

Effects of Health Claims on Consumption and Taste in Children: The Moderating Effects  
of Sex.

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**Abstract**

Research on adults has shown that when certain energy dense foods (EDF) are marketed as ‘healthy’, consumption of these foods increases during a single eating occasion. However, the effect health claims can have on consumption and taste in pre-adolescent children is largely unknown. The main objective of this thesis was to examine how health claims influence energy intake (EI) and liking in pre-adolescent children. A between-subject experimental design was used, whereby 66 participants (34 girls and 32 boys, mean  $\pm$  SD age:  $10.5 \pm 1.4$  years), consumed a chocolate milkshake while watching specific videos on YouTube® for 20 minutes. The participants were randomly assigned in equal numbers split into one of two groups. For one group (control), no label was added and nothing was said about the milkshake. In the experimental (health claim) group, the milkshakes were labeled and presented as “high in calcium, and healthy”. The primary outcomes were EI and liking of the milkshake, while appetite sensations were also assessed using visual analogue scales (VAS). Results from Analysis of Covariance (ANCOVA) indicate that compared to the same shake without a health claim, a chocolate milkshake that was advertised as healthy was perceived as healthier, although there was no effect on EI or taste. When sex was investigated, boys consumed significantly more calories than girls when the milkshake was advertised as healthy. The higher EI from boys in the ‘healthy’ condition suggests a health claim may elicit different food consumption behaviors between sexes. In addition, the participants from the experimental (healthy) group who rated the milkshake as highly healthy consumed significantly more calories than those from the same group who only rated the milkshake moderately healthy. Further research is needed to better determine the effects of different health claims on children’s taste and EI, and to corroborate these initial findings and examine

the underlying reasons for the observed sex differences.

## **Contributions**

The work contained in this thesis is my own, and I assume all responsibility for its content. The data contained in this thesis are original and from my thesis project examining the effects of health claims on consumption on pre-adolescents, of which I was a principal-investigator. I was responsible for the design of the study, participant recruitment, data collection, data analysis, and writing of the thesis manuscript. For the article contained in Part 2, I am the primary author and all contributions to this article are contained within Part 2. At the time of submission of this thesis the article was submitted for publication to the journal *Appetite*.

## **Acknowledgements**

I would like to acknowledge the advice, guidance, and opportunities that have been provided to me from my supervisor, Dr. Gary Goldfield. There have been some obstacles to overcome during my research project, and I don't think I would have been able to persist through them without the support from Gary. He has been available whenever required throughout this journey and his timely advice and comments on all issues have been greatly appreciated. Gary has allowed me to increase my knowledge in the research field and has given me the opportunity to work in another research project examining prenatal effects of smoking. Gary's advice and guidance were a significant contribution to this thesis and they can be seen in the writing of the thesis manuscript. Gary has been a great mentor, and I am very appreciative of that.

My co-supervisor Dr. Éric Doucet and my thesis committee members Dr. Jean-Phillipe Chaput and Dr. Bénédicte Fontaine-Bisson must be acknowledged for their helpful comments, suggestions, and questioning that was provided throughout the thesis process. I would also like to thank Dr. Jameason Cameron for his guidance and feedback throughout this research project. Jameason has always been there to help me with my project. In addition, I had the opportunity to work closely with Jameason on a project investigating the prenatal effects of smoking. Working with him on this project has allowed me to improve my own understanding of research methodologies and has allowed me to become more insightful and reflective when examining my own research projects. Collectively, their comments and suggestions were influential in the manuscript writing and can be found within the document. Without the help from all 5 committee members mentioned above, this manuscript would fail to exist.

I would also like to thank the English Montreal School Board for allowing me to collect data in their schools as well as the school principals and daycare technicians who allowed students to participate in my research project.

Finally, the participants involved in this study must be acknowledged. Without their participation none of this would have been possible.

**Prelude to Thesis**

This study contains all original data that I collected for the purpose of this study. The study received ethical approval from the University of Ottawa Research Ethics Board, Children's Hospital of Eastern Ontario, and the English Montreal School Board. The study was funded through my own personal finances.

This is a manuscript-based thesis that contains one original research paper. In part 1, I have provided a general introduction on the topic, a comprehensive literature review with focus on food studies, health claims, and eating habits in youth. Part 2 contains the research article that at the time the thesis was submitted for review to the journal *Appetite*. Part 3 contains a global discussion of the findings from this study, including the strengths, limitations, and future research opportunities. Part 4 contains a list of references contained in the thesis. Part 5 contains a copy of the ethical approvals, and all results that were not contained or presented in part 2.

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**Figure 1.** Perceived healthiness of milkshake rated post consumption. Comparisons between groups were analyzed by using ANCOVA. Significant differences between the control group and experimental group ( $P<0.001$ ). N=66 (33 per group).

**Figure 2.**

Comparison of energy intake between the males and females from the healthy condition vs. the control group. Comparison between groups was analyzed by using ANCOVA. Significant differences between sexes in the healthy condition ( $P<.05$ ), although no differences in consumption by sex in the control condition.

**Figure 3.**

Figure 3 shows data exclusively from participants in the healthy group. It is a comparison of energy intake from those who rated the milkshake moderately healthy vs. those who rated it highly healthy. Comparison between groups was analyzed by using ANOVA. Significant differences between the moderately healthy and highly healthy groups ( $P<0.001$ ).

**Figure 4**

Comparison of liking between participants from the healthy condition vs. the control condition. Comparison between groups was analyzed by using ANCOVA. There are no significant differences between groups, ( $P<0.54$ ).

**Figure 5**

Figure 5 shows data exclusively from participants in the healthy group. It is a comparison

of healthiness rating between participants who believe healthy foods can taste pleasant vs. those who believe healthy foods cannot taste pleasant. There are no significant differences between groups, ( $P < 0.37$ ).

**Abbreviations:** BMI=body mass index; EDF= energy dense foods; ANCOVA= analysis of covariance; VAS= visual analogue scales; EI= Energy Intake

## **PART 1**

### **Introduction**

Child obesity rates have significantly increased in recent decades (Abarca Gómez et al., 2017; Ogden, Carroll, Curtin, Lamb & Flegal, 2010; Sheilds & Tremblay, 2010). According to research, an increase in EI and improper nutrition has played an important role in the increase in obesity rates (Drewnowski & Specter, 2004; McFerran & Mukhopadhyay, 2013). Researchers argue that physical activity alone is not enough to promote weight loss and that altering eating habits is crucial in maintaining a healthy body weight (Caudwell, Hopkins, King, Stubbs, & Blundell, 2009; Malhotra, Noakes, & Phinney, 2015). Since eating behavior can likely play a part in childhood obesity, (Mikkilä, Räsänen, Raitakari, Pietinen & Viikari, 2005) it is valuable to gain a better understanding of factors that influence children to make healthy food choices.

Research shows that children are capable of categorizing foods as healthy or unhealthy (Nguyen, 2008) and that children from ten to twelve years old will often use front-of-package health claims to determine the healthiness of a product (Elliott & Brierley, 2012). When a food product possesses a health claim, children will perceive that food to be healthier in comparison to a non-labeled product (Soldavini, Crawford, & Ritchie, 2012; Wardle & Huon, 2000). The perceived healthiness of a product can often influence children's choice (Ares et al., 2016; Engell, Bordi, Borja, Lambert & Rolls, 1998; Dixon et al., 2014; Miller, Seiders, Kenny, & Walsh, 2011) as well as their taste experience (Lapierre, Vaala, & Linebarger, 2011; Soldavini et al., 2012; Wardle & Huon, 2000), although findings are mixed. Researchers have suggested that the inconsistent results may be attributed to whether a palatable-EDF or healthier food is being presented as 'healthy' (Wansink, Ittersum, & Painter, 2004).

Food manufacturers often use health claims on products marketed to children, yet many of these items are unhealthy as they are high in sugar, sodium, or saturated fat (Chacon, Letona, & Barnoya, 2013; Colby, Johnson, Scheett, & Hoverson, 2010; Elliott, 2008; Lapierre, Brown, Houtzer, & Thomas, 2016). Even though health claims may be intended to promote healthier choices, there is evidence that they may be counterproductive to maintaining a healthy body weight through increased consumption in adults (Bui, Tangari, & Haws, 2017; Cleeren, Geyskens, Peter, & Joost, 2016; Provencher, Polivy, & Herman, 2009; Suher, Raghunathan, & Hoyer, 2016; Wansink & Chandon, 2006).

Understanding how health claims influence children's EI and taste preferences have important public health implications given the amount of unhealthy foods marketed to children as 'healthy' (Chacon et al., 2013; Colby et al., 2010; Elliott, 2008; Royo-Bordonada, Bosqued-Estefanía, Damián, López-Jurado, & Moya-Geromini, 2016). Perceptions of healthiness can influence consumption and taste in adults (Wansink et al., 2004), but the effects remain unclear in children (Miller et al., 2011), and to our knowledge no research to date has yet to investigate how health claims influence EI in pre-adolescent children (Soldavini et al., 2012). It is important to examine whether marketing EDFs as healthy increases EI as this would play a contributing role in childhood obesity. In turn, the findings of this study may influence health professionals to further examine the potential effects of health claims on EI, and if these effects continue to be present in a long-term study.

## **2.0 Literature Review**

### ***2.1 Obesity***

The prevalence of obesity among children and adolescents in North America has drastically increased in recent decades (Ogden et al., 2010; Sheilds & Tremblay, 2010) although has recently leveled off in the U.S. (Abarca Gómez et al., 2017; Ogden et al., 2016). Approximately 30% of children are overweight or obese in Canada (Roberts, Shields, de Groh, Aziz, & Gilbert, 2012). Whereas, in the U.S., the prevalence of obesity between 2011-2014 was at 17% and extreme obesity was at 5.8% (Ogden, et al., 2016). Moreover, research also shows that child/adolescent obesity is very likely to persist into adulthood (Simmonds, Llewellyn, Owen, & Woolacott, 2016; Shields & Tjepkema, 2006).

One proposed solution to combat obesity is to choose to eat healthier foods (Dietz & Gortmaker, 2001; Gee & Agras, 2014; Story, Nanney, & Schwartz, 2009), which has been shown to be effective in reducing Body Mass Index (BMI) among children (Epstein, Paluch, Beecher, & Roemich, 2008). However, behavioral choice of healthy versus unhealthy foods is influenced by many factors (Eertmans, Baeyens, & Van Den Bergh, 2001; Wansink & Sobal; 2007).

### ***2.2 Behavioral Choice***

Food choices are complex behaviors determined by many factors and their interactions (Köster, 2009; List & Samek, 2015; Sobal & Bisogni, 2009). There are many theories that attempt to explain food choices although these theories possess low predictive validity (Köster, 2009; Sobal & Bisogni, 2009). Our food choices can be the outcome from a combination of biological, sociological, economical, and psychological

factors (Wansink & Sobal, 2007). Therefore, food choices may vary significantly between individuals (Connors, Bisogni, Sobal, & Devine, 2001). Nonetheless, taste is consistently reported as being the most important factor that influences food choice in adults as well as in children (Glanz, Basil, Maibach, Goldberg, & Snyder, 1998; Nestle et al., 1998; Nguyen, Girgis, & Robinson, 2015). Even though taste plays a crucial role in food choice (Nasser, 2001), there are other factors that influence choice and consumption.

According to Connors *et al.*, (2001), cost, time, social relationships and health are all important food related values that influence choice and consumption. In addition, Nestle *et al.*, (1998) emphasize that another important category to consider is attitudes, beliefs, and values. For example, someone may chose to be vegetarian based on their beliefs that killing animals for the purpose of consumption is cruel. Therefore their choices may be restricted in comparison to the non-vegetarian consumer who holds different beliefs.

Moreover, Glanz *et al.*, (1998) found that demographic variation was responsible for trends in food choices and consumption. Glanz *et al.*, (1998) highlight that their study showed that cost was the second most important factor that affected food consumption. Further, cost as well as convenience was a more pronounced factor among younger adults and those with a lower income (Glanz et al., 1998). Eertmans *et al.*, (2001) point out that if a highly liked food is inaccessible due to cost or time, consumers will shift their food choice to what is available in the environment.

Raynor & Epstein (2001) highlight that consumption increases when greater variety in a diet or meal is available. Therefore, Raynor & Epstein (2001) suggest

limiting the number of highly palatable EDFs in a meal. However, Fisher & Birch (1999) argue that restricting access to palatable foods is not an effective means of reducing intake among children and may be counterproductive. They showed that restricting access to palatable food actually increased children's response to that food, even more so for boys (Fisher & Birch, 1999). Furthermore, restricting access to palatable food increased children's subsequent selection and intake of that food.

Interestingly, Goldfield & Epstein (2002) showed that as highly palatable EDFs become less convenient and accessible, individuals shift their choice towards healthier alternatives such as fruits, vegetables and enjoyable sedentary activities. Thus, collectively, research indicates that limiting availability to high-energy foods while increasing access to healthier foods can help reduce EI.

### ***2.2.1 Healthiness & Choice***

As obesity rates continue to rise (Abarca Gómez et al., 2017), perceived healthiness of a product has become a significant factor in food choice (Lake et al., 2007) and portion size selection (Labbe, Rytz, Godinot, Ferrage, & Martin, 2017). The term 'healthy eating' varies significantly between people (Connors et al., 2001; Lake et al., 2007). Glanz *et al.*, (1998) found that women and older respondents rated health as a more important factor when choosing foods in comparison to the general population. Interestingly, Lake *et al.*, (2007) found that those with a higher socio-economic status as well as those with lower BMI's placed a greater emphasis on healthiness when choosing foods compared to the general population. Ironically, there is research that shows consumers who chose to consume products perceived as 'healthy' or 'diet' may also reward themselves by indulging in high-caloric foods (An, 2016; Chandon & Wansink,

2007; Her & Seo, 2017). Thus, their intentions to consume 'healthy' foods may actually be counterproductive to maintaining a healthy body weight. In addition, research also shows that the consumption of healthy products can cause consumers to engage in unhealthy behavior such as exercising less (Chiou et al., 2011). The consumption of healthy products can provide consumers with a false sense of invulnerability from other behaviors unfavorable to their health (Chiou et al., 2011).

Birch (1999) points out, a portion of the population is unlikely to take health into consideration in choosing foods, as they are unwilling to give up preferred foods. Research also shows that healthier foods are prone to lower taste expectations (Huang & Wu, 2016; Norton, Fryer & Parkinson, 2013; Raghunathan, Walker, Hoyer, 2006). If individuals associate healthy food with unpleasant taste expectations, it can deter them from choosing healthier products (Liem, Aydin, & Zanzi, 2012; Vadiveloo, Morwitz, & Chandon, 2013), although this is not always the case (Huang & Wu, 2016).

Moreover, parents report that they make a conscious effort to select healthy foods for their children (Abrams, Evans, & Duff, 2015; Krystallis, & Chrysochou, 2012; McIntyre & Baid, 2009). Some parents even present foods as healthy to their children in an effort to promote consumption (Achar, & Agrawal, 2015; Ross, 1995), although this method of persuasion may be counterproductive (Baranowski et al., 1993; Maimaran & Fishbach, 2014; McKinley et al., 2005). Interestingly, Finkelstein & Fishbach (2010) showed that if a healthy choice is imposed, adult consumers report feeling hungrier post consumption of a small snack par (12 grams, 50 calories) in comparison to not eating anything. This effect is more pronounced for individuals who are not concerned with watching their weight. Furthermore, adolescents have also reported that consuming a

small snack would lead them to greater hunger in comparison to not eating anything, and in consequence, they would snack more frequently (Crofton, Markey, & Scannell, 2014).

There is little research on how health claims affect children's choice (Miller et al., 2011; Nguyen et al., 2015). Miller et al. (2011) emphasize that the presence of a general health claim on a food perceived to be relatively healthy can deter pre-adolescent children (aged 8-12) from choosing the product. In contrast, when a general health claim was placed on a cereal perceived to be relatively unhealthy (EDF), children were more likely to choose the unhealthier product (Miller et al., 2011), which is consistent with findings from Dixon *et al.*, (2014). Based on the available evidence, albeit very limited, it is plausible that health claims can promote unhealthier choices while deterring healthier choices.

### **2.3 Health Claims**

The nutrition facts table is a display of nutritional information and is mandatory on pre-packaged foods in Canada (Health Canada, 2017a). The nutrition facts table provides consumers with information about a food's serving size, calories, macronutrient profile as well as percent daily value of certain micronutrients (Health Canada, 2017a). The nutrition facts table is generally accepted as a means to providing information to consumers to support healthy food choices (McCann et al., 2013). The nutrition facts table is used less so by children and adolescents in comparison to adults (Campos, Doxey, & Hammond, 2011). Further, food manufacturers will often market their product with health claims that are displayed on the front of the package (Miller et al., 2011; Vadiveloo et al., 2013).

Health claims describe the relationship between a food, food component, or

dietary supplement ingredient as it relates to reducing risk of a disease or health-related condition (Hasler, 2008). In Canada, a health claim is any representation in labeling or advertising that implies that a relationship exists between the consumption of a food and health (Inspection.gc.ca, 2014). There are three categories of food claims that can be used in the United States and Canada; general health claims, nutrient content claims, and structure/ function claims (Hasler, 2008; Inspection.gc.ca, 2016). A probiotic claim can be made in Canada as well (Inspection.gc.ca, 2016).

When health claims are present on food products, it can deter individuals from examining the nutrition facts table (Roe, Levy, & Derby, 1999; Verrill, Wood, Cates, Lando, & Zhang, 2017). As such, these health claims can have a significant impact on the perceived healthiness of a product (Labiner-Wolfe, Jordan Lin, & Verrill, 2010; Roe et al., 1999; Verrill et al., 2017) regardless of what the claim says or how small it is (Northup, 2014). In fact, even the presence of a nutrition symbol (i.e. health checkmark), changing the food label from white to green, or altering an ingredient from sugar to ‘fruit sugar’ is enough to alter the perceived healthiness of a product (Schuldt, 2013; Steenhuis et al., 2010; Sütterlin & Siegrist, 2015). Research shows that the presence of a health claim causes a ‘health halo’ effect, which causes consumers to categorize the food as healthy based on the presence of one positive attribute (i.e. low-fat, high in calcium) (Chandon & Wansink, 2007; Roe et al., 1999).

In 2010, 43% of foods and beverages had health claims on them according to the United States Department of Agriculture (Martinez, 2013, as cited in Vadiveloo et al., 2013). Interestingly, nutrition marketing appears to be used more frequently on products targeted to children than adults, 71% vs. 49%, respectively (Colby et al., 2010). One

American study found that 71% of packaged products marketed to children contained nutrition marketing and 59% of these products were high in saturated fat, sodium, and/or sugar (Colby et al., 2010). The health claim most often used on children's foods was a nutrient content claim (Colby et al., 2010). In research conducted in Canada, it was found that 48% of packaged food contained nutrition marketing (Schermel, Emrich, Arcand, Wong, & L'abbé, 2013). In addition, another Canadian study found that at least one nutrition claim appeared on 63% of products that were identified as fun foods marketed to children with poor nutritional quality (Elliott, 2008). This issue is persistent around the rest of the world as well (Mayhew et al., 2016). It appears food companies are placing health claims on foods that stretch the healthy attributes of their product and are often inaccurate or misleading (Chacon et al., 2013; Colby et al., 2010; Elliott, 2008). Thus, consumers may perceive products to be healthier than they actually are.

#### ***2.4 Energy Intake***

There is literature that suggests health claims can influence consumption among adults. Research has shown individuals are prone to consume higher amounts of EDFs when the food possesses a health claim in comparison to when no claim is made (Bui et al., 2017; Cavanagh & Forestell, 2013; Koenigstorfer, Groeppel-Klein, Kettenbaum, Klicker, 2013; Provencher et al., 2009; Suher et al., 2016; Wansink, & Chandon, 2006). The presence of a health claim increases perceived healthiness (Dixon et al., 2011; Northup, 2014; Roe et al., 1999) and 'healthy' foods are perceived as having fewer calories than they actually do (Carels, Konrad & Harper, 2007; Carels, Harper & Konrad, 2006). Therefore, Wansink & Chandon (2006) postulate that palatable-EDFs are prone to higher consumption if they are marketed as healthy as consumers may believe increased

intake is acceptable due to the food containing fewer calories (Koenigstorfer et al., 2013; Norton et al., 2013; Provencher et al., 2009). Engell et al., (1998) have also shown that pre-adolescent children who viewed dietary fat as unhealthy, would reportedly consume more low-fat cookies than regular cookies.

McCann *et al.*, (2013) highlight that prospective consumption was a strong predictor of increased consumption of a 'healthy' meal, as participants in their study identified how much they believed they would eat immediately before consumption through VAS. Interestingly, McCann *et al.*, (2013), demonstrate that a high fat/energy condition did not influence participants to lower their food intake in comparison to a baseline condition, whereas as a low fat/energy condition caused an increase in consumption compared to baseline. This suggests that participants were not regulating their intake based on label/energy content, rather indulging more when the product was perceived as healthy, or low-fat (McCann et al., 2013).

In contrast, consumers do not always consume higher amounts foods when healthiness is manipulated (Ebnetter, Latner, & Nigg, 2013; Gravel et al., 2012; Hovard, & Yeomans, 2015; Steenhuis et al., 2010). Interestingly, some studies showed no difference in consumption used a 'taste test' setting, in which participants had 10 minutes to consume as much food as they needed to answer the questions pertaining to sensory ratings. In comparison, some studies that showed differences in consumption used a more natural setting and/or a larger time frame for ad libitum consumption (Koenigstorfer et al., 2013; McCann et al., 2013; Suher et al., 2016; Wansink & Chandon, 2006).

It is essential to point out that choosing to eat healthy or low fat /light products can be conducive to weight loss (Wing & Hill, 2001), pending healthy/ low-fat choices

are not compensated with high calories foods during subsequent feedings (Chandon & Wansink, 2007). Furthermore, Versluis & Franes (2013) have shown that light/ low fat products are generally not being consumed in higher caloric amounts compared to their regular counterparts. However, it is important to note, the true concern is with the increased consumption of products that are marketed as low fat/carb or ‘healthy’ through a nutrient content claim yet are energy dense. Wansink & Chandon (2006) found that low fat energy dense snacks only contained 15% fewer calories than regular versions, despite containing 59% less fat per serving. In addition, some products low in fat contain high amounts of sugar and/or sodium (Colby et al., 2010; Elliott, 2008). Further, health claims are placed on variety on food products that are not necessarily healthy such as sugary cereal and fruit snacks (Northup, 2014).

There is little research on how perceived healthiness affects EI among pre-adolescent children. Wardle & Huon (2000) examined how healthiness affects children’s consumption although portions used were too small to draw conclusions. They provided children with 50 ml to drink and more than half the participants consumed the entire drink, hence a potential ceiling effect. Whereas, another study only asked children about how much food they would consume based on the labels (Engell et al., 1998). Maimaran & Fishbach (2014) showed that when 3-5 year old children were presented with crackers as instrumental to being strong, consumption decreased in comparison to the control group, which nothing was said about the crackers (Maimaran & Fishbach, 2014).

### ***2.5 Taste***

There are many factors that influence the effects of health claims on taste such as beliefs about the tastiness of healthy foods, energy density of the food, palatability, and

taste expectations (Eertmans et al., 2001; Provencher & Jacob, 2016; Raghunathan et al., 2006; Wansink et al., 2004). Raghunathan et al., (2006) emphasize that individuals possess an implicit belief that the unhealthier the food, the tastier they believe it to be, regardless if they explicitly state unhealthier foods don't taste better. Studies also suggest that children often consider healthy foods and tasty foods as mutually exclusive (Baranowski et al., 1993; McKinley et al., 2005) as taste has been reported as a significant barrier to healthy eating (Crofton et al., 2014; O'Dea, 2003; Stevenson, Doherty, Barnett, Muldoon, & Trew, 2007). Furthermore, the extent to which consumers believe healthy foods can taste good has shown to be an influencing factor in perceived taste rating and choice (Aaron, Mela, & Evans, 1994; Forwood, Walker, Hollands, & Marteau, 2013; Raghunathan et al., 2006). Simply put, research indicates that taste ratings will shift in a direction consistent with participant attitudes towards healthy foods (Engell et al., 1998; Westcombe & Wardle, 1997).

Prior research on adults has produced different findings concerning the effect a health claim has on taste (Wansink et al., 2004). In some cases a health claim has improved taste (Cavanagh & Forestell, 2013; Wansink et al., 2004), whereas in other cases a health claim has reduced taste evaluations (Raghunathan et al., 2006; Wansink & Park, 2002), and in some research the health claim had no effect on taste (Hovard & Yeomans, 2015; Kim & Kwak, 2015; Norton et al., 2013). Researchers suggest the inconsistent findings caused by health claims on taste may stem from whether a 'healthy' food or EDF is being promoted as 'healthy' (Wansink et al., 2004). Emphasizing the healthiness of an EDF has shown to cause a higher taste evaluation in comparison to the identical food without the claim (Cavanagh & Forestell, 2013; Ebneter et al., 2013;

Soldavini et al., 2012; Wansink et al., 2004). Wansink *et al.*, (2004) posit that a health claim can create a higher taste evaluation by causing a significant diminished taste expectation to the food (pre-taste), followed by the food highly surpassing expectations (post-taste), known as expectation disconfirmation. Based on the theory of Wansink *et al.*, (2004), it can be presumed that EDF's are prone to higher taste evaluations when possessing a health claim, as they are highly palatable (Birch, 1999). Literature on adults does demonstrate that if EDF's are not highly palatable (Steenhuis et al., 2010) or if the health claim used does not significantly reduce the food's taste expectations (Norton, et al., 2013), a health claim will not produce a greater taste rating.

The research on pre-adolescent children is limited although there appears to be a similar pattern to the one seen in adults. In recent studies, children (9 years old) rated Chips A'Hoy cookies and Goldfish crackers as tastier when these foods possessed a nutritional health claim (Soldavini et al., 2012). Children have also rated cereal as better tasting when name of the cereal (healthy bits) suggested it was healthy in comparison to an unhealthy title (sugar bits) (Lapierre et al., 2011). In addition, Engell et al., (1998) showed that pre-adolescent children preferred a cookie when it was labeled as low fat in comparison to when no label was present on the cookie.

In contrast, when health claims have been placed on healthier foods, consumers will rate the food as less pleasant in comparison to the control group (Jacquot, Berthaud, Sghair, Diep, & Brand, 2013; Raghunathan et al., 2006; Schouteten et al., 2015; Wardle & Solomons, 1994; Westcombe & Wardle, 1997). Wansink *et al.*, (2004) suggest healthier foods are not known to be highly palatable, thus a health claim made on the food would not decrease perceived taste (Wansink et al., 2004), and instead may cause a

lower taste evaluation, if any at all. In very young (3.5-5 years old) children, when Wheat Thin Crackers, a snack perceived as healthy by mothers, was presented as instrumental to a goal, this resulted in the crackers being rated lower in taste in comparison to when nothing was inferred about the crackers (Maimaran & Fishbach, 2014). Consistent with this finding, Wardle & Huon (2000) showed that children (age 9-11) rated a novel lemon drink lower in liking when it was identified as a health drink.

Collectively, it appears that the effect a health claim can have on taste and liking will vary dependent on the general palatability of the food (Raghunathan et al., 2006). In addition, attitudes towards healthy foods may also dictate the effect a health claim can have on taste and liking (Forwood et al., 2013).

## ***2.6 Sex differences***

Whether health claims made on food elicit different responses between males and females is not clear. In adults, some studies that examined the effect of health claims on food consumption either used female participants only (Carbonneau et al., 2015; Cavanagh & Forestell, 2013; Ebnetter et al., 2013; Provencher et al., 2009), did not discuss sex differences (Suher et al., 2016), or found no differences between sexes (Koenigstorfer et al., 2013; Wansink & Chandon, 2006).

In regards to research on children, one study found males might be more inclined to serve themselves larger portions of an EDF labeled as healthy (Engell et al., 1998;). It has also been underlined that boys are more likely to rely on nutrient data to dictate healthiness of a food in comparison to girls (Brierley & Elliott, 2015a). Although, there were no sex differences found for taste when manipulating the healthiness of a yogurt (Enax et al., 2015), and other studies did not evaluate sex differences when examining

taste (Lapierre et al., 2011; Soldavini et al., 2012).

## **2.7 BMI**

In research that examined the effect of health claims on consumption, some studies found no consumption differences between normal weight participants and participants who are overweight or obese, and BMI was also not a moderating factor (Carbonneau et al., 2015; Cavanagh & Forestell, 2013; Provencher et al., 2009).

However, one study did find that overweight individuals were more susceptible to health claims, thus they may consume even more calories in comparison to normal weight individuals (Wansink & Chandon, 2006). Other research did not examine BMI (Koenigstorfer, 2013; Suher et al., 2016), therefore it is important to assess whether BMI plays a role in EI and taste differences when a health claim is present.

## **2.8 How expectations influence liking**

Berridge (2007) emphasizes that liking can be described as the pleasure from eating a food. Berridge (2007) also emphasized that liking was an experience, and not an action. Some taste preferences are innate (i.e. sweet, salty), although it is also important to note that liking can be learned and unlearned (Rozin, 1990). Research suggests that expected liking based on either verbal information or seeing the product best predicts actual liking (Skaczkowski, Durkin, Kashima, & Wakefield, 2016; Tuorila, Meiselman, Cardello, & Leshner, 1998). In the last half-century, there have been many studies documenting how food expectancy is an influential factor in determining our taste and preferences (Skaczkowski et al., 2016). Individuals were unable to detect their favorite beer unless the drinks possessed labels (Allison & Uhl, 1964). Perrier water is only preferred to Old Fashioned Seltzer when the labels are showing (Nevid, 1981). Foods were evaluated to

have better nutritional profiles when labeled as organic (Lee, Shimizu, Kniffin, & Wansink, 2013).

There is also evidence that shows our perceived expectations are even powerful enough to alter our physiological state. Manipulating the perceived cost of wine to be more expensive can result in heightened activity in the medial orbital frontal cortex, which is known as the pleasure center of the brain (Plassmann, O'Doherty, Shiv, & Rangel, 2008). McClure *et al.*, (2004) have shown that participants enjoyed the taste of Coke better when it was consumed from a brand-named cup, and these taste ratings were consistent with an expected brain response using a MRI. Finally, manipulating the label of a milkshake has shown to alter ghrelin responses, suggesting participants' were more satiated when they believed they were drinking a high calorie beverage in comparison to a healthy one (Crum, Corbin, Brownell, & Salovey, 2011).

Interestingly, findings show individual expectations quickly return even after being proven to be false (Tuorila, Cardello, & Leshner, 1994). In Tuorila *et al's* (1994) study, participants tasted regular and fat-free versions of saltine crackers and pound cake, in which they expected the fat-free versions to taste worse. However, a blind taste test showed otherwise not matching participants' expectations. When subjects came back to the lab a month later, their pre-conceived notions about the fat-free versions had not changed, highlighting the impact of expectation on taste.

A health claim can force consumers to re-evaluate their expectations of a food if the claim provides 'new' information (Skaczkowski, et al., 2016; Szykman, Bloom & Levy, 1997). For example, a consumer may identify chocolate as highly palatable and unhealthy due to its sugar and fat content. Although, a health claim on the chocolate may

force the consumers to alter their previous expectations and form a new expectation of 'healthy' chocolate. In a study conducted by Norton *et al.*, (2013), subjects expected chocolate to not taste as good when it was labeled low-fat in comparison to no label.

In research conducted by Lee, Frederick, & Ariely (2006), results revealed that adding balsamic vinegar to beer under the labeling "special ingredient" could actually improve taste, although only when participants were not informed of the special ingredient. Participants who were only informed vinegar was the secret ingredient post consumption did not rate the taste of 'vinegar beer' significantly lower than unlabeled beer. Finally, it was only when participants were told vinegar was the secret ingredient pre-consumption, which caused taste ratings to be significantly lower. Lee *et al.*, (2006) suggest if participants receive information prior to an experience, they may search to confirm this information during the experience (i.e. taste test). Therefore, individuals may search for a 'health' labeled product to taste unpleasant based on their taste inferences towards healthy foods. As Köster (2009) pointed out, when we ask a simple question "do you like this?" the person may taste more attentively, potentially attempting to confirm expectations. For the most part, laboratory studies demonstrate that post consumption evaluations tend to be assimilated with prior expectations (Skaczkowski, *et al.*, 2016; Wansink *et al.*, 2004). The exceptions are if the taste has strongly disconfirmed expectations (Richardson, Dick & Jain, 1994; Schifferstein, Kole, & Mojet, 1999; Skaczkowski, *et al.*, 2016; Yeomans, Chambers, Blumenthal, & Blake, 2008).

## ***2.9 Justifying age group***

The proposed research focused on children from age 9-12 years old. Among American children between the ages of 6-11, obesity has increased from 6.5% of the

population in 1998, to 19.6% in 2008 (Ogden et al., 2010), although the percentage has leveled off since (Ogden et al., 2016). In Canada, 32.8 % of children between the ages of 5-11 are considered to be overweight or obese (Roberts et al., 2012). Interestingly, in that age group, the prevalence of obesity varies between sexes as the percentage of boys with obesity was more than triple the percentage of girls with obesity, 19.5% vs. 6.3%, respectively (Roberts et al., 2012).

The research on this age group is limited (Miller et al., 2011), yet children in this age group may have greater amount of choice than their younger peers due to a school setting (i.e. cafeteria, vending machines) and may influence parental purchases (Robinson, 2000). In addition, pre-adolescent children process information in a more complex manner than younger children, and are better able to analyze the nutrition-oriented messages they receive (Maimaran & Fishbach, 2014). Furthermore, younger children (8 and younger) may be more likely to regulate their food intake through internal signals and less likely influenced by external cues (Birch & Fisher, 1998). Pre-adolescent children may possess varying attitudes toward healthy food (Engell et al., 1998) compared to younger children, and may be vulnerable to front package claims (Elliott & Brierley, 2012), thus their intake may be influenced by packaging or other nutritional information (Elliott et al., 2013).

Little is known about how health claims affect children and no study has yet to investigate how health claims affect the EI of pre-adolescent children (aged 9-12 years). The pre-adolescent stage of development is clinically relevant to study given eating habits and food choices have been shown to be malleable (Mikkila et al. 2005). Thus, determining how health claims effects food taste and EI in the targeted population would

serve as a valuable contribution to the existing literature.

### ***2.10 Aims & Objectives***

The aim of the study was threefold. First we wanted to determine whether presenting an energy-dense chocolate milkshake to children as high in calcium and healthy for them (healthy manipulation group) would be perceived as healthier compared to a control group who did not receive any information about the milkshake. Secondly, we aimed to assess the differences in EI and perceived liking from the children in the healthy group vs. control group. Thirdly, we wanted to identify if children who believe healthy foods can taste good (pleasant), would rate a ‘healthy’ milkshake more favorably in liking compared to those who believed healthy foods cannot taste good (pleasant). The degree to which weight status and sex moderated the effects of health claims on consumption and taste were also examined as exploratory objectives.

### ***3.0 Hypotheses***

We hypothesized that (1) children would perceive a milkshake presented as high in calcium as healthier in comparison to a control group. Second, we predicted that children in the health claim group would (2) consume more calories and rate the milkshake more favorable in liking compared to children from the control group. Finally, we hypothesized that (3) children from the experimental (healthy) group who believed healthy foods can taste good (pleasant) would rate a ‘healthy’ milkshake more favorable in liking compared to those who believed healthy foods cannot taste good from the same group.

**PART 2-Article**

*This article has been submitted for publication to the journal Appetite and is presented in the format required for publication.*

The article reports the results of effects of health labels on consumption, and liking, *i.e.* the main objectives of the study, as well as the moderating effects of perceived healthiness and sex, as secondary and exploratory objectives. Of note, the Subjects and Methods section in this article is a slight modification than what has been submitted to Appetite. The reason for this modification was to save the reviewer time and avoid them having to read two ‘Subject and Method’ sections that are highly redundant, while including all the necessary details that may not be necessary for an article submission.

## **Health Claims Increase Food Consumption in Preadolescent Boys but not Girls**

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## ABSTRACT

This study examined the effects of a health claim on food consumption and liking in children, and whether these effects differ between boys and girls. A between-subjects experimental design was utilized whereby participants were randomly assigned to an experimental (“healthy”) group or control group. In the experimental group (n =17 boys, n=16 girls), children were given a milkshake with a label that displayed a nutrient content health claim indicating it was a “good source of calcium”. The control group (n = 15 boys, n= 18 girls) was given a milkshake without any health claim on the label. The sample was comprised of 9-12 year old children (mean  $\pm$  SD age: 10.5  $\pm$  1.4 years). Each participant received a cup with 17 ounces of milkshake inside, and consumed the shake while watching YouTube® videos. The amount of milkshake consumed was weighed. Liking, appetite sensations, and perceived healthiness were assessed using visual analogue scales (VAS). Controlling for age and sex, analysis of covariance (ANCOVA) indicated that the health claim increased perceived healthiness of the milkshake compared to the control group (~42 mm  $\pm$  28 vs. 73mm  $\pm$  42,  $P < 0.001$ , respectively). In the overall sample, there was no effect of the health claim on energy intake or on liking. However, when sex was investigated, in the healthy condition males consumed more calories than females (570  $\pm$ 240 vs. 359  $\pm$ 228,  $P < .008$ ), although no sex differences were observed in controls. These results suggest that advertising food as “healthy” may lead to greater food consumption in boys and therefore may be counterproductive for maintaining a healthy body weight.

**Keywords:** Energy Eating, food, obesity, health claims, children, sex differences

**Abbreviations:** BMI=body mass index; EDF= energy dense foods; ANCOVA= analysis

of covariance; VAS= visual analogue scales; EI= Energy Intake

## INTRODUCTION

Childhood obesity is a complex condition resulting from a combination of biological and environmental factors (Chaput, Doucet, & Tremblay, 2012); however, poor eating habits play an etiological role in the development of obesity (Drewnowski & Specter, 2004). Given that eating behaviors established during childhood can persist into adulthood (Kelder, Perry, Klepp, & Lytle, 1994; Lien, Lytle & Klepp, 2001; Mikkilä, Räsänen, Raitakari, Pietinen & Viikari, 2005), and may be more amenable to change than during adulthood (Epstein, Valoski, Kalarchian & McCurley, 1995), it would serve as a valuable contribution to the existing literature to gain a better understanding of factors that influence children's food choices.

Interestingly, nutrition marketing appears to be used more frequently for products targeted to children than products targeted to adults (Colby Scheett, & Hoverson, 2010). Research shows that most packaged products marketed to children contain nutrition marketing despite their poor nutritional quality (Chacon, Letona, & Barnoya, 2013; Colby et al., 2010; Elliott, 2008). When a food product possesses a health claim, children perceive that food to be healthier in comparison to a non-labeled product (Dixon et al., 2014; Soldavini, Crawford, & Ritchie, 2012). According to Chandon & Wansink (2007), the presence of a health claim causes a 'health halo' effect, thus consumers categorize the food as healthy based on the presence of one positive attribute (i.e. low-fat, high in calcium).

The perceived healthiness of a product can often influence children's choice (Engell, Bordi, Borja, Lambert & Rolls, 1998; Dixon et al., 2014; Miller, Seiders, Kenny, & Walsh, 2011). The literature suggests that if children are given a choice between a

healthy food and an unhealthier version, the children are less likely to choose the healthy food if it possesses a health claim. However, children are more likely to choose an unhealthy product compared to a healthier one when the unhealthier food possesses a health claim (Miller et al., 2011). Based on the available evidence, albeit limited, it is plausible that health claims can promote unhealthier food choices while deterring healthier choices. However, how health claims affect children's energy intake (EI) is largely unknown.

When energy dense foods (EDFs) are marketed as 'healthy', they are perceived as having fewer calories than they actually do, (Carels, Konrad & Harper, 2007; Carels, Harper & Konrad, 2006) and therefore increased EI is thought to be acceptable (Koenigstorfer, Groeppel-Klein, Kettenbaum, & Klicker, 2013; Norton, Fryer & Parkinson, 2013; Provencher, Polivy, & Herman, 2009; Skubisz, 2017; Wansink & Chandon, 2006). Conversely, when young children were presented with a neutral food as instrumental to achieve a goal, consumption decreased in comparison to the control group, for which nothing was said about the food (Maimaran & Fishbach, 2014). In adults, there is evidence that health claims may be counterproductive to maintaining a healthy body weight through increased EI (Cleeren, Geyskens, Peter, & Joost, 2016; Provencher et al., 2009; Wansink & Chandon, 2006).

Research suggests that if participants receive information prior to an experience (i.e. food is "healthy"), they may search to confirm this information during the experience (i.e. taste test) (Lee, Frederick, & Ariely, 2006). Thus, individuals may anticipate a 'health' labeled product to taste unpleasant due to the perceived nature of healthy foods (Raghunathan, Walker, Hoyer, 2006). If taste expectations are strongly disconfirmed by a

food being highly palatable, foods that are presented as healthy can receive a higher taste evaluation resulting in increased liking through a process referred to as expectation disconfirmation (Lee et al., 2006; Skaczkowski, Durkin, Kashima, & Wakefield, 2016; Wansink, Ittersum, & Painter, 2004). In pre-adolescent children, research shows perceived healthiness can affect liking, although its effect remains unclear (Engell et al., 1998; Lapierre, Vaala, & Linebarger, 2011; Soldavini et al., 2012).

To date, little is known on whether males and females display different eating behaviour in response to health claims. In adults, some food consumption studies focused specifically on female participants (Cavanagh & Forestell, 2013; Lafrenière, McNeil, Provencher & Doucet, 2017; Provencher et al., 2009), whereas other research found no differences between sexes (Suher, Raghunathan, & Hoyer, 2016; Wansink & Chandon, 2006). In children, research suggests males may be more inclined to serve themselves larger portions when EDF is labeled as healthy (Engell et al., 1998). Recent research also found that boys are more likely to rely on nutrient data in comparison to girls when determining the healthiness of a food (Brierley & Elliott, 2015a).

The present study is among the first to examine how a health claim influenced EI of an energy dense palatable milkshake in pre-adolescent children. A secondary aim of the proposed study was to examine how a health claim influenced liking. Moreover, we explored whether a child's beliefs about the tastiness of "healthy" foods influenced liking of the milkshake presented as healthy. Given the paucity of data, we investigated if weight status and sex moderated the effects of health claims on EI and liking of EDF.

Based on the previous literature, we predicted that a milkshake advertised as healthy would elicit a greater calorie intake in comparison to the control group. Secondly,

we also hypothesized that the milkshake marketed as healthy would induce a more favorable liking rating in comparison to the control. Finally, it was hypothesized that children from the experimental group who believed healthy foods can taste good (pleasant) would rate the milkshake more favorable in liking compared to children who did not possess this belief.

## **SUBJECTS AND METHODS**

### ***Subjects***

Participants consisted of a sample of students, 9-12 years old, recruited from seven different schools within the English Montreal School Board, in Montreal, Quebec, Canada. The study was conducted after school hours on school premises as to not interfere with schooling. Therefore, participants had to be part of the After-Care school program in order to volunteer for this study. Sixty-six (n=66) participants in an “After-Care” school program were recruited, 34 females and 32 males. Participants were equally distributed between the “healthy” experimental group, and the control group, with 33 participants in each group. Once the principal of the school permitted recruitment in their school, the researcher provided a brief explanation of the study to students in the After-Care program. Each student interested in participating in the research study was given a consent form to bring home and have it signed by a parental guardian. Originally, the consent form possessed an option for parent’s to provide their yearly income and education. However, among the initial consent forms handed out, most did not complete this section, and some parents contacted us about this section, as they did not see the purpose of the questions and consequently did not sign the consent forms. As a result, we decided to remove this section so it would not impede recruitment of participants.

Among the seven different schools we recruited from; we handed out 13 consent forms to Coronation School and recruited 2 participants, 20 consent forms to Our Lady of Pompei and recruited 6 participants, 35 consent forms to Gerald McShane and recruited 9 participants, 25 consent forms to Hampstead School and recruited 16 participants, 46 consent forms to East Hill School and recruited 13 participants, 18 consent forms to

Michelangelo and recruited 18 participants, 47 consent forms to Honoré Mercier and recruited 18 participants. In total, 204 consent forms were handed out, and 67 were returned and signed, indicating a participation rate of 32.8%.

When the participants who returned the parental consent form presented themselves for the study, the details of the study as well as the procedures of the study was explained to them. Once these steps had been taken, participants were asked to provide assent in order to take part in the study. Participants were allowed to drop out of the study at any time, and could refuse to complete any of the tasks without having to provide a reason. Out of the 66 participants, 4 females did not want their weight to be measured. Further, 2 participants did not answer two questions each. Whether this was done intentionally or by accident is unknown. As a reward for participating in the research study, students had the opportunity to win a pair of hockey tickets to a National Hockey League regular season game. No participant dropped out of the study. One student who provided consent to take part in the study did not participate as they were no longer part of the After-Care school program. All participants were recruited between the months of November 2015, to March 2016.

### **Study Design and Procedures**

A between-subjects experimental design was utilized whereby eligible and willing participants were randomly assigned to one of 2 groups: energy dense chocolate milkshake with nutrient content health claim (experimental group), or energy dense chocolate milkshake without any claim (control group). Participants were randomly assigned to a group by a computer-generated program, and no more than 5 students were tested at once. Also, participants were asked not to eat one-hour prior to testing to avoid

being sated before the experiment.

The study commenced with the researcher going over study procedures with students. Participants were asked not to talk for the duration of the study, as means to not influence others with comments about the milkshakes. In addition, the students were placed at opposite corners of the room and bristle boards were placed as dividers so students could not see each other. This was done to ensure peers did not influence food consumption behaviors. Participants responded to a questionnaire that assessed hunger and fullness through VAS prior to food consumption. In addition, participants were also asked about the last time they ate, as well as the contents of their meal (liquid foods included), and if they thought healthy foods could taste good. Participants were then asked to rate the taste (liking) and healthiness of chocolate milkshakes and other foods, prior to seeing, tasting or being given any information about the milkshake they were about to consume.

Participants were instructed that they would be watching two specific YouTube® videos; consisting of ten minutes each, for a total of 20 minutes. While watching the videos, they consumed the milkshake. They were told that the milkshakes would be removed after 20 minutes. This scenario provides a more realistic scenario for food consumption than a ‘taste test’ used in previous studies since many children can consume up to 25% of their caloric intake in front of a TV (Matheson, Killen, Wang, Varady & Robinson, 2004). In addition, recent food studies have also shown videos to participants during consumption in an effort to reproduce ecological context of food consumption (i.e. Suher et al., 2016; Werle, Balbo, Caldara, & Corneille, 2016). The videos shown to participants were educational videos that discussed school rules and cheating. The videos

were unrelated to eating/food, non-action, and possessed a small number of edits and cuts. Therefore, based on the existing literature, it would suggest these non-food specific videos were unlikely to influence consumption (Traversy, Borghese, Ferraro, & Chaput, 2014).

Based on existing literature that shows children can be influenced by packaging (Elliott, Carruthers Den Hoed & Conlon, 2013), the milkshakes were served in a CHOICE ® 20 oz. white opaque paper cup with a straw through the lid. Each cup contained 17 oz. of chocolate milkshake. A 17 oz. serving is a representative portion size of some drinks marketed for its ‘health’ benefits (i.e. Gatorade ® 20 oz., Neilson ® Chocolate Milk 16 oz.) as well as facilitates ad libitum consumption. Moreover, a milkshake is palatable enough so children will consume it, and since a cup covers the contents of the shake, the appearance of texture and color could not influence consumption or liking. In addition, according to Krystallis, & Chrysochou (2012) when purchasing healthy products, parents’ highest demand is in the dairy category.

Students were told they could drink as little or as much as they wanted. If they finished the first milkshake, they could have another. In the ‘healthy’ condition, the cup of the milkshake possessed a nutrient content claim on it that indicated the milkshake was ‘a good source of calcium’. The claim “good source of calcium” is the most commonly used nutrition-marketing statement (Colby et al., 2010), and would be legally allowed on the milkshake in the United States and Canada (Inspection.gc.ca, 2014; Hasler, 2008), increasing the ecological validity of these experimental manipulations. The image of the health claim was very similar to the one used by Neilson ® for their 1% partly skimmed chocolate milk. In addition to the visual health claim, the researcher told the participants

“this milkshake is high in calcium, it’s healthy for you”. In contrast, in the control condition, cups were identical except they did not possess a health label and nothing was said to participants about the milkshake when presented.

Once the participants completed watching both videos, milkshakes were removed and set aside for weighing. Participants then proceeded to complete the questionnaire, which assessed perceived healthiness of the milkshake they had just consumed, perceived liking (taste), hunger, and fullness. After the questionnaire was completed, participants’ height and weight was measured. These measurements were taken in a separate, private room. Moreover, at the end of testing session, participants in the healthy group were debriefed about their experimental conditions. They were informed that a significant amount of calcium or any other micronutrient (i.e. vitamin C, iron) does not necessarily mean a food is healthy. A food can be high in calcium or any other vitamin or mineral, yet still contain high levels of sugar, saturated fat, and/or sodium. Participants were then asked not to discuss the debriefing as well as details of the study with other students.

Each participant watched the videos on a laptop computer with headphones on. All participants from the same session were randomized and tested to the same group. Participants were tested once and each session took between 40-50 minutes depending on the length of time it took to complete the questionnaire. All testing was done in a school computer lab or classroom.

## **Measurements**

### **4.3.2 Energy intake.**

Seventeen ounces of milkshake was served to participants in a 20 oz. white,

opaque, paper cup with lid. The milkshake used in this study was a Hershey's Creamy Chocolate Milkshake ®. Per 350 ml, the drink contains 370 calories, 11 g of fat (7 g saturated), 57g of carbohydrates, 53g of sugar, 11 grams of protein and 280 mg of sodium. Its second ingredient is sugar, although it contains 35% of one's daily value (DV) of calcium. The milkshake does possess a nutrient content claim indicating it is an 'excellent source of protein, vitamin D, and calcium', although it is above the nutrient facts table instead of on the front of the package. According to the Federal Drug Administration, this product would be considered to be high in saturated fat (Colby et al., 2010). This product would also be considered to be high in sugar according to criteria used in the study by Colby *et al.*, (2010), in which the daily value of sugar was established by 5 research dieticians.

After having had the opportunity to consume the milkshake *ad libitum* for twenty minutes, it was removed and weighed in ounces with a Cuisinart Kitchen Scale, Cuisinart ® to the nearest gram. If perchance the participant consumed the entire milkshake, another was offered to them. This occurred in 13 participants out of 66. No participant spilled the milkshake.

#### **4.3.3 Taste**

The VAS used was 150 mm in length, with statements anchored at each end expressing the most positive and most negative rating of the participants' liking of the milkshake. Participants had to indicate to what extent they enjoyed the taste of the milkshake, ranging from 'like not at all' to 'extremely like' (as seen in Norton et al., (2013)). The VAS has been shown to be both reproducible and valid for measurement of appetite sensations in a laboratory setting (Flint, Raben, Blundell, & Astrup, 2000) and

has been used in previous research with pre-adolescents (Gribbon, McNeil, Jay, Tremblay & Chaput, 2015).

#### **4.3.4 Perceived Taste of healthy foods**

Previous research, (Raghunathan et al., 2006; Werle, Trendel, & Ardito, 2013) asked participants to what extent they agreed with the statement; “things that are good for me rarely taste good”. In an effort to construct the question so it would appear as neutral as possible, participants were asked to indicate how ‘healthy foods taste’ using a 150 mm long VAS ranging from ‘really bad’ to ‘really good’.

### **Secondary Measures**

#### **4.3.3 Anthropometric measurements**

Height and weight were measured using a standard physician’s scale and height rod (Health-o-Meter Professional Model 402KL, Continental Scale Corp., Chicago, IL, USA). Height was measured, without shoes, after a deep inspiration to the nearest ¼ inch with the participant’s feet together and head in the Frankfort plane. Weight was measured to the nearest ¼ pound. These measurements were used to calculate body mass index (BMI- kg/M<sup>2</sup>). BMI was determined and interpreted with the WHO BMI age growth charts (de Onis, et al., 2007), with children  $\geq 85^{\text{th}}$  BMI percentile classified as overweight or obese, and children between the 15<sup>th</sup> and 84<sup>th</sup> percentiles classified as “normal-weight”. These measurements were taken post food consumption as doing so prior may affect EI in certain individuals (McFarlane, Polivy, & Herman, 1998).

#### **4.3.4 Hunger & Fullness.**

Hunger and fullness were also assessed using 150 mm VAS, similar to previous

research conducted with children (Gribbon et al., 2015). Participants had to indicate how full they felt ranging from ‘not full at all’ to ‘extremely full’. They indicated their hunger on a scale ranging from ‘not hungry at all’ to ‘as hungry as I ever felt’ (as seen in Gribbon et al., 2015).

#### **4.3.5 Time and calories of last meal**

Participants also indicated the time they last ate as well as the contents of their meal. Energy intake was determined and analyzed using the Food Processor SQL software (version 9.6.2, ESHA Research).

#### **4.4 Sample size calculation**

No studies to date have examined the effects of health claims on food consumption in our targeted population of preadolescent (9-12 years) children, thus sample size was informed by data from methodologically similar studies conducted in adults. Provencher *et al.*, (2009) found that a health claim increased consumption of a palatable cookie in 99 adults from  $41.6\text{g} \pm 27.8$  to  $56.0 \pm 34.6$ , for an effect size of 0.52. Based on these effects, assuming power of 80%, alpha at .05, we could detect this effect with 118 participants, 59 in the health claim group and 59 in the control group. However, due to recruitment difficulty as well limited time and financial flexibility, the recruitment was ceased at 66 participants (33 children per group). It is also important to note that food studies with children tend to have a comparable number of participants as the current study (Maimaran & Fishbach 2014; Soldavini et al., 2012; Wardle & Huon, 2000), making results comparable.

#### **5.0 Statistical Analysis**

Prior to statistical analysis, distributions of the variables were assessed for

normality by group, healthy condition vs. no claim. This was done by using the Shapiro-Wilk *W* test, examining Kurtosis and Skewness, and identifying variance homogeneity. To compare the effects of healthy claims on consumption, taste, and other variables of interest, ANCOVA and non-parametric tests (Mann-Whitney *U*) were conducted. These tests were used on variables that were normally and not normally distributed, respectively. Given the same pattern of results emerged for both types of analyses, only the ANCOVA results are presented as this analysis is robust enough to detect for small violations of normality as we observed (Tabchnick & Fidell, 2006). In addition, the units of measurement in variables of interest are more meaningful, thus aiding interpretation. Furthermore, ANCOVA allows variables to be statistically controlled and to explore interactions, where non-parametric statistics do not.

In order to determine if there were any pre-experimental group or sex differences on demographics, BMI percentile, and appetite sensations, two way analyses of variance (ANOVAs) with group (healthy vs. control) and sex (boys vs. girls) as independent variables were conducted.

To test the primary and secondary objectives, the effect of the health label (experimental vs. control) on consumption, liking, and perceived healthiness, one-way ANCOVAs were used for which we controlled for pre-meal hunger and BMI percentile as these factors are well known to influence taste and food consumption in laboratory studies. Two-way ANCOVA's were conducted to examine whether the effects of health claims (healthy vs. control) on consumption and taste were moderated by either sex (male vs. female) or weight status (normal weight vs. overweight/obese), controlling for age and pre-meal hunger. If main or interaction effects reached statistical significance,

differences were explored with post-hoc tests. Effect sizes were examined using the Cohen's *d* method, reflecting the magnitude of the mean difference between groups in SD units. Differences were considered significant at  $p < 0.05$ . All statistical analyses were performed using SPSS Statistics 24.0 (SPSS Inc., Chicago, IL, USA).

## RESULTS

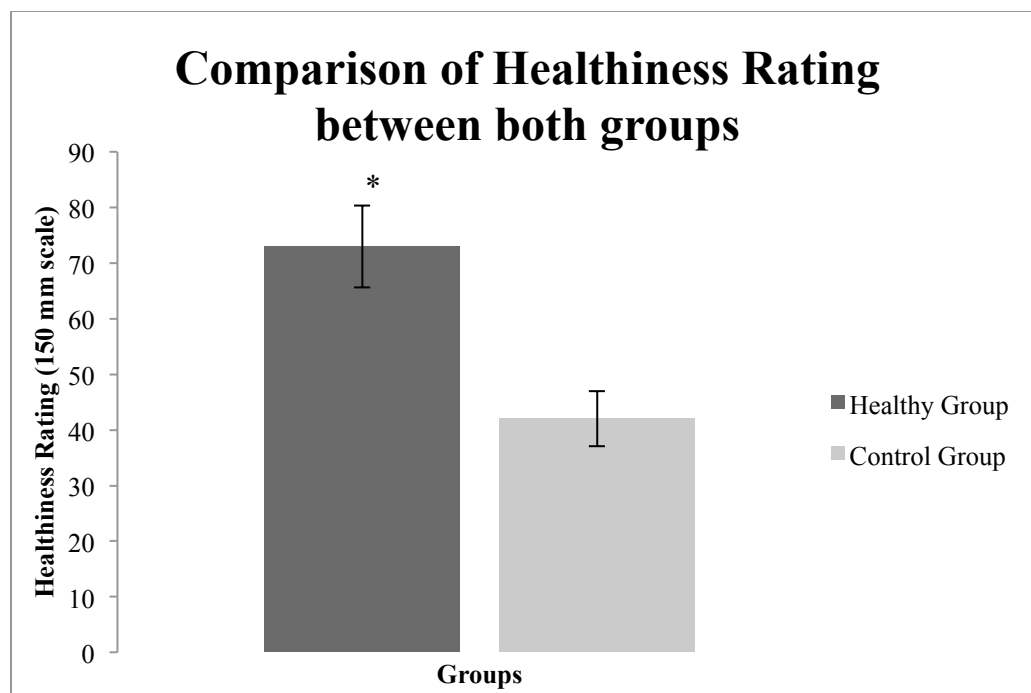
### *Participants' characteristics*

**Table 1** shows the descriptive characteristics of participants distinguished by group and sex. On average, participants were 10 years old (10.4 years old  $\pm$  .88). In addition, participants consumed on average 478 calories ( $\pm$  215) in the allotted 20-minute time frame. As shown in Table 1, results from two-way ANOVA's on hunger were assessed pre-consumption and there were no main effects for Group (control vs. experimental) ( $F(1, 62) = 1.86, P > 0.67$ ), Sex ( $F(1, 62) = .220, P > 0.64$ ) or the Group x Sex interaction ( $F(1, 62) = 1.44, P > 0.24$ ). In addition, as seen in Table 1, there were no differences between participants' age, weight, and BMI percentile. There were also no group, sex or interaction effects for any baseline variables.

### *Perceived Healthiness*

We observed that when a milkshake was presented with a health claim participants rated the milkshake significantly healthier in comparison to the control condition with no health claim information ( $F(1, 64) = 12.14, P < 0.001$ ; **Figure 1**). The effect size was assessed as large (Cohen's  $d$ : 0.86).

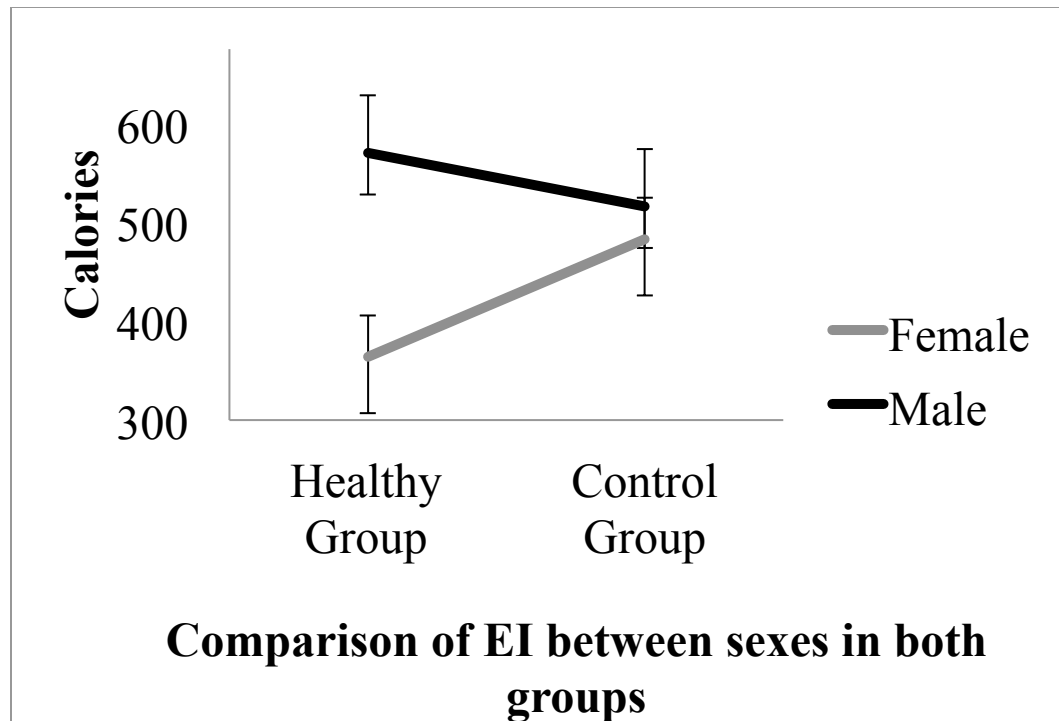
### **Figure 1**



### *Energy Intake*

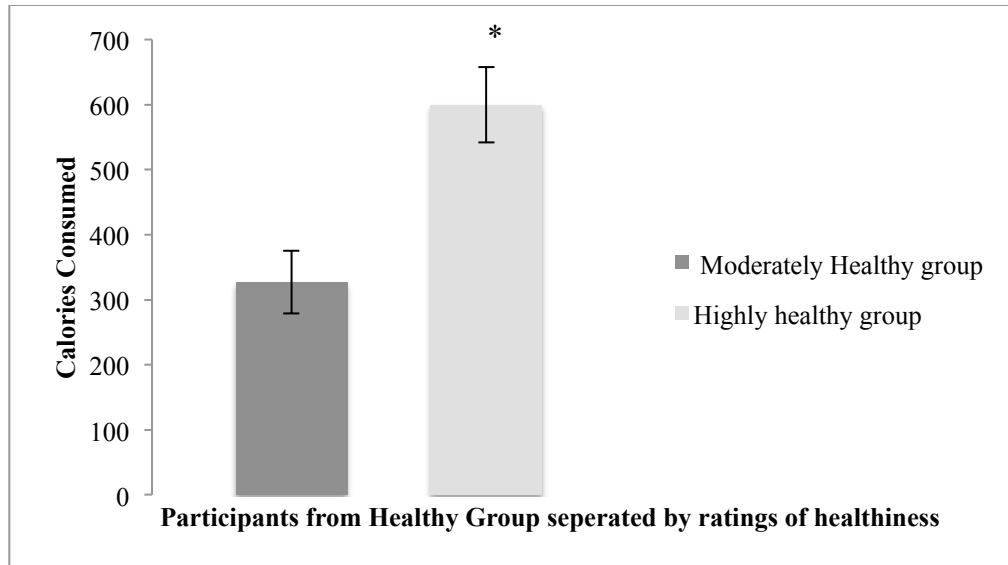
ANCOVA revealed a significant two-way interaction between sex x health claim ( $F(1, 56) = 3.8, P = .05$ ) when statistically controlling for pre-meal hunger, and BMI percentile. Post-hoc tests indicated differences in consumption between boys and girls from the healthy group. On average, males in the healthy condition consumed significantly more calories than females in the healthy condition ( $570 \pm 240$  vs.  $364 \pm 231$ ). However, in the control group, there were no significant differences in EI by sex, with males consuming  $516 (\pm 157)$  and females consuming  $483 (\pm 184)$  calories,  $P = 0.61$  (See Figure 2).

**Figure 2**



In the experimental group, a median split was performed to examine the EI differences between those who perceived the milkshake to be highly healthy vs. those who perceived it as moderately healthy. An ANOVA test revealed there was a main effect of Group ( $F(1, 31) = 13.03, P < .001$ ) whereby those from the highly healthy group consumed significantly more calories than those who rated the milkshake moderately healthy ( $600 \pm (237)$  vs.  $327 (\pm 193)$ ) (see **Figure 3**).

**Figure 3**



Similar results emerged after statistically controlling for BMI percentile, and pre-meal hunger using ANCOVA ( $F(1, 27) = 10.58, P < .003$ ). Results from a two-way ANCOVA showed there was no significant group x sex interaction ( $F(1, 25) = .053, P > .82$ ).

### ***Liking***

There were no main effects of group ( $F(1, 56) = .512, P > .48$ ), sex ( $F(1, 56) = .829, P > .37$ ) or the group x sex interaction ( $F(1, 56) = 1.1, P > .3$ ) on liking of the shake. There were also no main effects of group when a dichotomous split was performed of participants in the healthy condition, between those who think healthy foods can taste good (pleasant) vs. those who believe health cannot taste good ( $F(1, 32) = .826, P > 0.37$ ).

In the experimental group, a median split was performed to examine the taste differences between those who perceived the milkshake to be highly healthy vs. those who perceived it as moderately healthy. An ANOVA revealed there was a main effect of Group ( $F(1, 32) = 7.57, P < .010$ ) whereby those from the highly healthy group rated the taste of the milkshake significantly better than those from the moderately healthy group

(131  $\pm$ (18) vs. 101 ( $\pm$ 41).

## **DISCUSSION**

We set to investigate whether a health claim would significantly impact perceived healthiness of a milkshake. In addition, we predicted that this claim would foster greater consumption and liking. Our results show that a health claim significantly increased perceived healthiness of a milkshake. When boys and girls were pooled together, the findings do not confirm our main hypothesis that children will consume more EDF if it is perceived as healthy, inconsistent with previous findings with adults (Provencher et al., 2009; Wansink & Chandon, 2006). However, our study is the first to show that when sex was factored into the analyses, boys consumed significantly more calories than girls when the milkshake was labeled as healthy, while no such difference was noted when the milkshake was served without a label. Moreover, participants from the healthy condition whom rated the milkshake ‘highly healthy’ consumed nearly double the calories than those who rated the shake as ‘moderately healthy’. These results were similar to a recent study that showed perceived healthiness was positively correlated with food consumption (Lafrenière et al., 2017).

For our secondary hypothesis, there was no difference in taste rating between the control group and those in the healthy condition as both groups rated the shake highly palatable. These findings are in contrast with those obtained with adults (Cavanagh & Forestell, 2013; Wansink et al., 2004) and children (Lapierre et al., 2011; Soldavini et al., 2012). Based on the theory of expectation disconfirmation (Wansink et al., 2004), in order for the ‘healthy’ milkshake to receive a higher taste rating than the control group, the health claim must significantly lower taste expectations. It may be possible that

telling participants ‘this milkshake is high in calcium, it’s healthy for you’ influenced perceived healthiness, but did not significantly lower taste expectations. Our findings match the results seen in a study by Norton et al., (2013). When they presented chocolate as low fat, it only slightly lowered taste expectations, and as a result, no differences in taste ratings were reported.

Of note, our results showed that participants from the healthy condition who rated the milkshake highly healthy also preferred its taste in comparison to those who only rated the shake moderately healthy. This may suggest that those who thought the milkshake would be really healthy expected taste to be compromised and to their surprise it was not, which resulted in a higher taste evaluation (Wansink e al., 2004).

In addition, children were explicitly asked about the taste of healthy foods. Responses were dichotomized into groups; those who believed healthy foods taste good, versus those who believed healthy foods cannot taste good (pleasant). Previous research (Forwood, Walker, Hollands, & Marteau, 2013; Raghunathan et al., 2006) identified this belief as a factor in choice and liking in adults, although our study found no differences in liking between the two groups. Perhaps in children, beliefs about tastiness of healthy foods may not affect liking, but future research is needed to corroborate these findings.

This was the first study to our knowledge to examine how health claims influence EI in pre-adolescent children, whereas previous research focused on how health claims influenced liking and choice in children (Dixon et al., 2014; Lapierre et al., 2011; Miller et al., 2011; Soldavni et al., 2012; Wardle & Huon, 2000). We hypothesized that a health claim would increase consumption of an EDF, milkshake in this instance. Although in the overall sample it appears that the health claim did not influence EI during one eating

occasion, the results of this study illustrate that a health claim can elicit differences in EI between pre-adolescent boys and girls. Although future research is needed to better determine the mechanisms underlying these sex differences, the following may provide some insight into some possible reasons why boys consumed more than girls in response to a health claim.

Recent research highlights boys and girls possess different concepts of what healthy food consists of (Brierley & Elliott, 2015b). It appears boys are more likely to rely on the presence of a nutrient claim to inform them of a food's healthiness in comparison to girls (Brierley & Elliott, 2015a; Brierley & Elliott, 2015b). Boys expressed an interest in eating healthy as doing so would promote proper growth, provide them with energy for sports, and help them maintain a healthy body composition (Brierley & Elliott, 2015a). Calcium is advocated for the growth of healthy bones (Ebeling, Daly, Kerr, & Kimlin, 2013), and chocolate milk has been promoted as a sports recovery drink (BUILT WITH CHOCOLATE MILK, 2015; Lauricella, & Koster, 2016; Karp et al., 2006; Pritchett, Bishop, Pritchett, Green, & Katica; 2009). Based on the limited literature, it is possible boys felt permission or even encouraged to increase consumption of a food (healthy milkshake) that they felt would foster healthy growth. There is also literature on adult males suggesting that foods can possess symbolic values and therefore promote increased consumption (Rozin, Hormes, Faith & Wansink, 2012). Even though perceived healthiness ratings did not differ by sex, it is plausible that a 'healthy' chocolate milkshake is a food boys identified with, and as a result increased their EI.

The EI differences between sexes can potentially be concerning for boys, although our study only assessed one eating occasion. Recent research in adults suggests

that there are individuals who likely consume more protein in order to compensate for lack of physical activity and/or for the macronutrients' perceived health benefits (Hartmann, & Siegrist, 2016). As aforementioned, it is possible that boys demonstrated greater EI due to the perceived health benefit(s) of the milk shake (i.e. stronger bones/muscles). In contrast, research shows women are more concerned about avoiding fat (Rizk & Treat, 2015), and if this perception was held in girls, that could explain why they did not increase their milkshake consumption under the healthy manipulation. Although, recent research found no evidence that young adults or adolescents are concerned about avoiding fat intake (Bucher, Collins, Diem & Siegrist, 2016; Crofton et al., 2014; De Vlieger, Collins, & Bucher, 2017).

There are several methodological limitations and strengths of this study that warrant mention. A limitation to this study is that the findings cannot be generalized to all pre-adolescent children as participants were chosen based on a convenience sample, and only 32% of children/parents approached consented to participate. This was a laboratory study with artificially imposed time constraints, and even though we used a 20-minute consumption period to make results comparable to other studies (Provencher et al., 2009; Gravel et al., 2012), it is possible some children needed more time than allotted to finish the milkshakes. Thus, future studies may consider a larger time frame for those participants who drink/eat slower than others, or may want to consider a larger sample of participants to confirm our initial findings.

It is also unknown if an alternative health claim (i.e. fat free, low carb) may yield different effects on EI and liking, highlighting other areas to be investigated. Also of note, consumers may increase their EI of 'healthy' foods during one eating occasion, but

may or may not consume 'healthy' foods more often throughout the day/week/month. Given we did not track subsequent meals, it is impossible to know whether consumption of the milkshake influenced food compensation over the next meal(s) as we have seen in past research (Chandon & Wansink, 2007). Thus, further research is needed to determine the long-term effects health claims possess on children's taste and EI.

The main strength of this study was its between-subjects (randomized) experimental design, as it eliminates the carryover or order effects shown to be a factor in previous research using within-subjects designs that examined health claims and consumption (Roefs & Jansen, 2004). This was also the first study to examine the effect of health claims on consumption in pre-adolescent children, thus providing a novel contribution to the literature. Moreover, a common nutrient content claim was used (Colby et al., 2010), on a drink widely consumed by children and similar to chocolate milk, which the health benefits have been debated (Lauricella, & Koster, 2016), enhancing the ecological validity of the study manipulation and findings.

## **Conclusion**

The current study is the first to show that a nutrient health claim led to higher EI in pre-adolescent boys compared to girls. We also showed that those who perceived the milkshake to be highly healthy consumed more calories and rated the milkshake more favorably compared to those from the same experimental group that perceived the milkshake as only moderately healthy. Seeing as this was the first study to examine the effect of health claims on EI and liking in pre-adolescent boys and girls, subsequent studies are needed to corroborate these findings. Furthermore, future research may want to focus on feeding responses to health claims conducted over several episodes to

examine if increased energy intake occurs over time and whether or not there is food compensation to regulate increased intake.

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**Table 1. Assessments and** descriptive characteristics of participants, prior to consumption.

N= 66 participants unless otherwise indicated, 33 per group

Variables	Healthy (S.D)	Control (S.D)	<i>P</i> value
Age	10.3 ± 0.8	10.6 ± 0.9	.21
Height (cm)	146 ± 8	147 ± 8	.66
Weight (kg)	44 ± 12	44 ± 9	.93
BMI percentile (%)	68 ± 28	70 ± 28	.76
Pre meal hunger (VAS, mm)	77 ± 44	72 ± 40	.62
Expected Healthiness	47± 35	41 ± 31	.44
Expected Liking	120 ± 39	116 ± 31	.58

Variables	Male Mean (S.D.)		Female Mean (S.D)	
	Healthy (17)	Control (15)	Healthy (16)	Control (18)
Age	10.4 ± .9	10.7 ± .1	10.3 ± .8	10.5 ± .9
Height (cm)	145 ± 8	147 ± 9	147 ± 7	147 ± 7
Weight (kg)	44 ± 11	44 ± 10	44 ± 13	44 ± 8
BMI percentile (%)	73 ± 25	66 ± 32	63 ± 31	74 ± 24
Pre meal hunger (VAS, mm)	73 ± 42	81 ± 45	83.± 45	65 ± 36
Expected Healthiness	51 ± 34	50 ± 36	40.± 31	37 ± 23
Expected Liking	125 ± 29	114 ± 36	123 ± 39	123 ± 25

S.D.: standard deviation; BMI: body mass index; VAS: visual analogue scale; mm: millimeters

No significant differences between groups

**Table 2.** Effects of Health claims on Appetite

Variables	Healthy (S.D)	Control (S.D)	<i>P</i> value	Cohen's <i>d</i>
Healthiness Rating (VAS, mm)*	73 ± 42	42 ± 28	.001	.87
Liking (VAS, mm)	116 ± 35	120 ± 26	.596	-0.13
Energy intake (calories)	467 ± 255	488 ± 169	.696	-0.10

\*Statistically significant

**Table 3.** Effects of Health claims on Appetite by Sex

Variables	Male Mean (S.D.)		Female Mean (S.D.)	
	Healthy (17)	Control (15)	Healthy (16)	Control (18)
Healthiness Rating (VAS, mm)	77 ± 40	43 ± 28	68 ± 46	41 ± 29
Liking (VAS, mm)	122 ± 27	121 ± 28	110 ± 41	119 ± 26

S.D.: standard deviation; VAS: visual analogue scale; mm: millimeters.

### **Part 3-Global Discussion**

As discussed in Part 1 of the thesis, very little is known about how health claims influence EI and liking in pre-adolescent children (Soldavini et al., 2012); hence, the purpose of this thesis was to examine these effects.

Our data show that when a chocolate milkshake was advertised as ‘healthy’ through a nutrient content claim on the label, children rated the milkshake significantly healthier in comparison to the control group. This is consistent with previous literature conducted on adults (Gravel et al., 2012; Provencher et al., 2009) as well as children (Dixon et al., 2014; Soldavini et al., 2012).

In regards to our predicted hypotheses about liking, there was no difference in liking between the control and experimental group. There was also no difference in liking from participants in the healthy group who believed healthy foods can taste good compared to those who believed healthy foods cannot taste good (pleasant). These results are not line with previous studies seen in past research conducted on adults (Cavanagh & Forestell, 2013; Forwood et al., 2013; Raghunathan et al., 2006; Wansink et al., 2004) and children (Lapierre et al., 2011; Soldavini et al., 2012). Of note, both milkshakes were rated as highly palatable and this may be in part responsible for the lack of differences. Alternatively, in order for the healthy milkshake to receive a more favorable rating than its unlabeled counterpart, the health claim would need to elicit a lowered expectation and it is possible that it did not in this case which has been seen in past literature (Norton et al., 2013).

Moreover, our main hypothesis suggested children from the health group would consume significantly more calories than those from the control group. Our data did not

support our prediction, although when sex was investigated, boys in the healthy group consumed significantly more calories than girls in the healthy group, but no sex differences existed in the controls. Data also showed that participants from the healthy condition that rated the milkshake as very healthy consumed more calories (nearly double) than those who rated it moderately healthy. Collectively, it appears a nutrient content claim can influence's pre-adolescent children's perception of healthiness and for undetermined reason(s), boys consume more calories than girls in response to a health claim.

A between subject design was utilized as it minimized the risk of contamination among participants as those from the experimental group had to be debriefed about the study to avoid being subjected to deception. This type of design was also conducive given the financial and time restraints. Furthermore, past research that used a within subject design to examine the effect of a health claim on milkshake consumption found that participants increased their consumption on the second visit, regardless of group (control vs. experimental) (Roefs & Jansen, 2004). The authors postulated that the increased consumption was due to participants feeling more comfortable during the second session. Due to the aforementioned reasons, a between subject design was used.

This study provides a novel contribution to the literature, although it is difficult to generalize the findings. To start with, the study was completed with a convenience sample, and was conducted under a laboratory setting with artificially imposed time constraints. Given the setting, there could also be a residual confounding despite controlling for age and BMI percentile. Also, the sample size used was smaller than what would have been ideal based on the power calculation from the Provencher *et al.*, (2009)

study. Given that EI data are subjected to greater imprecision in an adolescent population (Chaput et al., 2016), a larger sample size would be beneficial in future research to verify sex differences. It is also important to mention that boys possess a greater lean body mass and Resting Metabolic Rate (RMR) than girls (Buchholz, Rafii & Pencharz, 2001) and RMR and lean body mass has been shown to influence food intake (Cameron et al., 2016). This sex difference was not taken into account in our study.

Moreover, white cups were used in an effort to not influence liking through packaging or brand (Elliott et al., 2012). As a result, we were concerned that students would not examine the bland cup and notice the health claim. Therefore, a verbal prompt was given in addition to the health claim to ensure the health manipulation would be effective in order to properly assess consumption and liking. A health claim in conjunction with a verbal prompt may be unrealistic in a real-world setting. Therefore, future research may want to consider using an existing package as Soldavini et al., (2012) did, and take into account that brand and packaging may impact liking as shown by previous research (Carrillo, Varela, & Fiszman, 2012; Elliot et al., 2012).

In addition, even though our study used the most commonly used health claim, high in calcium (Colby et al., 2010), participants may have responded differently to an alternative health claim (i.e. low fat, high protein)(Kaur, Scarborough, & Rayner, 2017). Moreover, we only examined the effect of a health claim on a snack food (chocolate milkshake). To our knowledge there are two studies that examined the effect of health claims on full meals. McCann et al., (2013) reported that mostly men consumed more calories in response to a low fat claim. Whereas Carbonneau et al., (2015), investigated females over a ten day span and found no differences in EI between three different

conditions (low fat vs. energy label vs. control). Even though both aforementioned studies involved adults; the discrepancy between sexes is noteworthy given the findings of our study. Of note, in the study by Carbonneau *et al.*, (2015) there were no differences in perceived healthiness between all three experimental conditions and this could potentially explain the lack of EI differences between groups.

Our study also only examined one eating occasion, thus subsequent EI was unaccounted for. Research has shown that some consumers will increase their EI of a meal after having thought to consume a low-fat snack in comparison to a high-fat snack pre meal (Shides & Rolls, 1995). Chandon & Wansink (2007) have also shown that some consumers will reward themselves with indulgent foods after consuming healthier foods. Therefore assessing subsequent EI is crucial if we want to develop a deeper understanding of the effect of health claims on both acute and longer-term consumption.

Given the novel nature of the study, future research should focus on corroborating these findings and examine EI over a longer period of time, similar to the work of Carbonneau *et al.*, (2015). As aforementioned in the literature review, in the age group of 6-11, in Canada, boys are three times more likely to be classified as obese than girls (Roberts *et al.*, 2012). Furthermore, we also know that boys do not consume as much vegetables as girls (Brug *et al.*, 2017; Bere, Brug, & Klepp, 2008; Lehto *et al.*, 2015), and research demonstrates vegetable consumption plays an important role in maintaining a healthy body weight (Kepper *et al.*, 2016; Lin & Morrison, 2002). Therefore, assisting boys in making healthier food choices can potentially be valuable in assisting them to maintain a healthy bodyweight.

Researchers have suggested that regulating the design of packages and implementing warning labels can be beneficial in aiding children make healthier choices (Arrúa, et al., 2017a). Both adults and children are susceptible to health claims. A health claim can elicit a health halo effect or magic bullet effect, increasing perceived healthiness of a food and potentially attributing inappropriate benefits to a food (Chandon & Wansink, 2007; Roe et al., 1999; Soldavini et al., 2012). Research has shown that the presence of a warning label identifying products with high content of a key nutrient (i.e. sugar, sodium, saturated fat) may mitigate the effect a health claim can induce. Both children (Arrúa et al., 2017a; Yoo et al., 2017) and adults (Arrúa, 2017b), perceived food products as less healthful when a warning label was present on a package.

Chile has recently decided to enforce mandatory labeling law for packaged foods high in calories, salt, sugar and/or saturated fat (Boza, Guerrero, Barreda, & Espinoza, 2017). Health Canada has also recently proposed to introduce a mandatory front-of-package labeling requirement for foods high in sodium, saturated fat, and sugar (Health Canada, 2017b). Even though, the effect a health claim possesses varies (Kaur et al., 2017; Provencher & Jacob, 2016), a mandatory labeling law of foods high sodium, saturated fat, and sugar may potentially decrease purchases (Roberto, Wong, Musicus, & Hammond, 2016) and in turn potentially decrease EI of unhealthy foods.

Research in a natural/real world setting is needed to better determine the effectiveness warning labels can have on purchases and consumption. The total body of research shows the effect health claims possess on dietary choice may vary when comparing real world settings to lab-based artificial settings, with the latter being more pronounced (Kaur et al., 2017). Therefore, it is possible that other countries may want to

assess the outcomes from the Chilean law prior to implementing their own type of mandatory food labeling.

Implementing a mandatory warning claim may also influence food companies to reformulate their products to avoid placing the label on their product (Kloss, Meyer, Graeve, Vetter, 2015; Vyth, Steenhuis, Roodenburg, Brug, & Seidell, 2010; Young & Swinburn, 2002). Reformulating products refers to companies altering food ingredients to manufacture a healthier final product. Researchers advocate that the reformulation of products possesses great potential for better health (van Raaij, Hendriksen, & Verhagen, 2009). Since Finland adopted a warning label for products with high salt content in the 1990's, salt content of products has decreased 20-25% (Kloss et al., 2015), and salt consumption has also decreased 30-40% (Pietinen, Paturi, Reinivuo, Tapanainen, & Valsta, 2010).

Moreover, Elliott & Brierley (2012) suggest that nutrition literacy and media literacy are both needed for children to properly determine the healthiness of food and make better choices. There are only a small number of studies that examined the effect school-based educational interventions possess for enhancing adolescents ability to assess health claims (Nordheim, Gundersen, Espehaug, Guttersrud, & Flottorp, 2016). Most studies only demonstrate short terms effects (Nordheim et al., 2016) and none of these studies have examined the health claims made on food packages. Studies that examine the long term effects of school-based educational interventions are needed in order to better determine their effectiveness in helping children make healthier choices. There is limited evidence that adults who possess greater nutritional literacy are less susceptible to health claims (Lee et al., 2013). Therefore, studies should also examine if greater

nutritional and media literacy will minimize the effect the health halo has on children.

### **Conclusions**

The current study is the first to show that a nutrient health claim led to greater EI in pre-adolescent boys compared to girls. We also showed that those who perceived the milkshake to be highly healthy consumed more calories and exhibited higher taste ratings compared to those from the same experimental group that rated the milkshake as moderately healthy. Future research may want to focus on feeding responses to health claims conducted over several episodes to examine if increased EI occurs over time and whether or not there is food compensation to regulate increased intake.

## PART 4

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## Appendices

Figure 4

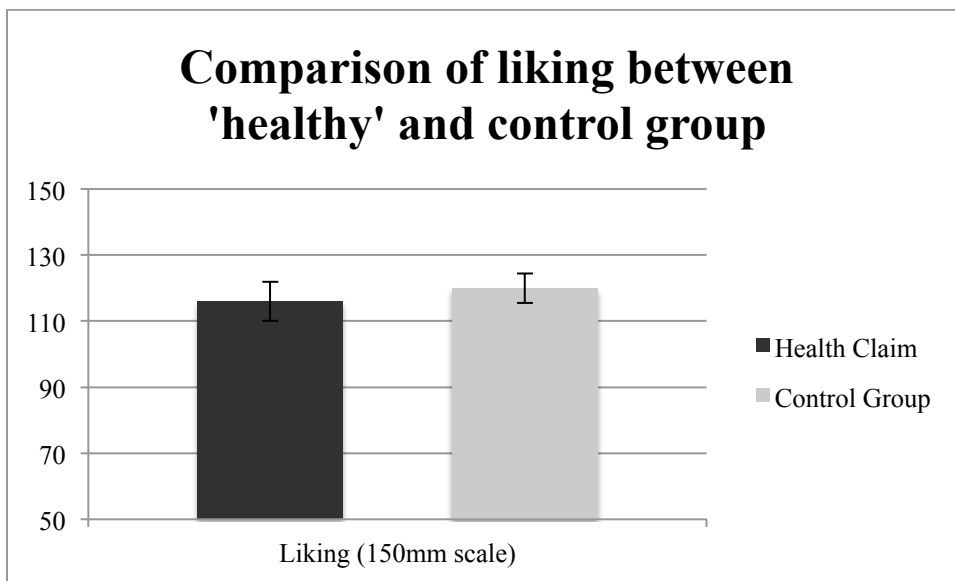


Figure 5

