th>
<th></th>
<th></th>
<th>FA</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CON</td>
<td>GLU</td>
<td>CON</td>
<td>GLU</td>
<td>pooled</td>
<td></td>
</tr>
<tr>
<td>NW boys</td>
<td>950 ± 79</td>
<td>782 ± 67</td>
<td>1010 ± 64</td>
<td>728 ± 52</td>
<td>868 ± 37</td>
<td></td>
</tr>
<tr>
<td>(n = 11)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OW/OB boys</td>
<td>1094 ± 103</td>
<td>970 ± 94</td>
<td>1184 ± 90</td>
<td>957 ± 91</td>
<td>1051 ± 48</td>
<td></td>
</tr>
<tr>
<td>(n = 16)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pooled</td>
<td>1035 ± 69</td>
<td>894 ± 64a</td>
<td>1113 ± 61</td>
<td>864 ± 61a</td>
<td>976 ± 33</td>
<td></td>
</tr>
<tr>
<td>(n = 27)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1 Data are presented as means ± SEM. CON, control no calories; GLU, glucose; FA, food ads; NFA, non-food ads; NW, normal weight; OB, obese; OW, over weight.

2 Drink (p < 0.001), ads (p = 0.397), weight (p = 0.123), drink*weight (p = 0.400), drink*ads (p = 0.042) and ads*weight (p = 0.469) (3-factor ANOVA with drink, ads and weight as main factors).

a Significantly different from CON (Tukey-Kramer post hoc test)
5.2.2. Study 2: Girls

The treatment means for the effect of the main factors on food intake are shown in Table 5-4. Drink (p < 0.001) but not ads nor weight (p > 0.05), affected food intake. Food intake was 15% lower after the GLU drink compared to the CON drink. There was a drink by weight interaction (p = 0.025), explained by a 21% reduction in food intake after the GLU drink in OW/OB (p < 0.001) but only 11% in NW girls (p = 0.014), independent of ads. There was also an ads by weight interaction (p = 0.012) but Tukey-Kramer post hoc test did not reveal the differences. However, within each of the NW and OW/OB groups, a post hoc analysis using a 2-factor ANOVA with drink and ads as main factors showed that food intake increased by 9% when children watched FA compared to NFA in OW/OB (p = 0.033) but not in NW girls (p = 0.306), regardless of type of drinks. There was no drink by ads interaction (p > 0.05).

Table 5-4 Food intake (kcal) in NW and OW/OB girls

<table>
<thead>
<tr>
<th></th>
<th>NFA</th>
<th>FA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CON</td>
<td>GLU</td>
</tr>
<tr>
<td>NW girls</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(n = 14)</td>
<td>696 ± 41</td>
<td>617 ± 27</td>
</tr>
<tr>
<td>OW/OB girls</td>
<td>798 ± 59</td>
<td>619 ± 66</td>
</tr>
<tr>
<td>(n = 9)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pooled</td>
<td>736 ± 35</td>
<td>618 ± 29</td>
</tr>
<tr>
<td>(n = 23)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1 Data are presented as means ± SEM. CON, control no calories; GLU, glucose; FA, food ads; NFA, non–food ads; NW, normal weight; OB, obese; OW, overweight.

2 Drink (p = 0.005), ads (p = 0.306) and drink*ads (p = 0.942) (2-factor ANOVA)

3 Drink (p <0.001), ads (p = 0.033) and drink*ads (p = 0.770) (2-factor ANOVA)

4 Drink (p < 0.001), ads (p = 0.244), weight (p = 0.179), drink*weight (p = 0.025), drink*ads (p = 0.798) and ads*weight (p = 0.012) (3-factor ANOVA).
5.3. Cumulative energy intake

5.3.1. Study1: Boys

The treatment means for the effect of the main factors on cumulative energy intake are shown in Table 5-5. There was no main effect of drink (p = 0.619), ads (p = 0.390) or weight (p = 0.080) on cumulative energy intake. There was an interaction between drink and ads (p = 0.038), as well as drink and weight (p = 0.029).

The drink by ads interaction is explained by a 7% increase in cumulative energy intake after the GLU drink while boys watched NFA (p = 0.006) but no effect with FA (p = 0.663), regardless of weight. Furthermore, within each drink treatment, a post hoc analysis using 2-factor ANOVA with ads and weight as main factors shows a trend for the effect of ads on food intake (p = 0.081) indicating 8% higher cumulative energy intake with FA compared to NFA after the CON drink but not after the GLU drink (p = 0.258).

In analysis of the interaction between drink and weight, Tukey-Kramer post hoc test did not reveal any significant differences. However, within each of the NW and OW/OB boys, post hoc analysis using a 2-factor ANOVA with drink and ads as main factors shows cumulative energy intake increased 7% after the GLU drink in OW/OB boys (p = 0.048) but was not affected in NW boys (p = 0.255), independent of ads.
Table 5-5 Cumulative energy intake (kcal) in NW and OW/OB boys.¹

<table>
<thead>
<tr>
<th></th>
<th>NFA</th>
<th></th>
<th>FA</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CON</td>
<td>GLU</td>
<td>CON</td>
<td>GLU</td>
<td>pooled</td>
<td></td>
</tr>
<tr>
<td>NW boys²</td>
<td>950 ± 79</td>
<td>958 ± 71</td>
<td>1010 ± 64</td>
<td>904 ± 55</td>
<td>955 ± 33</td>
<td></td>
</tr>
<tr>
<td>(n = 11)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OW/OB boys³</td>
<td>1094 ± 103</td>
<td>1223 ± 105</td>
<td>1184 ± 90</td>
<td>1210 ± 101</td>
<td>1178 ± 49</td>
<td></td>
</tr>
<tr>
<td>(n = 16)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pooled⁴</td>
<td>1035 ± 69</td>
<td>1115 ± 72ᵃ</td>
<td>1113 ± 61</td>
<td>1085 ± 69</td>
<td>1087 ± 34</td>
<td></td>
</tr>
<tr>
<td>(n = 27)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

¹ Data are presented as means ± SEM. CON, control no calories; GLU, glucose; FA, food ads; NFA, non – food ads; NW, normal weight; OB, obese; OW, over weight.

² Drink (p = 0.259), Ads (p = 0.943) and drink*ads (p = 0.170) (2-factor ANOVA)

³ Drink (p = 0.032), Ads (p = 0.260) and drink*ads (p = 0.115) (2-factor ANOVA)

⁴ Drink (p = 0.619), ads (p = 0.390), weight (p = 0.080), drink*weight (p = 0.029), drink*ads (p = 0.038) and ads*weight (p = 0.462) (3-factor ANOVA with drink, ads and weight as main factors).

ᵃ Significantly different from CON (NFA) (Tukey-Kramer post hoc test)
### 5.3.2. Study 2: Girls

The treatment means for the effect of the main factors on cumulative energy intake are shown in Table 5-6. Drink (p < 0.001) but not ads (p = 0.289) or weight (p = 0.054) affected cumulative energy intake in girls. Cumulative energy intake increased 12% after the GLU drink compared to the CON drink. There was a trend for effect of weight on cumulative energy intake where cumulative energy intake was 19% higher in OW/OB compared to NW girls.

There was also an ads by weight interaction (p = 0.017) but Tukey-Kramer post hoc test did not reveal the differences. However, within each of the NW and OW/OB groups, a post hoc analysis using a 2-factor ANOVA with drink and ads as main factors shows, cumulative energy intake was not affected by ads in NW (p = 0.262) but increased 8% with FA compared to NFA in OW/OB girls (p = 0.040), independent of drink.

<table>
<thead>
<tr>
<th></th>
<th>NFA</th>
<th>FA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CON</td>
<td>GLU</td>
</tr>
<tr>
<td><strong>NW girls</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(n = 14)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CON</td>
<td>696 ± 41</td>
<td>786 ± 28</td>
</tr>
<tr>
<td>GLU</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>OW/OB girls</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(n = 9)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CON</td>
<td>798 ± 59</td>
<td>868 ± 65</td>
</tr>
<tr>
<td>GLU</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Pooled</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(n = 23)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>736 ± 35</td>
<td>818 ± 31</td>
</tr>
</tbody>
</table>

Data are presented as means ± SEM. CON, control no calories; GLU, glucose; FA, food ads; NFA, non-food ads; NW, normal weight; OB, obese; OW, overweight.

Drink (p = 0.001), Ads (p = 0.288) and drink*ads (p = 0.939) (2-factor ANOVA).

Drink (p = 0.018), Ads (p = 0.040) and drink*ads (p = 0.779) (2-factor ANOVA).

Drink (p < 0.001), ads (p = 0.289), weight (p = 0.054), drink*weight (p = 0.727), drink*ads (p = 0.782) and ads*weight (p = 0.017) (3-factor ANOVA).

### 5.4. Caloric compensation
5.4.1.1. Study 1: Boys

The treatment means for the effect of the main factors on caloric compensation are shown in Table 5-7. Both ads (p = 0.014) and weight (p = 0.039) affected caloric compensation. Caloric compensation at meal time for the calories in the GLU drink increased from 70% to 121% when the program contained NFA and FA respectively. Furthermore, regardless of type of ads caloric compensation was higher in NW (131%) compared to OW/OB boys (71%). There was no interaction effect between main factors (p > 0.05).

Table 5-7 Meal-time caloric compensation (% CC) for the glucose drink in NW and OW/OB boys.¹

<table>
<thead>
<tr>
<th></th>
<th>NFA</th>
<th>FA</th>
<th>pooled</th>
</tr>
</thead>
<tbody>
<tr>
<td>NW boys (n = 11)</td>
<td>99 ± 24</td>
<td>162 ± 34</td>
<td>131 ± 21</td>
</tr>
<tr>
<td>OW/OB boys (n =16)</td>
<td>50 ± 12</td>
<td>93 ± 25</td>
<td>71 ± 14</td>
</tr>
<tr>
<td>Pooled² (n = 27)</td>
<td>70 ± 13</td>
<td>121 ± 21</td>
<td>96 ± 13</td>
</tr>
</tbody>
</table>

¹ Data are presented as means ± SEM. CC (%) = [CON food intake (kcal) - GLU food intake (kcal)/kcal in GLU] *100. CON, control no calories; GLU, glucose; FA, food ads; NFA, non – food ads; NW, normal weight; OB, obese; OW, over weight.

² Ads (p = 0.014), weight (p = 0.039), ads*weight (p = 0.620) (2-factor ANOVA with ads and weight as main factors).
5.4.1.2. Study 2: Girls

The treatment means for the effect of the main factors on caloric compensation are shown in Table 5-8. Average caloric compensation at meal time for calories in the GLU drink was 54% in girls and was not affected by ads (p = 0.723) or weight (p = 0.194). There was no interaction effect between main factors (p > 0.05).

Table 5-8 Meal-time caloric compensation (CC, %) for the glucose drink in NW and OW/OB girls.¹

<table>
<thead>
<tr>
<th></th>
<th>NFA</th>
<th>FA</th>
<th>pooled</th>
</tr>
</thead>
<tbody>
<tr>
<td>NW girls</td>
<td>47 ± 17</td>
<td>39 ± 24</td>
<td>43 ± 14</td>
</tr>
<tr>
<td>(n = 14)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OW/OB girls</td>
<td>75 ± 18</td>
<td>67 ± 20</td>
<td>71 ± 13</td>
</tr>
<tr>
<td>(n = 9)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pooled</td>
<td>58 ± 13</td>
<td>50 ± 16</td>
<td>54 ± 10</td>
</tr>
<tr>
<td>(n = 23)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

¹ Data are presented as Mean ± SEM. CC (%) = [CON food intake (kcal) - GLU food intake (kcal)/kcal in GLU] *100. CON, control no calories; GLU, glucose; FA, food ads; NFA, non–food ads; NW, normal weight; OB, obese; OW, overweight.

² Ads (p = 0.723), weight (p = 0.194), ads*weight (p = 0.995) (2-factor ANOVA).
5.5. Water intake

5.5.1. Study 1: Boys

The treatment means for the effect of the main factors on water intake are shown in Table 5-9. Average water intake was 225 ml and was not affected by drink (p = 0.484), ads (p = 0.762) or weight (p = 0.139) or the interaction between the main factors (p > 0.05).

Table 5-9 Water intake (ml) in NW and OW/OB boys

<table>
<thead>
<tr>
<th></th>
<th>NFA CON</th>
<th>GLU</th>
<th>FA CON</th>
<th>GLU</th>
<th>pooled</th>
</tr>
</thead>
<tbody>
<tr>
<td>NW boys (n = 11)</td>
<td>175 ± 47</td>
<td>164 ± 32</td>
<td>189 ± 50</td>
<td>181 ± 37</td>
<td>177 ± 20</td>
</tr>
<tr>
<td>OW/OB boys (n = 16)</td>
<td>275 ± 43</td>
<td>264 ± 39</td>
<td>257 ± 41</td>
<td>235 ± 42</td>
<td>258 ± 20</td>
</tr>
<tr>
<td>Pooled (n = 27)</td>
<td>234 ± 33</td>
<td>224 ± 28</td>
<td>229 ± 32</td>
<td>213 ± 29</td>
<td>225 ± 15</td>
</tr>
</tbody>
</table>

1 Data are presented as means ± SEM. CON, control no calories; GLU, glucose; FA, food ads; NFA, non-food ads; NW, normal weight; OB, obese; OW, over weight.

2 Drink (p = 0.484), ads (p = 0.762), weight (p = 0.139), drink*weight (p = 0.846), drink*ads (p = 0.899) and ads*weight (p = 0.177) (3-factor ANOVA).
5.5.2. Study 2: Girls

The treatment means for the effect of the main factors on water intake are shown in Table 5-10. Average water intake was 163 ml and was not affected by drink (p = 0.484), ads (p = 0.762) or weight (p = 0.139). There was no interaction effect between the main factors (p > 0.05).

Table 5-10 Water intake (ml) in NW and OW/OB girls

<table>
<thead>
<tr>
<th></th>
<th>NFA</th>
<th>FA</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CON</td>
<td>GLU</td>
<td>CON</td>
<td>GLU</td>
</tr>
<tr>
<td>NW girls</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(n = 14)</td>
<td>120 ± 38</td>
<td>136 ± 40</td>
<td>123 ± 36</td>
<td>132 ± 34</td>
</tr>
<tr>
<td>OW/OB girls</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(n = 9)</td>
<td>212 ± 56</td>
<td>218 ± 37</td>
<td>215 ± 50</td>
<td>231 ± 51</td>
</tr>
<tr>
<td>Pooled</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(n = 23)</td>
<td>156 ± 33</td>
<td>168 ± 29</td>
<td>159 ± 30</td>
<td>171 ± 30</td>
</tr>
</tbody>
</table>

Data are presented as means ± SEM. CON, control no calories; GLU, glucose; FA, food ads; NFA, non-food ads; NW, normal weight; OB, obese; OW, overweight. Drink (p = 0.485), ads (p = 0.807), weight (p = 0.096), drink*weight (p = 0.966), drink*ads (p = 0.953) and ads*weight (p = 0.775) (3-factor ANOVA).
5.6. Subjective appetite

5.6.1. Pre-meal subjective appetite

5.6.1.1. Study 1: Boys

The treatment means for the effect of the main factors on average changes from baseline in subjective appetite scores pre-meal are shown in Table 5-11. Pre-meal average appetite, desire-to-eat, hunger, fullness, PFC and thirst were affected by time (p < 0.005) but not drink or weight (p > 0.05). Average appetite (9 mm), desire-to-eat (11 mm), hunger (10 mm), and PFC (8 mm) increased and fullness (7 mm) and thirst (8 mm) decreased over time in the pre-meal period (between 0 to 30 min). There was no interaction between the effects of main factors.
### Table 5-11

Average change from baseline in pre-meal subjective appetite score (mm) in boys: Effect of drink, weight and time$^1$

<table>
<thead>
<tr>
<th>Drink</th>
<th>Weight</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>CON</td>
<td>GLU</td>
<td>NW</td>
</tr>
<tr>
<td>Average appetite$^2$</td>
<td>5 ± 1</td>
<td>4 ± 1</td>
</tr>
<tr>
<td>Desire-to-eat$^3$</td>
<td>7 ± 1</td>
<td>5 ± 1</td>
</tr>
<tr>
<td>Hunger$^4$</td>
<td>7 ± 1</td>
<td>5 ± 1</td>
</tr>
<tr>
<td>Fullness$^5$</td>
<td>-2 ± 2</td>
<td>-3 ± 1</td>
</tr>
<tr>
<td>PFC$^6$</td>
<td>5 ± 1</td>
<td>3 ± 1</td>
</tr>
<tr>
<td>Thirst$^7$</td>
<td>-6 ± 2</td>
<td>-7 ± 2</td>
</tr>
</tbody>
</table>

$^1$Data are presented as means ± SEM, change from baseline (0 min) (n = 27; NW, n = 11). CON, control; GLU, glucose; NW, normal weight; OB, obese; OW, over weight; PFC, prospective food consumption.

$^2$Average appetite (mm) = [desire to eat + hunger + (100 − fullness) + PFC]/4]. Time (p < 0.001), drink (p = 0.369), weight (p = 0.302), time*drink (p = 0.757), time*weight (p = 0.246) and drink*weight (p = 0.243) (3-factor ANOVA).

$^3$Time (p < 0.001), drink (p = 0.201), weight (p = 0.636), time*drink (p = 0.433), time*weight (p = 0.634) and drink*weight (p = 0.404) (p = 0.643) (3-factor ANOVA).

$^4$Time (p < 0.001), drink (p = 0.398), weight (p = 0.187), time*drink (p = 0.749), time*weight (p = 0.158) and drink*weight (p = 0.104) (3-factor ANOVA).

$^5$Time (p = 0.003), drink (p = 0.716), weight (p = 0.144), time*drink (p = 0.851), time*weight (p = 0.084) and drink*weight (p = 0.984) (3-factor ANOVA).

$^6$Time (p < 0.001), drink (p = 0.174), weight (p = 0.737), time*drink (p = 0.608), time*weight (p = 0.836) and drink*weight (p = 0.689) (3-factor ANOVA).

$^7$Time (p < 0.001), drink (p = 0.747), weight (p = 0.828), time*drink (p = 0.722), time*weight (p = 0.832) and drink*weight (p = 0.790) (3-factor ANOVA).
5.6.1.2. Study2 : Girls

The treatment means for the effect of the main factors on average changes from baseline in subjective appetite scores pre-meal are shown in Table 5-12. Pre-meal average appetite, desire-to-eat, hunger, PFC and thirst were only affected by time (p < 0.01) but not drink or weight (p > 0.05). Average appetite (9 mm), desire-to-eat (12 mm), hunger (12 mm) and PFC (7 mm) increased and thirst (9 mm) decreased over time in the pre-meal period (between 0 to 30 min). Fullness was not affected by any of the time (p = 0.216), drink (p = 0.443) or weight (p = 0.920). There was a time by weight interaction in their effects on hunger (p = 0.042), explained by an average of 16 mm increase in pre-meal hunger over time in NW (p < 0.001) but not in OW/OB girls (p = 0.394).
Table 5-12: Average change from baseline in pre-meal subjective appetite score (mm) in girls: Effect of drink, weight and time.

<table>
<thead>
<tr>
<th>Drink</th>
<th>Weight</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>CON</td>
<td>GLU</td>
<td>NW</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average appetite$^2$</td>
<td>5 ± 1</td>
<td>4 ± 1</td>
</tr>
<tr>
<td>Desire-to-eat$^3$</td>
<td>8 ± 2</td>
<td>5 ± 1</td>
</tr>
<tr>
<td>Hunger$^4$</td>
<td>7 ± 1</td>
<td>6 ± 1</td>
</tr>
<tr>
<td>Fullness$^5$</td>
<td>-2 ± 2</td>
<td>0 ± 1</td>
</tr>
<tr>
<td>PFC$^6$</td>
<td>4 ± 1</td>
<td>3 ± 1</td>
</tr>
<tr>
<td>Thirst$^7$</td>
<td>-7 ± 2</td>
<td>-7 ± 2</td>
</tr>
</tbody>
</table>

$^1$ Data are presented as means ± SEM, change from baseline (n = 23; NW, n = 14). CON, control; GLU, glucose; NW, normal weight; OB, obese; OW, overweight; PFC, prospective food consumption.

$^2$ Average appetite (mm) = [desire to eat + hunger + (100 – fullness) + PFC)/4]. Time (p < 0.001), drink (p = 0.233), weight (p = 0.438), time*drink (p = 0.613), time*weight (p = 0.153), drink*weight (p = 0.947) (3-factor ANOVA).

$^3$ Time (p < 0.001), drink (p = 0.139), weight (p = 0.490), time*drink (p = 0.526), time*weight (p = 0.296), drink*weight (p = 0.709) (3-factor ANOVA).

$^4$ Time (p < 0.001), drink (p = 0.602), weight (p = 0.223), time*drink (p = 0.577), time*weight (p = 0.038), drink*weight (p = 0.614) (3-factor ANOVA).

$^5$ Time (p = 0.216), drink (p = 0.443), weight (p = 0.920), time*drink (p = 0.851), time*weight (p = 0.996), drink*weight (p = 0.984) (3-factor ANOVA).

$^6$ Time (p = 0.003), drink (p = 0.475), weight (p = 0.623), time*drink (p = 0.847), time*weight (p = 0.275), drink*weight (p = 0.466) (3-factor ANOVA).

$^7$ Time (p < 0.001), drink (p = 0.993), weight (p = 0.427), time*drink (p = 0.847), time*weight (p = 0.275), drink*weight (p = 0.466) (3-factor ANOVA).
5.6.2. Post-meal subjective appetite

5.6.3. Study 1: Boys

The treatment means for the main factors on post-meal subjective appetite score change from 30 min are shown in Table 5-13. Post-meal average appetite, desire-to-eat, hunger, fullness and PFC were not affected by any of the factors ($p > 0.05$). Only ads ($p < 0.001$) but not drink ($p = 0.301$) or weight ($p = 0.386$) affected thirst. Thirst was less reduced, on average by 13mm, post-meal when boys watched FA compared to NFA.
Table 5-13 Change in post-meal subjective appetite score (mm) in boys: Effect of drink, ads and weight.¹

<table>
<thead>
<tr>
<th></th>
<th>Drink</th>
<th>Ads</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CON</td>
<td>GLU</td>
<td>NFA</td>
</tr>
<tr>
<td>Average appetite²</td>
<td>-52 ± 3</td>
<td>-51 ± 3</td>
<td>-52 ± 3</td>
</tr>
<tr>
<td>Desire-to-eat³</td>
<td>-50 ± 4</td>
<td>-50 ± 4</td>
<td>-50 ± 4</td>
</tr>
<tr>
<td>Hunger⁴</td>
<td>-52 ± 4</td>
<td>-47 ± 4</td>
<td>-49 ± 4</td>
</tr>
<tr>
<td>Fullness⁵</td>
<td>54 ± 4</td>
<td>56 ± 3</td>
<td>56 ± 4</td>
</tr>
<tr>
<td>PFC ⁶</td>
<td>-54 ± 4</td>
<td>-51 ± 4</td>
<td>-52 ± 4</td>
</tr>
<tr>
<td>Thirst⁷</td>
<td>-5 ± 4</td>
<td>-10 ± 4</td>
<td>-14 ± 3</td>
</tr>
</tbody>
</table>

¹ Data are presented as means ± SEM, post-meal (60 min) minus pre-meal (30 min) (n = 27; NW, n = 11). CON, control; FA, food ads; GLU, glucose; NFA, non-food ads; NW, normal weight; OB, obese; OW, over weight; PFC, prospective food consumption.

² Average appetite (mm) = [desire to eat + hunger + (100 – fullness) + PFC)/4]. Drink (p = 0.683), weight (p = 0.841), ads (p = 0.782), drink*weight (p = 0.450), drink*ads (p = 0.539) and ads*weight (p = 0.276) (3-factor ANOVA).

³ Drink (p = 0.672), weight (p = 0.652), ads (p = 0.914), drink*weight (p = 0.103), drink*ads (p = 0.713) and ads*weight (p = 0.295) (3-factor ANOVA).

⁴ Drink (p = 0.364), weight (p = 0.809), ads (p = 0.999), drink*weight (p = 0.228), drink*ads (p = 0.412) and ads*weight (p = 0.533) (3-factor ANOVA).

⁵ Drink (p = 0.881), weight (p = 0.878), ads (p = 0.587), drink*weight (p = 0.254), drink*ads (p = 0.997) and ads*weight (p = 0.871) (3-factor ANOVA).

⁶ Drink (p = 0.399), weight (p = 0.532), ads (p = 0.847), drink*weight (p = 0.485), drink*ads (p = 0.427) and ads*weight (p = 0.056) (3-factor ANOVA).

⁷ Drink (p = 0.301), weight (p = 0.386), ads (p < 0.001), drink*weight (p = 0.644), drink*ads (p = 0.591) and ads*weight (p = 0.512) (3-factor ANOVA).
5.6.4. Study 2: Girls

The treatment means for the effect of the main factors on post-meal subjective appetite score change from 30 min are shown in Table 5-14. Post-meal average appetite, desire-to-eat, hunger, fullness, PFC and thirst were not affected by any of the main factors (p > 0.05). There was a drink by weight interaction on PFC (p = 0.046), explained by an average of 8 mm higher decrease in post-meal PFC after the CON drink (-43 ± 5) compared to the GLU drink (-35 mm ± 5) in NW but no effect in OW/OB girls (GLU, -43 ± 7 vs. CON, -39 ± 7) however the Tukey-Kramer post hoc test did not reveal the differences.
**Table 5-14** Change in post-meal subjective appetite score (mm) in girls: Effect of drink, ads and weight

<table>
<thead>
<tr>
<th></th>
<th>Drink</th>
<th>Ads</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CON</td>
<td>GLU</td>
<td>NFA</td>
</tr>
<tr>
<td>Average appetite$^2$</td>
<td>-46 ± 4</td>
<td>-42 ± 3</td>
<td>-44 ± 4</td>
</tr>
<tr>
<td>Desire-to-eat$^3$</td>
<td>-44 ± 5</td>
<td>-37 ± 4</td>
<td>-41 ± 5</td>
</tr>
<tr>
<td>Hunger$^4$</td>
<td>-46 ± 4</td>
<td>-42 ± 4</td>
<td>-46 ± 4</td>
</tr>
<tr>
<td>Fullness$^5$</td>
<td>52 ± 5</td>
<td>50 ± 5</td>
<td>51 ± 5</td>
</tr>
<tr>
<td>PFC$^6$</td>
<td>-41 ± 4</td>
<td>-38 ± 4</td>
<td>-41 ± 4</td>
</tr>
<tr>
<td>Thirst$^7$</td>
<td>-10 ± 4</td>
<td>-10 ± 4</td>
<td>-9 ± 4</td>
</tr>
</tbody>
</table>

$^1$ Data are presented as means ± SEM, post-meal (60 min) minus pre-meal (30 min) (n = 23; NW, n = 14). CON, control; FA, food ads; GLU, glucose; NFA, non-food ads; NW, normal weight; OB, obese; OW, overweight; PFC, prospective food consumption.

$^2$ Average appetite (mm) = [desire to eat + hunger + (100 – fullness) + PFC]/4]. Drink (p = 0.168), weight (p = 0.839), ads (p = 0.826), drink*weight (p = 0.094), drink*ads (p = 0.637) and ads*weight (p = 0.221) (3-factor ANOVA).

$^3$ Drink (p = 0.118), weight (p = 0.952), ads (p = 0.899), drink*weight (p = 0.265), drink*ads (p = 0.525) and ads*weight (p = 0.533) (3-factor ANOVA).

$^4$ Drink (p = 0.163), weight (p = 0.452), ads (p = 0.355), drink*weight (p = 0.586), drink*ads (p = 0.751) and ads*weight (p = 0.787) (3-factor ANOVA).

$^5$ Drink (p = 0.684), weight (p = 0.200), ads (p = 0.748), drink*weight (p = 0.279), drink*ads (p = 0.129) and ads*weight (p = 0.177) (3-factor ANOVA).

$^6$ Drink (p = 0.550), weight (p = 0.855), ads (p = 0.649), drink*weight (p = 0.046), drink*ads (p = 0.868) and ads*weight (p = 0.306) (3-factor ANOVA).

$^7$ Drink (p = 0.960), weight (p = 0.381), ads (p = 0.393), drink*weight (p = 0.660), drink*ads (p = 0.288) and ads*weight (p = 0.054) (3-factor ANOVA).
5.7. Physical comfort

5.7.1. Pre-meal physical comfort

5.7.1.1. Study 1: Boys

The treatment means for the effect of the main factors on pre-meal physical comfort average change from baseline are shown in Table 5-15. Time (p = 0.041) but not drink (p = 0.112) or weight (p = 0.442) affected pre-meal physical comfort. Physical comfort was on average 6 mm less than baseline after consumption of the drinks (5 min vs. 0 min, p = 0.046) and then increased to baseline value at 30 min (30 min vs. 0 min, p = 0.913). There was no interaction between the main factors effect (p > 0.05).

Table 5-15 Average change from baseline in pre-meal physical comfort (mm) in boys: Effect of drink, weight and time1

<table>
<thead>
<tr>
<th>Drink</th>
<th>Weight</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CON</td>
<td>NW</td>
</tr>
<tr>
<td>Physical comfort</td>
<td>-4 ± 1</td>
<td>-4 ± 1</td>
</tr>
</tbody>
</table>

1 Data are presented as means ± SEM, change from baseline (0 min) (n = 27; NW, n = 11). CON, control; GLU, glucose; NW, normal weight; OB, obese; OW, over weight; PFC, prospective food consumption.

2 Time (p = 0.041), drink (p = 0.112), weight (p = 0.442), time*drink (p = 0.649), time*weight (p = 0.880) and drink*weight (p = 0.484) (3-factor ANOVA).

a Significantly different from 0 min (p = 0.046, Tukey-Kramer post hoc test)
5.7.1.2. Study 2: Girls

The treatment means for the effect of the main factors on pre-meal physical comfort average change from baseline are shown in Table 5-16. Time (p = 0.003) but not drink (p = 0.102) or weight (p = 0.170) affected pre-meal physical comfort. Physical comfort was on average 5mm less than baseline after consumption of the drinks at 5 min (0 min vs. 5 min, p = 0.015), then increased to the baseline value at 30 min (5 min vs. 30 min, p = 0.004). There was no interaction among the effect of the main factors (p > 0.05).

Table 5-16 Average change from baseline in pre-meal physical comfort (mm) in girls: Effect of drink, weight and time

<table>
<thead>
<tr>
<th>Drink</th>
<th>Weight</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>CON</td>
<td>GLU</td>
<td>NW</td>
</tr>
<tr>
<td>CON</td>
<td>GLU</td>
<td>OW/OB</td>
</tr>
<tr>
<td></td>
<td>0 ± 1</td>
<td>0 ± 1</td>
</tr>
</tbody>
</table>

Data are presented as means ± SEM, change from baseline (0 min) (n = 23; NW, n = 14). CON, control; GLU, glucose; NW, normal weight; OB, obese; OW, overweight.

Time (p = 0.003), drink (p = 0.102), weight (p = 0.170), time*drink (p = 0.477), time*weight (p = 0.342), drink*weight (p = 0.448) (3-factor ANOVA).

a Significantly different from 0 min (p = 0.015, Tukey-Kramer post hoc test)

b Significantly different from 5 min (p = 0.004, Tukey-Kramer post hoc test)
5.7.2. Post-meal physical comfort

5.7.2.1. Study 1: Boys

The treatment means for the effect of the main factors on post-meal subjective appetite score change from 30 min are shown in Table 5-17. None of the drink (p = 0.634), weight (p = 0.301), ads (p = 0.655) or interactions among the factors (p > 0.05) affected post-meal physical comfort.

Table 5-17 Change in post-meal physical comfort (mm) in boys: Effect of drink, ads and weight

<table>
<thead>
<tr>
<th>Drink</th>
<th>Ads</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CON</td>
<td>GLU</td>
<td>NFA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>FA</td>
</tr>
<tr>
<td>NW</td>
<td></td>
<td>OW/OB</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Physical comfort | -2 ± 3 | -4 ± 4 | -3 ± 4 | -2 ± 4 | 3 ± 4 | -7 ± 4 |

1 Data are presented as means ± SEM, post-meal (60 min) minus pre-meal (30 min) (n = 27; NW, n = 11). CON, control; FA, food ads; GLU, glucose; NFA, non-food ads; NW, normal weight; OB, obese; OW, over weight; PFC, prospective food consumption.

2 Drink (p = 0.634), weight (p = 0.301), ads (p = 0.655), drink*weight (p = 0.488), drink*ads (p = 0.452) and ads*weight (p = 0.804) (3-factor ANOVA).
5.7.2.2. Study 2: Girls

The treatment means for the effect of the main factors on post-meal physical comfort are shown in **Table 5-18**. None of the factors (p > 0.05) affected post-meal physical comfort.

**Table 5-18** Change in post-meal physical comfort (mm) in girls: Effect of drink, ads and weight

<table>
<thead>
<tr>
<th>Drink</th>
<th>Ads</th>
<th>Weight</th>
<th>Physical comfort</th>
</tr>
</thead>
<tbody>
<tr>
<td>CON</td>
<td>GLU</td>
<td>NFA</td>
<td>-1 ± 2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>FA</td>
<td>0 ± 3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NW</td>
<td>1 ± 2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>OW/OB</td>
<td>-1 ± 3</td>
</tr>
</tbody>
</table>

1 Data are presented as means ± SEM, post-meal (60 min) minus pre-meal (30 min) (n = 23; NW, n = 14). CON, control; FA, food ads; GLU, glucose; NFA, non-food ads; NW, normal weight; OB, obese; OW, overweight.

2 Drink (p = 0.788), weight (p = 0.427), ads (p = 0.278), drink*weight (p = 0.957), drink*ads (p = 0.826) and ads*weight (p = 0.114) (3-factor ANOVA).
5.8. Drink sweetness and palatability

5.8.1. Study 1: Boys

The treatment means for the effect of the main factors on drink sweetness and drink palatability are shown in Table 5-19. None of the factors affected drink sweetness or drink palatability \( (p > 0.05) \). However, a significant interaction was found between drink and weight on drink palatability \( (p = 0.011) \) but Tukey-Kramer post hoc test did not reveal the differences. However, within each of the NW and OW/OB groups, a post-hoc analysis using a 1-factor ANOVA with drink as main factor showed that drink palatability was on average 11 mm less after GLU \( (65 \pm 5) \) compared to CON \( (76 \pm 5) \) in NW \( (p = 0.007) \) but was not affected in the OW/OB group \( \text{GLU, 71} \pm 5 \text{ vs. CON, 65} \pm 5; p = 0.210) \).

<table>
<thead>
<tr>
<th></th>
<th>Drink Palatability</th>
<th>Drink Sweetness</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CON</td>
<td>GLU</td>
</tr>
<tr>
<td>Drink palatability(^2)</td>
<td>70 ± 4</td>
<td>69 ± 3</td>
</tr>
<tr>
<td>Drink sweetness  (^3)</td>
<td>80 ± 2</td>
<td>76 ± 2</td>
</tr>
</tbody>
</table>

\(^1\) Data are presented as means ± SEM \( (n = 27; \text{NW, n = 11}) \). CON, control; GLU, glucose; NW, normal weight; OB, obese; OW, over weight.
\(^2\) Drink \( (p = 0.405) \), weight \( (p = 0.796) \), drink\(^\ast\)weight \( (p = 0.011) \), (2-factor ANOVA).
\(^3\) Drink \( (p = 0.097) \), weight \( (p = 0.139) \), drink\(^\ast\)weight \( (p = 0.071) \) (2-factor ANOVA).
5.8.2. Study 2: Girls

The treatment means for the effect of the main factors on drink sweetness and palatability are shown in Table 5-20. None of the main factors affected drink palatability or sweetness (p > 0.05).

Table 5-20 Drink palatability and sweetness (mm) in girls: Effect of drink and weight

<table>
<thead>
<tr>
<th></th>
<th>Drink</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CON</td>
<td>GLU</td>
</tr>
<tr>
<td>Drink palatability</td>
<td>55 ± 5</td>
<td>59 ± 5</td>
</tr>
<tr>
<td>Drink sweetness</td>
<td>81 ± 3</td>
<td>76 ± 3</td>
</tr>
</tbody>
</table>

1 Data are presented as means ± SEM, (n = 23; NW, n = 14). CON, control drink; GLU, glucose drink; NW, normal weight; OB, obese; OW, overweight.

2 Drink (p = 0.303), weight (p = 0.706), drink*weight (p = 0.596) (2-factor ANOVA).

3 Drink (p = 0.267), weight (p = 0.178), drink*weight (p = 0.178) (2-factor ANOVA).
5.9. Food palatability and TV program acceptability

5.9.1. Study 1: Boys

The treatment means for the effect of the main factors on food palatability and TV program acceptability are shown in Table 5-21. Only Drink (p = 0.020) but not weight (p = 0.580) or ads (p = 0.132) affected food palatability. Food palatability was 5 mm lower after the GLU drink compared to the CON drink.

None of the factors affected TV program acceptability (p >0.05).

Table 5-21 Food palatability and TV program acceptability in boys: Effect of drink, ads and weight

<table>
<thead>
<tr>
<th>Drink</th>
<th>Ads</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>CON</td>
<td>GLU</td>
<td>NFA</td>
</tr>
<tr>
<td>87 ± 2</td>
<td>82 ± 2</td>
<td>83 ± 2</td>
</tr>
<tr>
<td>FA</td>
<td>NW</td>
<td>OW/OB</td>
</tr>
<tr>
<td>86 ± 2</td>
<td>86 ± 2</td>
<td>83 ± 2</td>
</tr>
</tbody>
</table>

Food palatability 2

TV acceptability 3

1 Data are presented as means ± SEM (n = 27; NW, n = 11). CON, control; GLU, glucose; NW, normal weight; OB, obese; OW, over weight; PFC, prospective food consumption.

2 Drink (p = 0.020), weight (p = 0.580), ads (p = 0.132), drink*weight (p = 0.385), drink*ads (p = 0.744) and ads*weight (p = 0.115) (3-factor ANOVA with drink, weight and ads as main factors).

3 Drink (p = 0.342), weight (p = 0.544), ads (p = 0.432), drink*weight (p = 0.824), drink*ads (p = 0.378) and ads*weight (p = 0.501) (3-factor ANOVA with drink, weight and ads as main factors).
5.9.2. Study 2: girls

The treatment means for the effect of the main factors on food palatability and TV program acceptability are shown in Table 5-22. None of the main factors affected food palatability ($p > 0.05$).

TV program acceptability was only affected by ads ($p = 0.013$) but not drink ($p = 0.803$) or weight ($p = 0.232$). TV program acceptability was 4mm higher when girls watched FA compared to NFA.

Table 5-22 Food palatability (mm) and TV program acceptability (mm) in girls: Effect of drink, ads and weight

<table>
<thead>
<tr>
<th>Food palatability</th>
<th>Drink</th>
<th>Ads</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CON</td>
<td>GLU</td>
<td>NFA</td>
</tr>
<tr>
<td>83 ± 3</td>
<td>80 ± 3</td>
<td>82 ± 3</td>
<td>82 ± 3</td>
</tr>
<tr>
<td>TV acceptability</td>
<td>82 ± 3</td>
<td>82 ± 3</td>
<td>80 ± 3</td>
</tr>
</tbody>
</table>

Data are presented as means ± SEM, (n = 23; NW, n = 14). CON, control; FA, food ads; NFA, non-food ads; GLU, glucose; NW, normal weight; OB, obese; OW, overweight.

Drink ($p = 0.242$), weight ($p = 0.336$), ads ($p = 0.932$), drink*weight ($p = 0.704$), drink*ads ($p = 0.977$) and ads*weight ($p = 0.554$) (3-factor ANOVA with drink, weight and ads as main factors).

Drink ($p = 0.803$), weight ($p = 0.232$), ads ($p = 0.013$), drink*weight ($p = 0.615$), drink*ads ($p = 0.642$) and ads*weight ($p = 0.093$) (3-factor ANOVA with drink, weight and ads as main factors).
5.10. Correlations

5.10.1. BMI percentile and body fat mass

5.10.1.1. Study1: Boys

Body fat mass (%) increased with higher BMI percentile (Pearson correlation coefficients; r = 0.66, p < 0.001).

5.10.1.2. Study2: Girls

Body fat mass (%) was higher with higher BMI percentile (Pearson correlation coefficients r = 0.37, p < 0.001; n = 23).
5.10.2. Associations between food intake and each of weight, age, BMI percentile, percent FM, water intake and behavioral factors

5.10.2.1. Study 1: Boys

Associations between food intake (kcal) and each of weight (kg), age, BMI percentile, FM (%), water intake (ml), restraint, external and emotional eating scores are shown in Table 5-23. Food intake (kcal) increased with weight (r = 0.57, p < 0.001), age (r = 0.23, p = 0.013), BMI percentile (r = 0.27, p = 0.004), fat mass (r = 0.33, p < 0.001), water intake (r = 0.38, p < 0.001) and restraint (r = 0.35, p < 0.001) but not external (r = 0.10, p = 0.285) or emotional eating scores (r = 0.04, p = 0.657).

Table 5-23 Association between food intake (kcal) and each of weight (kg), age, BMI percentile, fat mass (%) and water intake (ml), restraint, external and emotional eating scores in boys

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>r</td>
<td>p</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>0.57</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Age (y)</td>
<td>0.23</td>
<td>0.013</td>
</tr>
<tr>
<td>BMI percentile</td>
<td>0.27</td>
<td>0.004</td>
</tr>
<tr>
<td>Fat mass (%)</td>
<td>0.33</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Water intake (ml)</td>
<td>0.38</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Restraint</td>
<td>0.35</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>External</td>
<td>0.10</td>
<td>0.285</td>
</tr>
<tr>
<td>Emotional</td>
<td>0.04</td>
<td>0.657</td>
</tr>
</tbody>
</table>

1Pearson correlation coefficients. BMI, body mass index.
5.10.2.2. Study 2: Girls

Associations between food intake (kcal) and each of weight (kg), age, BMI percentile, FM (%), water intake (ml), restraint, external and emotional eating scores are shown in Table 5-24. Food intake (kcal) increased by BMI percentile \( r = 0.32, p = 0.002 \) and emotional eating \( r = 0.30, p = 0.004 \) but was not affected by weight \( r = 0.16, p = 0.129 \), age \( r = -0.03, p = 0.734 \), fat mass \( r = 0.09, p = 0.417 \), water intake \( r = -0.06, p = 0.591 \), restraint \( r = -0.10, p = 0.322 \) or external eating scores \( r = -0.06, p = 0.557 \).

**Table 5-24** Associations between food intake (kcal) and each of weight (kg), age, BMI percentile, fat mass (%) and water intake (ml), restraint, external and emotional eating scores in girls

<table>
<thead>
<tr>
<th></th>
<th>r</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Girls (n = 23)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>0.16</td>
<td>0.129</td>
</tr>
<tr>
<td>Age (y)</td>
<td>-0.03</td>
<td>0.734</td>
</tr>
<tr>
<td>BMI percentile</td>
<td>0.32</td>
<td>0.002</td>
</tr>
<tr>
<td>Fat mass (%)</td>
<td>0.09</td>
<td>0.417</td>
</tr>
<tr>
<td>Water intake (ml)</td>
<td>-0.06</td>
<td>0.591</td>
</tr>
<tr>
<td>Restraint</td>
<td>-0.10</td>
<td>0.322</td>
</tr>
<tr>
<td>External</td>
<td>-0.06</td>
<td>0.557</td>
</tr>
<tr>
<td>Emotional</td>
<td>0.30</td>
<td>0.004</td>
</tr>
</tbody>
</table>

\(^1\)Pearson correlation coefficients. BMI, body mass index.
5.10.3. Visual analog scores and food intake

5.10.3.1. Study 1: Boys

Pearson correlation coefficients and p-values for the association between food intake and measures of subjective appetite, thirst, physical comfort, drink sweetness, drink palatability, food palatability and TV program acceptability are shown in Table 5-25. Food intake increased only with desire-to-eat at 30 min (r = 0.23, p = 0.018) but was not associated with average appetite (r = 0.18, p = 0.060), hunger (r = 0.15, p = 0.135), fullness (r = -0.14, p = 0.148), PFC (r = 0.16, p = 0.110) or thirst (r = 0.07, p = 0.476). There is a trend for a positive association between average appetite at 30 min and food intake.

Furthermore, food intake (kcal) decreased with drink palatability (r = -0.20, p = 0.42) but was not associated with drink sweetness (r = 0.16, p = 0.103), food palatability (r = 0.02, p = 0.843) or TV program acceptability (r = 0.09, p = 0.359).
Table 5-25 Associations between food intake (kcal) and visual analog scores

<table>
<thead>
<tr>
<th>Time</th>
<th>VAS</th>
<th>Boys (n = 27)</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>r</td>
<td>p</td>
<td></td>
</tr>
<tr>
<td>30²</td>
<td>Average appetite</td>
<td>0.18</td>
<td>0.060</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Desire-to-eat</td>
<td>0.23</td>
<td>0.018</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hunger</td>
<td>0.15</td>
<td>0.135</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fullness</td>
<td>-0.14</td>
<td>0.148</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PFC</td>
<td>0.16</td>
<td>0.110</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Thirst</td>
<td>0.07</td>
<td>0.476</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>Physical comfort</td>
<td>0.00</td>
<td>0.936</td>
<td></td>
</tr>
<tr>
<td>5³</td>
<td>Drink sweetness</td>
<td>0.16</td>
<td>0.103</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Drink palatability</td>
<td>-0.20</td>
<td>0.042</td>
<td></td>
</tr>
<tr>
<td>60⁴</td>
<td>Food palatability</td>
<td>0.02</td>
<td>0.843</td>
<td></td>
</tr>
<tr>
<td></td>
<td>TV acceptability</td>
<td>0.09</td>
<td>0.359</td>
<td></td>
</tr>
</tbody>
</table>

¹ Pearson correlation coefficients. PFC, perspective food consumption; VAS, visual analog scales.

² Meal was provided at 30 min

³ Drink was terminated at 5 min

⁴ Meal was terminated at 60 min
5.10.3.2. Study 2: Girls

Pearson correlation coefficients and p-values for the associations between food intake and measures of subjective appetite, thirst, physical comfort, drink sweetness, drink palatability, food palatability and TV program acceptability are shown in Table 5-26. Food intake (kcal) increased with desire-to-eat at 30 min \( r = 0.23, p = 0.030 \) but was not associated with average appetite \( r = 0.20, p = 0.056 \), hunger \( r = 0.18, p = 0.177 \), fullness \( r = -0.13, p = 0.224 \) or PFC \( r = 0.16, p = 0.137 \) in girls. Food intake also increased with higher food palatability \( r = 0.34, p < 0.001 \) but was not affected by thirst \( r = 0.00, p = 0.980 \), physical comfort \( r = 0.20, p = 0.057 \), drink sweetness \( r = -0.01, p = 0.924 \), drink palatability \( r = 0.10, p = 0.347 \) or TV program acceptability \( r = 0.09, p = 0.409 \).
Table 5-26 Associations between food intake (kcal) and visual analog scores

<table>
<thead>
<tr>
<th>Time</th>
<th>VAS</th>
<th>girls (n = 23)</th>
<th>r</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>30²</td>
<td>Average appetite</td>
<td></td>
<td>0.20</td>
<td>0.056</td>
</tr>
<tr>
<td></td>
<td>Desire-to-eat</td>
<td></td>
<td>0.23</td>
<td>0.030</td>
</tr>
<tr>
<td></td>
<td>Hunger</td>
<td></td>
<td>0.18</td>
<td>0.177</td>
</tr>
<tr>
<td></td>
<td>Fullness</td>
<td></td>
<td>-0.13</td>
<td>0.224</td>
</tr>
<tr>
<td></td>
<td>PFC</td>
<td></td>
<td>0.16</td>
<td>0.137</td>
</tr>
<tr>
<td></td>
<td>Thirst</td>
<td></td>
<td>0.00</td>
<td>0.980</td>
</tr>
<tr>
<td>30³</td>
<td>Physical comfort</td>
<td></td>
<td>0.20</td>
<td>0.057</td>
</tr>
<tr>
<td>5³</td>
<td>Drink sweetness</td>
<td></td>
<td>-0.01</td>
<td>0.924</td>
</tr>
<tr>
<td></td>
<td>Drink palatability</td>
<td></td>
<td>0.10</td>
<td>0.347</td>
</tr>
<tr>
<td>60⁴</td>
<td>Food palatability</td>
<td></td>
<td>0.34</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td></td>
<td>TVA</td>
<td></td>
<td>0.09</td>
<td>0.409</td>
</tr>
</tbody>
</table>

¹Pearson correlation coefficients. PFC, perspective food consumption; VAS, visual analog scales.

² Meal was provided at 30 min
³ Drink was terminated at 5 min
⁴ Meal was terminated at 60 min
5.10.4. Thirst and water intake

5.10.4.1. Study 1: Boys

There was a trend for increased water intake with higher thirst at 30 min (Pearson correlation coefficients; $r = 0.18$, $p = 0.063$; $n = 27$).

5.10.4.2. Study 2: Girls

Water intake increased with higher thirst at 30 min (Pearson correlation coefficients; $r = 0.41$, $p < 0.001$; $n = 23$).

5.10.5. Drink palatability and weight

5.10.5.1. Study 1: Boys

Drink palatability decreased with higher body weight (Pearson correlation coefficients; $r = -0.20$, $p = 0.034$; $n = 27$).

5.10.5.2. Study 2: Girls

Drink palatability decreased with higher body weight (Pearson correlation coefficients; $r = -0.45$, $p < 0.001$; $n = 23$).

5.10.6. Restraint and caloric compensation

5.10.6.1. Study 1: Boys

Caloric compensation decreased with higher restraint scores in boys (Pearson correlation coefficients; $r = -0.28$, $p = 0.043$; $n = 27$).

5.10.6.2. Study 2: Girls
Caloric compensation was not associated with restraint scores in girls (Pearson correlation coefficients; $r = 0.11$, $p = 0.453$; $n = 23$).
6 Discussion

This is the first study to report the effects of FA in a concurrent meal on food intake in OW/OB and NW boys and girls. The results lead to the suggestion that preventing FA in TV programs for children is unlikely to be an effective strategy for combating obesity in children although OW/OB girls may benefit. The primary hypothesis that FA at a meal increase food intake (decrease satiation) in OW/OB but not in NW subjects was supported in girls but not boys. However, the secondary hypothesis that FA result in reduced satiety and hence greater food intake after consumption of pre-meal calories was rejected. Food advertisements did not modify the response to the GLU drink in girls and contrary to the hypothesis they magnified the reduction in energy intake following the GLU drink in boys.

Food advertisements did not affect energy intake from a concurrent meal in NW, OW/OB boys (Table 5-3) or NW girls (Table 5-4). These results contrast with reports of FA increasing energy intake from snacks such as M&Ms in 8-12 y old boys [117] and fish crackers in 7-11 y old children [118] and cookies and tortilla chips in adults [118]. However, in these studies, the consumed energy was much smaller amounts (approximate estimate average in children, 150 Kcal) than that which led to satiation in a meal setting condition like the present study (on average 840 Kcal), as well as a study in adult women who were exposed to FA but did not increase energy intake from a meal of ground beef and mashed potatoes [120, 144]. Taken together it may be suggested that the concept of mindless eating [145] applies when familiar snacks are available in the absence of attention but at meal time, hunger and physiological factors are stronger determinants of the amount of foods consumed.

Food advertisements increased food intake (9%, table 5-4) in OW/OB girls but not OW/OB boys (Table 5-3); these findings are difficult to explain as the literature provides no consistent effect of sex or weight status on response to FA. Previous studies found that OW/OB children recognized more FA [115] and increased their snack intake more in response to FA than NW children [116]. Furthermore, children with higher waist circumference show higher hippocampus activation in response to energy dense food pictures [124] but the effect of sex was not reported in these studies. In contrast, exposure to FA increased M&M intake in boys but not in girls [117]. The authors suggested that this was because FA were directed mainly at
boys and had more boy characters than girls. Furthermore, the majority of the participants in this study were NW [117]. Therefore, the content of FA may also affect the sex specific responses and their interaction with weight status. In the present study, TV program acceptability was rated higher after FA compared to NFA in girls but not in boys (Tables 5-21 and 5-22) although no differences were found between the ratings of girls compared with the boys.

Another possible explanation for greater response to FA in OW/OB girls may be related to their TVV habits. Pre-school children who often watch TV increased snack intake while watching TV whereas in others who watch less TV, energy intake was reduced [99]. Furthermore, in 6 to 13 y olds, those who watched more TV during the week (an indirect measure of exposure to FA) were more affected by FA and therefore chose more foods as their preferred foods after FA compared to those who watched less TV [112]. Unfortunately, TVV habits were not measured in the current studies. But clearly, the contribution of FA in TV programs to excess food intake and obesity requires further investigation.

The design of the study, in which a pre-meal caloric load (GLU drink) was given, provides novel observations suggesting sex differences in satiety responses and their interaction with TVV. In contrast to the modest effect of FA, the GLU drink suppressed food intake in both boys and girls (Tables 5-3 and 5-4). However, mealtime caloric compensation for calories consumed pre-meal was incomplete in girls (54%, table 5-8) but not in boys (96%, table 5-7). Incomplete caloric compensation in girls with both FA and NFA indicates that TVV alone distracts the 9 – 14 y old girls from the physiological signals of satiety, leading to decreased caloric compensation and increased cumulative energy intake after the GLU drink. A previous study also showed mealtime TVV reduced compensation for the calories consumed before the meal from 139% to 16% in peri-pubertal girls [3]. Both studies contradict the hypothesis that the effect of TVV on obesity is due to higher exposure to FA alone as proposed by Halford [116] and Zimmerman [107].

Evidence that sex and weight status interacts to determine the response to physiological and environmental cues was provided in these studies. Difference in caloric compensation was shown between the NW boys (131%) and OW/OB boys (71%) but not in girls. This observation
was consistent with the significantly lower scores for cognitive restraint in NW compared to OW/OB boys (Table 5-1). Similarly, in this study, higher restraint was associated with higher food intake (Table 5-23) and lower caloric compensation in boys but not girls. A previous study, also did not find any association between restraint and food intake in girls of this same age group [3]. This is in contrast to most studies of adult females showing association between restraint and increased overeating in response to food cues and environmental distractions (e.g. TVV) [146-149] and increased salivation in response to presence of pizza in restraint adult males and females [150].

Increased caloric compensation in boys, from 70 % to 120 % (Table5-4), for the calories in the GLU drink, in response to FA during the TV show was unexpected and also in contrast to the hypothesis. Meal-time caloric compensation for previously ingested GLU calories was incomplete (70%) with NFA in boys, similar to previous findings that showed incomplete caloric compensation in the presence of TV in the absence of food cues [102]. However, the result of higher caloric compensation in response to FA may not be necessarily an indication of better response to the calories from the GLU drink. Rather it may be an artifact of slightly higher food intake during exposure to FA compared to NFA after the CON drink. Although not statistically significant, food intake after the CON drink was 7% higher with FA compared to NFA (p = 0.062) but 3% lower after the GLU drink (p = 0.301) (Figure 6-1). Thus, the apparent increased compensation after the GLU drink in boys when the TV program had FA arises from combination of the increase in energy intake in the CON condition but slightly lower food intake after the GLU drink. Therefore, the effect of FA on caloric compensation in boys requires further investigation.
Figure 6-1 Interaction between drink composition and type of ads in boys (■: NFA; □: FA). Drink (p < 0.001), ads (p = 0.397), weight (p = 0.123), drink*weight (p = 0.400), drink*ads (p = 0.042) and ads*weight (p = 0.469) (3-factor ANOVA with drink, ads and weight as main factors). Compensation for the calories in the GLU drink was 76% in NFA condition and 120% in the FA condition. Food intake increased 7% with FA after the CON drink (paired t-test, p = 0.062) but decreased 3% after the GLU drink (paired t-test, p = 0.301). Values are Mean ± SEM (n = 27, NW= 11). CON, control no calories; GLU, glucose; FA, food ads; NFA, non – food ads.

Consistent with our previous studies [3, 102, 127, 131, 151], the measurements of subjective appetite suggests that children fail to report a decrease in appetite after consuming caloric beverages. In contrast to adults [125, 126, 152, 153], average appetite, hunger, desire-to-eat and PFC did not decrease and fullness did not increase after the GLU drink compared to CON in either boys (Table 5-11) or girls (Table 5-12). Because the GLU drink resulted in lower food intake it can be suggested that feelings of subjective appetite and physiological regulation of food intake following liquid calories are disconnected. However, as reported in previous studies [3, 102, 127, 151] children appear to be able to interpret the questionnaire and reflect their appetite to the consumption of a solid food. They reported a decrease in average appetite, desire to eat, hunger and PFC as well as increase in fullness after the pizza meal (Tables 5-13 and 5-14).

Although subjective appetite measures do not reflect the content of the pre-meal calorie intake in children, previous studies found that subjective appetite scores immediately
before the meal correlated with food intake in both boys [102, 103] and post-pubertal girls [3]. However, in the current study, desire-to-eat at 30 min was the only measure of subjective appetite that positively associated with food intake in both boys (Table 5-25) and girls (Table 5-26). This lack of association between overall subjective appetite measures and food intake may be an indication that TV programs that contain advertisements (both FA and NFA) during a meal reduce the contribution of subjective appetite to the regulation of food intake.

A partial explanation for the failure of the GLU drink to suppress appetite may be that the children consume beverages primarily to quench thirst. To date it is unclear if either children or adults chose a caloric beverage for quenching thirst or satisfying appetite [154, 155]. In the current studies, in contrast to the failure of the GLU drink to suppress appetite, children accurately reflected changes in their thirst after consumption of the drinks and reported that FA affected their thirst responses. Both boys (Tables 5-11, 5-13) and girls (Tables 5-12, 5-13) decreased their thirst scores after consumption of both GLU and CON drinks pre-meal and further after consumption of water during the meal. In addition, pre-meal thirst was predictive of meal-time water intake in girls ($r = 0.41, p < 0.001$) and there was a trend for positive association between thirst and water intake in boys ($r = 0.18, p = 0.063$). Because meal-time water intake was not affected by FA (Table 5-9) post-meal thirst was expected to be reduced to the same level in both conditions. However, post-meal thirst ratings were higher after FA compared to NFA in boys (Table 5-13). Further studies are required to examine the effect of FA on thirst and to define the inter-relationship between fluid and caloric intake in beverages with thirst and appetite.

Drink palatability has been shown to have either no relationship [20, 156] or positive association [103] with food intake in children. In the current study, in girls, there was also no association between drink palatability and food intake (Table 5-26). In contrast, drink palatability was negatively associated with food intake in boys (Table 5-25). This negative association was driven by the OW/OB group (Figure 6-2). Drink palatability was also negatively associated with body weight in both girls ($r = -0.45, p < 0.001$) and boys ($r = -0.20, p = 0.034$). However, this can be explained because the GLU drink contained 1.0 g/kg body weight glucose monohydrate in the fixed amount of water (250 ml). Thus, the GLU concentration of the drink was higher for subjects with higher body weight and was less palatable. Nevertheless, even
though participants with higher body weight found the drink less palatable, heavier boys (Table 5-12) but not girls (Table 5-13) had higher food intake. Hence a negative association was found between drink palatability and food intake in boys.

**Figure 6-5.10.62** Association between drink palatability (mm) and glucose concentration (g/250ml) in NW (○) and OW/OB (×) boys. Drink palatability was negatively associated with weight in OW/OB (Pearson correlation coefficients; \( r = -0.41, p = 0.001; n = 16 \)) but not NW (Pearson correlation coefficients; \( r = 0.13, p = 0.414; n = 11 \)) boys.

Physical comfort decreased after consumption of the drinks and then increased in pre-meal period (Tables 5-15 and 5-16). This is in part related to the palatability of the drinks because physical comfort at 5 min after consumption of the drinks was lower in association with lower palatability in boys (Pearson correlation coefficients; \( r = 0.41, p < 0.001; n = 27 \)) and girls (Pearson correlation coefficients ; \( r = 0.37, p < 0.001; n = 23 \)).

External eating scores were measured because sensitivity to external food cues is hypothesized to contribute to obesity. In the present studies external eating scores were not different between the weight or sex groups (tables 5-1 and 5-2). Furthermore, these scores were not correlated with food intake (tables 5-23 and 5-24). These results are consistent with findings in 9-11 y old children in UK [115] and girls in Netherlands [134] but contrast those
showing that external eating scores in OW and OB children compared to NW participants, using same questionnaire, is higher in Spanish children [135] and lower in Dutch boys [134]. Therefore, the interaction between ethnicity and weight in response to externality scores using the DEBQ for children requires further investigation.

In summary, this study provides little evidence in support of the hypothesis that FA in TV programs are significant contributors to increased food intake and obesity in children. However, there are several weaknesses to the study which challenge the ecological validity of the results. First, in order to isolate the effect of FA, level of exposure to FA was 11 times that of what children are usually exposed to in a 30 min period. It has been shown that exposure to as little as two minutes of FA can increase snack intake in children [118]. However, the level of exposure in this study (8 min in half an hour) is comparable to previous studies showing five min of FA in a 15 min program [115, 116]. Second, it is suggested that FA influence food choices. Therefore, it is possible that both the quantity and variety of FA in each program were counterproductive to a realistic examination of hypothesis. In addition, pizza which is a preferred food for children of this age, was rated highly palatable (Tables 5-21and 5-22), and led to high caloric intake at the meal, as found in other studies [157, 158]. This may have contributed to the lack of effect of FA. Finally, the environment in the feeding room is not representative of in-home eating and perhaps affects normal behavioral response to food cues.

In conclusion, FA in a TV program during consumption of a pizza meal by NW and OW/OB boys and girls increased food intake only in OW/OB girls and increased caloric compensation for the GLU drink at meal time in boys but had no effect in girls.
7 FUTURE DIRECTIONS

Another limitation of this study was that we did not control for puberty and role of puberty on food intake control in response to FA needs to be explored. In this age group, especially girls are going through puberty and are experiencing a lot of hormonal changes that can affect their food intake [159]. In our lab, we have shown previously that TVV at mealtime has different effect on girls at different stages of puberty [3]; while it reduces caloric compensation in peri-pubertal girls it has no effect on post-pubertal girls. Future studies should analyze the effect of pubertal stage of the participants on their response to FA.

The effect of exposure to FA at mealtime on later meals needs to be examined. In this study the effect of FA on satiation from a concurrent meal and satiety from a previously ingested caloric drink was tested. However, watching FA at meal-time can affect energy intake later in the day. Few studies have shown that watching FA increases snack intake right after exposure [116]. However, it is not clear if participants would compensate for the extra energy intake at later meals.

Brain responses to FA and their possible effect on food intake need to be explored. A number of recent studies have related excessive food intake in OB participants to the rewarding system of the brain that is also involved in drug addiction; it was hypothesized that activation of this region of the brain motivated the intake of the reward, being drug in drug addicts or food in obese people, so that the stimuli of food are potent enough to trigger hunger and motivate eating. In adults, analysis of 3-T magnetic resonance imaging (MRI) scans in OB women showed that presentation of high-calorie food pictures were significantly more effective in stimulating the reward system of the brain, compared to low-calorie food pictures [123]. This effect was not as strong in NW participants [123]. In adolescents, higher hippocampus activation (a major part of the reward system of the brain) in response to high-calorie food pictures was significantly correlated to higher waist circumference (an indicator of abdominal obesity) and baseline blood insulin levels [124]. It is important to examine whether the activation of the reward system actually translates to increased food intake.

Collecting blood samples and assessing hormonal changes allows a more physiological based research. Hormonal measurements are required to assess the potential of FA’s effect on
stimulation of hunger. In the current study only subjective hunger was measured. However, activation of cephalic phase involves several hormonal secretions including gastrointestinal hormones and pancreatic polypeptide [15]. Measurements of hormonal differences between participants with different weight status or pubertal stage may help understand the differences in participants’ responses to FA.

Effect of type of FA (high fat/ high sugar vs. low fat/ fruits and vegetables) on food intake can be explored. It has been shown that FA that promote candies are more likely to modify children’s snack choices immediately after exposure compared to ads that promote fruits and vegetables [113]. Furthermore, currently companies have self-regulations to promote their healthier options to children. Therefore, it is important to identify the effect of different types of FA on children’s food intake.
8 Reference List


ATTN: PARENTS OF CHILDREN AGED 9-14 YEARS

We are conducting a research study about food intake control in children that will help to address the problems of overeating & obesity.

REQUIREMENTS: healthy, 9-14 year old boys & girls

INVOLVES: 1 screening + 4 weekend sessions (breakfast & lunch included)

As a reward for taking part at each session, the child will receive a $20 movie pass. Parents receive $12 travel reimbursement.

Please contact us at (647) 292 - 9214
9.1.2. Recruitment slip

Want to make an extra $20 in movie passes?

If you or your child know of a boy or girl who may be interested in participating in our study, your child may be eligible to receive an extra $20 in movie passes!

This may be a friend from a different school than the one where your child received the recruitment letter, a relative or a neighbour.

For the referral, the child must:
  - be between 9 and 14 years of age, &
  - have been born at term, &
  - not be taking medications.

* In order for your child to receive the movie passes, your referral must attend the screening portion of the study *

If you know of someone who may be interested, please have them call the project coordinator Shokoufeh@ (647)292-9214

Thanks in advance for your help! We hope you enjoyed participating in our studies!
9.1.3. Recruitment letter for parents

Effect of Television Viewing at Mealtime on Food Intake in Children
Recruitment Letter for Parents

Dear Parent

The University of Toronto is leading a cross-institutional team of researchers investigating the physiological and environmental determinants of energy intake regulation on the health of children and young adolescents. In our current work we are conducting studies aimed at understanding the controls of food intake in children, with the ultimate goal of finding ways to address the problems of overeating and obesity that are becoming a concern among those people involved in the long term health of Canadians.

We are asking the parents of girls and boys 9 to 14 years old to allow their daughter/son to take part in a research study. Their participation is quite straightforward: on four separate mornings your child will consume a sweet drink followed by a pizza lunch 30 min later with or without television viewing. They will also fill out a short questionnaire about their television viewing behaviors. The study will take place on four weekend or holiday mornings at the FitzGerald Building, Department of Nutritional Sciences (150 College Street, Room 329).

There are criteria for participation that you need to be aware of, the child must:
- be between 9 and 14 years of age, and
- be healthy, and have been born at term, and
- not be taking medications.

As a reward for taking part, at each session the child will be given a free movie pass ($20 gift certificate).

This study has been fully approved by the University of Toronto Health Sciences II ethics review committee.

If you would like your son/daughter to participate, or to get further information beyond that provided in this letter, please contact Ms. Shokoufeh Khodabandeh, Project Coordinator at (647) 292-9214, at the University of Toronto (Department of Nutritional Sciences).

Thank you for your support in this important research.

Sincerely,
Shokoufeh Khodabandeh

Dr. Harvey Anderson, Department of Nutritional Sciences, University of Toronto.
Dr. Nick Bellissimo, Departments of Nutritional Sciences and Exercise Science, University of Toronto.
Ms. Barkha Patel, Department of Nutritional Sciences, University of Toronto.
Dr. Paul Pencharz, Departments of of Paediatrics and Nutritional Sciences, University of Toronto.
Dr. Scott Thomas, Faculty of Physical Education and Health, University of Toronto.
Telephone screening:
Appendix II - Screening Questionnaires

9.2.1. Telephone screening questionnaire

Children's Study Telephone Screening
Department of Nutritional Sciences, University of Toronto
Food Intake Control in Children

Name: ________________________
Age: ________________________ DOB: __________ _______________ Term Baby: Y/N
Height: _____________ cm / feet  Weight___________________ Kg / LB Normal birth weight: Y/N
Has your child gain or lost weight recently: Y/N
Does your child usually have breakfast: Y/N
Does your child like (foods to be used in study):
Milk Y/N cereal Y/N juice: Y/N Pizza: Y/N
Is your child following a special diet? Y/N
Does your child have food allergies or sensitivity? Y/N
Health problems? Y/N
If yes, what problem __________
Medication? Y/N
If yes what ____________
Grade ____________________ Special class? Y/N
Skipped/ repeated grades? Y/N  Learning difficulty / problems? Y/N
Behavioural / emotional problems? Y/N
If yes please explain ____________
Include in study? Y/N
If not, Why ____________
Appointment date _____________ time _________
Investigator _________________ date _____________________
9.2.2. Study information sheet and parent consent form

Effect of Television Viewing at Mealtime on Food Intake in Children

Study Information Sheet and Parent’s Consent Form

Investigators: Dr. G. Harvey Anderson  
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Email: paul.pencharz@sickkids.ca

Dr. Scott Thomas  
Faculty of Physical Education and Health, University of Toronto  
Phone: (416) 978-6957  
Email: scott.thomas@utoronto.ca
Purpose of Research:

The purpose of this study is to determine the effects of television viewing on food intake regulation in normal weight and obese 9-14 year-old children. This experiment is being conducted through the Department of Nutritional Sciences at the University of Toronto by Dr. G. Harvey Anderson (principal investigator), Shokoufeh Khodabandeh (project coordinator), Dr. Nick Bellisimo, Dr. Paul Pencharz, and Dr. Scott Thomas. Your son/daughter will be required to attend four feeding sessions conducted over a 4-week period, for a total of 5 visits (4 food intake measurement sessions + 1 visit to measure physiological parameters) to the University of Toronto campus. Each visit will last approximately 90 minutes.

The purpose of our research is to develop an understanding of factors affecting the control of food intake in children. Knowing the determinants of the regulation of food intake in children will allow us to develop strategies and recommendations for the prevention of obesity.

Procedure:

Appetite Assessment:

For those parents who express interest in having their son/daughter participate, some information about the child will be requested by telephone, by the project coordinator, Shokoufeh Khodabandeh. If the child was born at term, is healthy and does not receive any medications, an information session will be arranged.

During the information session, the researcher will explain the full details of the study. Parents that give consent to have their son/daughter participate will sign a consent form. The parent will receive copies of consent forms and of the study information sheet. If the child wishes to participate and signs a children’s assent form, his/her weight, height, and body fat using painless techniques, will be measured.

The boys and girls will then be asked to rank their preference for pizza that will be served as the lunch meal at each session.

The boys/girls who participate in this study, will be requested to go to the FitzGerald Building, Department of Nutritional Sciences, University of Toronto, for four individual morning sessions. These sessions will be held on weekends, over four weeks. The children will be brought to the laboratory and returned home either by parents or a research assistant, as preferred by the parents.

On each of the four test days, the children will have a standardized breakfast of cereal, milk and juice at home, either at 8:00 am or 9:00 am (the time will be consistent for each child). The children will arrive at FitzGerald Building, either at 10:00 am or 11:00 am (but consistent throughout for each child).

Children will fast for 12 hours before breakfast and after breakfast until their arrival, except for water, which will be allowed up to one hour before their arrival.
Each child will receive one glass of sweetened Kool-aid containing sugar or artificial sweetener. The sugar drink will contain similar amount of sugar as common soft drinks or fruit juice. Each child will receive both drinks, one on each day in no set order, with or without television viewing.

McCain pizza and spring water (purchased at Loblaws) will be served 30 minutes after the boys/girls have consumed the drink. Children will be told that they may eat as little or as much as they like. The amount of food eaten by each child will be measured.

During two of the four feeding sessions a cartoon program will be running. The television show (e.g. Batman, Superman, Hannah Montana, So You Think You Can Dance, or The Simpsons) will play for 30 – 40 min while the child eats, excluding advertisements. During the initial telephone conversation the parent will be given an overview of the cartoon content that will be shown to children during the test meal. If the parent gives their consent to allow us to show the cartoon to the child, and all other inclusion criteria are met, an information visit will be scheduled for the parent and child.

The boys/girls will also be requested to complete scales on which they will place a pencil mark to describe their desire to eat (“Very weak” to “Very strong”), hunger (“Not hungry at all” to “As hungry as I’ve ever felt”), fullness (“Not full at all” to “Very full”), how much food they could eat (“A large amount” to “Nothing at all”), sweetness of the drinks (“Not sweet at all” to “Extremely sweet”). They will complete these scales during the information session, in order to become familiar with the test instruments.

The children will be fully supervised during the study sessions. They will be engaged in age appropriate entertainment (as distraction) eg: reading, puzzles, cards, before lunch. The study session will end either at 11:30 am or at 12:30 pm after the pizza meal.

**Physiological Testing:**

Physiological testing will be performed on one weekend morning, separate from the food intake assessment sessions, at the Athletic Centre. First, the child will undergo testing to measure resting metabolic rate followed by a DXA certified technologist.

**Body Composition Assessment:**

Three methods will be used to estimate the amount of muscle and fat tissue in your child’s body.

**Skinfolds:**

The skinfold thickness technique is performed by pinching the skin between the thumb and forefinger and placing calipers on the fold measuring the width of thickness of the two layers of skin and subcutaneous fat underneath. The assumptions underlying the rationale of measuring skinfold thickness are that skinfold thickness is an adequate measure of subcutaneous fat (fat under the skin) and that there is a defined relationship between subcutaneous fat and total body fat.
Bioelectrical Impedance Analysis:

Bioelectrical impedance analysis (BIA), a recently developed technique for measuring body fat content in both adults and children, is simple and painless and is an effective method for measuring body fat in children. BIA is based on measurement of electrical resistance in the body to a tiny current (that the subject cannot feel). The principle of BIA lies in that muscle mass in the body is a better conductor of electricity than fat which has lesser amounts of water and electrolytes.

Dual Energy X-Ray Absorptiometry:

Dual energy x-ray absorptiometry (DXA) is a relatively new method to estimate body composition and is able to determine the bone, muscle and fat content of the body. The procedure is painless, and is routinely used in modern medical practice and research settings in children and adults. Whole-body DXA scans are usually completed in under 20 min with minimal radiation exposure (1 mSv or 1/100th of the equivalent radiation exposure of a chest x-ray) and will be performed in Dr. Scott Thomas’s laboratory in the Athletic Center by a certified operator.

Resting Metabolic Rate:
This test measures your energy level. You will be asked to lie quietly without moving for 30-45 minutes after you arrive in the Lab on a bed and then for an additional 30 minutes with a clear, vented hood covering your entire head. An assistant will be present for the entire study; the area where you will remain during the test will be private. The test will provide valuable information for how much energy (calories) you burn in a 24-hour time period. This test will take approximately 1.5 hours to complete.

Confidentiality:

Records relating to participants will be kept confidential in a locked cabinet in the Department of Nutritional Sciences and no disclosure of personal information of the children or parents will take place except where required by law. Participants will have a code and a number that will identify them in all documents, records and files to keep their name confidential. All data will be entered into Microsoft Excel files, available only to investigators. Each participant will have a file, also only available for investigators. All forms and printouts will be stored in the individual files – and clearly labeled. All documents will be kept for a minimum of five years following completion of the study and then securely destroyed.

Risks:

Dual Energy X-Ray Absorptiometry Testing: DXA involves low-energy X-rays. There is a minimal amount of radiation exposure during this procedure of less than 10 mrem, less than the amount experienced during a round-trip airplane flight across the country. For comparison, the average person is exposed to approximately 360 mrem per year from all sources. Although there is some risk of X-ray exposure, it is well below the level that causes adverse effects and uses one-hundredth the X-ray exposure of a chest X-ray.
Resting Metabolic Rate: There is a slight risk of feeling claustrophobic during this test. The room, however, is open and an assistant will be present during the entire 1.5 hour study. The test may be stopped at any time during the measurement process.

Tanner Staging Assessment:

Tanner stages are scales that assess physical development in children and adolescents, based on external primary and secondary sex characteristics, such as the size of the breasts, genitalia, and development of pubic hair. The way in which appetite is regulated is related to where children are in their pubertal development. In order to assess pubertal stage, the children will be asked to complete a questionnaire about puberty and changes in their bodies. Depending on the sex of the child, the children will be presented with cartoon pictograms of different stages of physical/sexual development (e.g., breast size, pubic hair, genitalia) and the children will be asked to pick the picture that best represents their stage of puberty. These pictograms have been used extensively in children. If for any reason the children are not willing to participate, they have the option of asking their parents to answer the questionnaire and select the pictograms for them. The children may decline the pubertal staging if they wish. Parents are welcome to discuss the reasons for including Tanner stages as part of the study or any comment or concerns with Dr. Jill Hamilton at jill.hamilton@sickkids.ca

Benefits:

As the causes of obesity remains undefined, the potential benefits from this study will be a better understanding of the regulation food intake in children and might contribute to the prevention of obesity in children.

Questions and further information:

If you have any questions or would like further information concerning this research project, please do not hesitate to call: Shokoufeh Khodabandeh, Project Coordinator at (416)978-6894, Barkha Patel at (416) 978-4153, Dr. Nick Bellissimo, Investigator at (416) 978-6894, or Dr. Harvey Anderson, Investigator at (416)-978-1832.

If you have questions or concerns about your rights as a research participant, please contact Marianna Richardson, Research Ethics Coordinator, Health Sciences marianna.richardson@utoronto.ca or 416-946-5806.

Dissemination of findings:

A summary of results will be made available to you to pick up after the study is completed.

Consent:

I acknowledge that the research procedures described above and of which I have a copy, have been explained to me and that any questions that I have asked have been answered to my satisfaction. I know that I may ask additional questions now or in the future. I am aware that participation in the study will not involve any health risk to my child.
I understand that for purposes of the research project, if my child or I choose to withdraw from the study at any time, we may do so without prejudice.

Upon completion of each study session, my child will receive a $20 gift certificate to the theatre. The final summary and results of the study will be available for me to pick up from the Department of Nutritional Sciences, University of Toronto. I am aware that the researchers may publish the study results in scientific journals, keeping confidential my son or daughter’s identity.

I hereby consent for my child, ________________ , to participate in this study.

__________________________________  __________________________
(Name of parent or guardian)          (Signature of parent or guardian)

__________________________________  __________________________
(Name of witness)                     (Signature of witness)

Date: ______________(dd/mm/yy)
9.2.3. Children’s assent form

Effect of Television Viewing at Mealtime on Food Intake in Children

Children’s Assent Form

Purpose of Research:

The purpose of this study is to evaluate the effects of television viewing on appetite control in children. My weight, height, and body fat using painless techniques, will be measured during the information visit. I will also be required to drink a sweetened beverage (within 5 minutes) and complete special scales to show if I am hungry or full during each session. I will also be provided with a pizza lunch at the end of each study session (that I will eat in the Department of Nutritional Sciences, University of Toronto). All the experimental sessions will be on weekends and school holidays, so I don’t need to be absent from school. I will be asked to fill out a questionnaire that is related to my stage of puberty (changes in my body as I grow up). I will also be asked to look at some cartoon pictures of various stages of puberty and select the picture that best resembles me.

I know that my participation in the study will not involve any health risk to me.

Also, if at any time I decide to stop participating, that will be O.K. I understand that information related to me will be kept confidential. I know that I will receive a $20 gift certificate to the theatre after completion of each study session, as a “thank you” for my participation.

“I was present when __________________________ read this form and gave his/her verbal assent.”

______________________________
Signature

Name of the person who obtained assent:

______________________________

Date: __________________ (dd/mm/yy)
9.2.4. Background information

Background Information
Department of Nutritional Sciences, University of Toronto

Food Intake Control in Children

Child’s Name: __________________________

Child’s Date of Birth: __________________________ dd/mm/yy

Child’s Sex: Male/Female (circle correct choice)

If female, has your child begun to menstruate? Yes/No

What age was your child when she had her first period? ___________ years

Ethnic Background: __________________________

Mother’s Name: __________________________

Mother’s weight: ___ kg/lb Height: ___ cm/inches (circle unit)

Father’s Name: __________________________

Father’s weight: ___ kg/lb Height: ___ cm/inches (circle unit)

Subject ID: __________________________

Investigator: __________________________

Date: __________________________
9.2.5. Contact information

**Contact Information**
Department of Nutritional Sciences, University of Toronto
Food Intake Control in Children

<table>
<thead>
<tr>
<th>Field</th>
<th>Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Child's Name:</td>
<td></td>
</tr>
<tr>
<td>Address:</td>
<td></td>
</tr>
<tr>
<td>Home phone #:</td>
<td></td>
</tr>
<tr>
<td>Mother's name:</td>
<td></td>
</tr>
<tr>
<td>Mother's Cell #:</td>
<td></td>
</tr>
<tr>
<td>Mother's work #:</td>
<td></td>
</tr>
<tr>
<td>Mother's e-mail:</td>
<td></td>
</tr>
<tr>
<td>Father's name:</td>
<td></td>
</tr>
<tr>
<td>Father's Cell #:</td>
<td></td>
</tr>
<tr>
<td>Father's work #:</td>
<td></td>
</tr>
<tr>
<td>Father's e-mail:</td>
<td></td>
</tr>
<tr>
<td>Source of referral:</td>
<td></td>
</tr>
</tbody>
</table>

Subject ID: __________________________

Investigator: __________________________

Date: __________________________ (dd/mm/yy)

9.2.6. Food acceptability list

Food Acceptability List
**Food Intake in Children**

**Name:**


**BREAKFAST**
On each test day you will consume at home the same breakfast provided by the investigators. Please indicate whether you will be able to consume all the following:

- 1 cup nonfat milk (250 mL)  
  **Yes/No** (circle correct choice)
- Honey Nut Cheerios (26 g)  
  **Yes/No**
- Junior Tropicana orange juice (236 mL)  
  **Yes/No**

**BEVERAGE**
Please indicate whether you will be able to drink a sweet beverage if it is provided at a study session.

**Yes/No**

**LUNCH**
You will also be provided with a pizza meal the day of the study. To enable us to provide you with a meal that you will enjoy, please indicate whether you would like to be served:

1. All pepperoni pizza (cheese, pepperoni)
2. All 3 cheese pizza (mozzarella, cheddar, parmesan)
3. A combination of pepperoni and 3 cheese pizzas

(circle correct choice)

If you answered #3, and you would like a combination of both types, please indicate if you would like more:

pepperoni OR 3 cheese pizza (circle correct choice)

**Investigator:**


**Date:**


**9.3. Appendix III- Dutch Eating Behavior Questionnaire**
Dutch Eating Behaviour Questionnaire for Children
Scoring sheet

Please complete sections 1 and 2 and then turn over.

1. Subject and test details

Name: ________________________________

Date of birth: ________________________

Age: ________________________________

Gender: male   female

Today's date: ________________________

2. Your weight, height, etc.

A. Current weight (kg): ________________________________

B. Current height (cm): ________________________________

C. Has your body weight been constant over the past six months?
   yes, my weight did not change much
   no, I lost ________ kg
   no, I gained ________ kg
   no, sometimes I gained weight and sometimes I lost weight

D. Have you ever had an episode of eating an amount of food that others would regard as unusually large?
   yes
   no

Please do not mark below this line

BMI (please take the age of the child into account): ________________________________

<table>
<thead>
<tr>
<th>DEBQ scale</th>
<th>Raw score</th>
<th>Number of items</th>
<th>Scale score</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emotional eating</td>
<td>7</td>
<td>7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>External eating</td>
<td>6</td>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Restrained eating</td>
<td>7</td>
<td>7</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Please turn over >>>>>>
**Dutch Eating Behaviour Questionnaire for Children**

**Instructions**
Below you'll find 20 questions about eating. Please read each question carefully and tick the answer that suits you best. Only one answer is allowed. Don't skip any answer. There are no incorrect answers; it's your opinion that counts.

<table>
<thead>
<tr>
<th>Question</th>
<th>No</th>
<th>Sometimes</th>
<th>Yes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Do you feel like eating whenever you see or smell good food?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. If you feel depressed do you get a desire for food?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. If you feel lonely do you get a desire for food?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Do you keep an eye on exactly what you eat?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Does walking past a candy store make you feel like eating?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Do you intentionally eat food that helps you lose weight?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Does watching others eat make you feel like eating too?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. If you have eaten too much do you eat less than usual the next day?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Does worrying make you feel like eating?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Do you find it difficult to stay away from delicious food?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Do you intentionally eat less to avoid gaining weight?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. If things go wrong do you get a desire for food?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. Do you feel like eating when you walk past a restaurant or fast food restaurant?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14. Have you ever tried not to eat in between meals to lose weight?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15. Do you have a desire to eat when you feel restless?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16. Have you ever tried to avoid eating after your evening meal to lose weight?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17. Do you have a desire for food when you are afraid?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18. Do you ever think that food will be fattening or slimming when you eat?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19. If you feel sorry do you feel like eating?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20. If somebody prepares food do you get an appetite?</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**PLEASE CHECK, TO BE SURE THAT YOU TICKED EVERY QUESTION.**

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9.4. Appendix IV- Nutritional Composition of the Pizza Served at Test Meals

<table>
<thead>
<tr>
<th></th>
<th>Per 1 pizza</th>
<th>Pepperoni (87g)</th>
<th>Three Cheese (81 g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calories</td>
<td></td>
<td>180</td>
<td>180</td>
</tr>
<tr>
<td>Fat (g)</td>
<td></td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Saturated Fat (g)</td>
<td></td>
<td>2.5</td>
<td>2.5</td>
</tr>
<tr>
<td>Trans Fat (g)</td>
<td></td>
<td>0.1</td>
<td>0.1</td>
</tr>
<tr>
<td>Cholesterol (mg)</td>
<td></td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>Sodium (mg)</td>
<td></td>
<td>400</td>
<td>360</td>
</tr>
<tr>
<td>Carbohydrates (g)</td>
<td></td>
<td>23</td>
<td>22</td>
</tr>
<tr>
<td>Fibre (g)</td>
<td></td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Sugar (g)</td>
<td></td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Protein (g)</td>
<td></td>
<td>9</td>
<td>9</td>
</tr>
</tbody>
</table>

9.5. Appendix V- Study day questioners

9.5.1. Feeding session cover sheet

Feeding Session Cover Sheet
Department of Nutritional Sciences, University of Toronto

Food Intake Control in Children

Subject ID: _______________  Session: ___

Date: _______________

Baseline Questionnaire (to be asked by investigator)

1. Have you had the standardized breakfast this morning? YES/NO
2. At what time did you have the standardized breakfast?

3. Have you had anything to eat or drink for 10 - 12 hours before breakfast?  YES/NO

   If yes, please describe briefly

   ____________________________________________________________

4. Have you had anything to eat or drink after breakfast before arriving here?  YES/NO

   If yes, please describe briefly

   ____________________________________________________________

5. Are you taking any medication?  YES/NO

   If yes, please describe briefly

   ____________________________________________________________

Comments/Notes:

Investigator: ______________________________

9.5.2. VAS

9.5.2.1. Motivation to eat

Appendix 5a

Visual Analogue Scale
Motivation to Eat

DATE: ______________________________

NAME: ______________________________

These questions relate to your “motivation to eat” at this time. Please rate yourself by placing a small “x” across the horizontal line at the point which best reflects your present feelings.

1. How strong is your desire to eat?
2. How hungry do you feel?

NOT 
Hungry ________________________________ 
at all % not at all

As hungry as I have ever felt

3. How full do you feel?

NOT 
Full ________________________________ 
at all % not at all

VERY Full

4. How much food do you think you could eat?

NOTHING ________________________________ 
at all % not at all

A LARGE amount
9.5.2.2. Physical comfort

Visual Analogue Scale
Physical Comfort

Subject ID: __________________
Date: _______________

This question relates to your "motivation to eat" at this time. Please rate yourself by placing a small "x" across the horizontal line at the point which best reflects your present feelings.

1. How well do you feel?

NOT well ___________________________ VERY well
at all
9.5.2.3. Drink sweetness

Visual Analogue Scale
Sweetness

Time =

Subject ID: ________________________

Date: ________________________

Please rate the level of sweetness by placing a small “x” across the horizontal line at the point which best reflects your present feelings.

How sweet have you found the beverage?

NOT sweet ________________________________ Extremely sweet
at all

sweet
9.5.2.4. Drink palatability

TIME = 

Visual Analogue Scale
Pleasantness

Subject ID: __________
Date: __________

This question relates to the palatability of the drink you just consumed. Please rate the pleasantness of the food by placing a small "x" across the horizontal line at the point which best reflects your present feelings.

1. How pleasant have you found the drink?

NOT at all ___________________________ VERY pleasant

very pleasant ___________________________ very pleasant
9.5.2.5. Food palatability

TIME =

Visual Analogue Scale
Pleasantness

Subject ID: __________________
Date: ________________

This question relates to the palatability of the food you just consumed. Please rate the pleasantness of the food by placing a small "x" across the horizontal line at the point which best reflects your present feelings.

1. How pleasant have you found the food?

NOT at all ____________________________ VERY pleasant
pleasant ____________________________  }


9.5.2.6. TV program acceptability

TIME =

Visual Analogue Scale
TV Program Acceptibility

Subject ID: ____________

Date: ____________

This question relates to how well you enjoyed the TV program. Please rate yourself by placing a small "x" across the horizontal line at the point which best reflects your present feelings.

1. How well did you enjoy the TV programs?

NOT well ________________________________ VERY well
at all ________________________________
### 9.5.3. Food intake sheet

<table>
<thead>
<tr>
<th>Tray 1</th>
<th>Before</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pepperoni (g)</td>
<td>Pepperoni (g)</td>
<td></td>
</tr>
<tr>
<td>3 Cheese (g)</td>
<td>3 Cheese (g)</td>
<td></td>
</tr>
<tr>
<td>Water (g)</td>
<td>Water (g)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Tray 2</th>
<th>Before</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pepperoni (g)</td>
<td>Pepperoni (g)</td>
<td></td>
</tr>
<tr>
<td>3 Cheese (g)</td>
<td>3 Cheese (g)</td>
<td></td>
</tr>
<tr>
<td>Water (g)</td>
<td>Water (g)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Tray 3</th>
<th>Before</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pepperoni (g)</td>
<td>Pepperoni (g)</td>
<td></td>
</tr>
<tr>
<td>3 Cheese (g)</td>
<td>3 Cheese (g)</td>
<td></td>
</tr>
<tr>
<td>Water (g)</td>
<td>Water (g)</td>
<td></td>
</tr>
</tbody>
</table>

Session: ______________________
Investigator: ______________________
Date: ___________ (dd/mm/yy)

Glucose load: ___________

Session: ______________________
Investigator: ______________________
Date: ___________ (dd/mm/yy)
9.5.4. Reminder slips

Thank you for your participation!

Your next appointment is ____________ at ______ am.

You will be done by _____ at the latest.

Location: 150 College St (College and Queens Park) FitzGerald Building. Please wait at the brown door facing College St.

Remember to fast for 12 hrs before eating the provided breakfast @ ____ am on the day of the study. Please eat the entire breakfast, but do not eat or drink anything else.

You may bring homework or quiet entertainment to use ONLY when in room 320.

If you feel ill, it is better to re-schedule.

If you need to re-schedule or have any questions please call Miss. Shokoufeh @ 647-292-9214
Appendix VI - Sample size calculations

The equation used to calculate sample size when testing for the mean of a normal distribution (two-sided alternative), for within subject designs, is:

\[ n = \left[ (z_{1-\alpha/2} + z_{1-\beta}) \cdot \sigma/\Delta \right]^2 \]

\( \alpha = 0.05 \), probability of Type I error

\( \beta = 0.20 \), probability of type II error

\( Z_{0.975} = 1.96 \)

\( Z_{0.90} = 1.28 \)

\( \sigma = 209 \text{ kcal} \)

\( \Delta = 189 \text{ kcal} \)

\( n = 12 \)

Because, no previous study in our lab looked at the effect of food advertisements, the sample sizes were calculated based on the changes in food intake in response to the glucose drink from previous studies at our lab using the similar study design, at the same age group. \( \sigma \) represents standard deviation. \( \Delta \) represents the average difference in food intake between glucose treatment and control. \( n \) is the number of subjects required.