The accuracy of parental reporting of preschoolers' dietary intake using an online self-administered 24-hour recall

by
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ABSTRACT

THE ACCURACY OF PARENTAL REPORTING OF PRESCHOOLERS' DIETARY INTAKE USING AN ONLINE SELF-ADMINISTERED 24-HOUR RECALL

Angela Wallace   Advisor: Professor Jess Haines University of Guelph, 2016

The purpose of the current study was to assess the criterion validity of ASA24-Canada (an online automated self-administered 24-hour dietary recall) for capturing dietary intake among children aged 2 to 5 years (n=40) using parental proxy reporting.

The study was conducted in a daycare setting, where parent-reported intake was compared to true intake for three meals.

On average across all eating occasions, 79% of the foods consumed by the children were reported by the parents as exact or close matches. Although parents could accurately identify the food/beverage items their children consumed, they significantly overestimated total energy, most nutrients and portion size intakes.

The findings of this research suggest the parent-reported ASA24 can allow for the collection of reliable sources of information about food/beverage items children consume; however, further research and improved portion size estimate techniques are needed to ensure that comprehensive intake data is provided.

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List of Abbreviations

ACAES = Australian Child and Adolescent Eating Survey

ASA24 = Automated Self-Administered 24-hour Recall

AMPM = Automated Multiple Pass Method

BMI = Body Mass Index

CCLC = Child Care and Learning Centre

CCHS = Canadian Community Health Survey

CI = Confidence Interval

CHO = Carbohydrates

DLW = Doubly Labeled Water

EI = Energy Intake

EPAQ = Eating and Physical Activity Questionnaire

FFQ = Food Frequency Questionnaire

IDEFICS = Identification and Prevention of Dietary and Lifestyle Induced Health Effects in Children and Infants

Kcal = Kilocalories

NCI = National Cancer Institute

NHANES = National Health and Examination Survey

PRO = Protein

SACINA = Self Administered Children and Infant's Nutrition Assessment

SSB = Sugar Sweetened Beverage

TE = Total Energy

TEE = Total Energy Expenditure

USDA = United States Department of Agriculture

1.0 Introduction

Accurately assessing dietary intake is important for many reasons including identifying factors that influence dietary intake, assessing the relationship between diet and various health outcomes, assessing dietary changes over time, and evaluating the outcome of different dietary interventions (Adamson & Baranowski, 2014). Measuring children's food intake is particularly important as food preferences have an important influence on dietary patterns and early childhood is a critical time in the development of these food preferences. (Fox et al., 2010, te Velde et al., 2012). In addition, the prevalence of obesity has significantly increased over the past 30 years, with 2 of every 10 children aged 2-5 years being classified as obese (Fox et al., 2010). Thus, having a better understanding of preschool children's dietary intake can help inform clinicians, researchers, and higher level policies and programs in providing targeted advice and/or interventions that help guide and foster the development of healthy eating patterns in early childhood (Fox et al., 2012).

For young children (8 years of age and younger), parents are typically used as proxy reporters for recalling dietary intake, primarily because young children have lower literacy levels, difficulty estimating portion sizes, very limited knowledge of food names, and limited cognitive abilities (Burrow et al., 2010). Commonly used dietary assessment tools include, 24-hour recalls, food frequency questionnaires, and food records. Validation studies in which direct observation has been compared to 24-hour recalls completed by parents have identified that parents are capable of accurately reporting their children's intake in home settings (Baranowski et al., 1991, Klesges et al., 1987, Eck et al., 1989). However, many of these studies included well-educated parents who were present during all meal observations, which may not reflect typical mealtime for young children. For example, in 2011, almost half (46%)

of Canadian parents reported using some form of childcare, suggesting that being present during all meal occasions is likely a rare occurrence (Statistics Canada, 2015). Thus, a common concern is the reliability and accuracy of reported food intake when the child is outside the home (Livingstone et al., 2000). Additionally, studies have found that over- and underestimation of food intake is prevalent with proxy reporters due to difficulties in estimating portion size, typically making the accuracy of recalls poor at the individual level but acceptable at the group level (Klesges et al., 1987, Eck et al., 1989, Baranowski et al., 1991, Reilly et al., 2001, Fisher et al., 2008). Some studies also suggest that over- or underreporting is influenced by child or parent characteristics (e.g. child/parent weight status, gender etc.), however limited research is available and findings have been inconsistent (Bornhorst et al., 2013, Livingstone et al., 2000). Given all the contributing factors mentioned above, it is difficult to determine the accuracy of parent proxy reporting of children's dietary intake.

Currently, there are few online, efficient, and validated dietary assessment tools available for use in pediatric populations (Burrows et al., 2010). Considering that today's society thrives on technology, having dietary assessment tools available online is needed and would allow for ease of administration. In addition, technological methods create cost savings, as you don't need to hire and train an individual to administer the questionnaire or recall and can reduce respondent burden, as they can assess the tool from different locations. Evidence has suggested that the interview-administered 24-hour recall is the preferred method when assessing children's dietary intake (Diep et al., 2015). However, this method has traditionally required highly trained interviewing staff and intake software, making it expensive and burdensome in various research and clinical settings (Diep et al., 2015). With innovations in dietary assessment and current technology, it has been possible to develop diverse ways to minimize self-report errors, enhance accuracy, and make it easier for individuals to report diet (Adamson & Baranowski, 2014). To date, most technological dietary assessment tools have been developed to measure adult's dietary intake, with limited research focusing on proxy reporting of preschool aged children. However, there has been recent interest in identifying and evaluating technological methods to address the need for assessment of dietary intake in children (Adamson & Baranowski, 2014). Computer-based 24-hour recalls can be a cost effective and efficient way to collect dietary data (Diep et al., 2015). The ASA24-Canada (an automated self-administered 24-hour recall) is an online tool developed by the National Cancer Institute that enables multiple, automatically coded, self administered 24-hour recalls (National Cancer Institute, 2016).

Knowing that more efficient and validated online tools are needed to assess children's dietary intake, this study focused on exploring the accuracy of parental recall in measuring preschool aged children's dietary intake, utilizing an online dietary assessment tool. More specifically, the primary aim of this study was to assess the criterion validity of ASA24-Canada for capturing the true dietary intake among 2 to 5-year-old children with parents and/or guardians as proxy reporters.

The second aim of this study was to explore whether the accuracy of parental report varies in relation to parent/child sex, parent/child body mass index (BMI) or child age.

Accurate pediatric dietary assessment is critical for both research and clinical settings. The results of this research will help inform studies that require a robust tool for dietary assessment among young children. These findings will be of particular interest for preschoolers as it will contribute to the development of new knowledge on the accuracy of parental report regarding dietary intake in young children attending childcare.

2.0 Literature Review

2.0.1 Methods for assessing dietary intake in children

The ability to accurately assess preschoolers' (children aged 2-5 years) dietary intake is important on many levels, from individual health to population program planning and disease prevention. Firstly, dietary assessment can allow both researchers and clinicians to gather dietary intake information that helps capture patients and subjects dietary intake. Having the ability to determine what groups of children eat can help inform nutrition education as well as larger scale interventions (e.g. creating breakfast programs for schools to encourage children's breakfast consumption). Secondly, nutrition habits and eating behaviours are established in early childhood and these eating behaviours typically track into adulthood. Eating behaviours and dietary habits, in turn, effect long-term health status and could have an impact on overall health and chronic disease risk (Livingstone et al., 2000). Thirdly, a change in dietary intake, for example increasing fruit and vegetable intake, can potentially help prevent obesity along with other chronic conditions in childhood and adulthood (Olukotun & Seal, 2015). Without accurate dietary assessment methods, it is difficult to capture changes in children's dietary intake patterns. However, there are many factors that contribute to making dietary assessment challenging in preschoolers including; the tendency for children to eat small amounts of food frequently, children's limited cognitive abilities to complete questionnaires or dietary records, continually changing food consumption habits, and children moving from child care settings (i.e. school) to home (Andrellucchi et al., 2009).

The following section will provide further detail regarding common methods for assessing dietary intake in children, a discussion on the approaches to assessing the relative and true validity of pediatric dietary assessment tools, and a review of parental proxy reporting.

Self-report dietary assessment methods

Having the ability to directly observe dietary intake is rare, thus we often rely on self-report instruments such as food frequency questionnaires (FFQ), 24-hour dietary recalls, food records, and other dietary questionnaires (National Cancer Institute, 2014). The current study will be assessing the validity of a self-report dietary assessment tool against an objective measure of dietary data.

2.0.2 Food Frequency Questionnaires (FFQs)

Food frequency questionnaires (FFQs) are tools that ask individuals or their proxy-reporters (e.g., parents) to report frequency of consumption of specific food and beverages items. FFQs are used to collect retrospective information on individuals' food consumption over a specified period of time (Olukoton & Seal, 2015). FFQs are the most common dietary assessment tool used in large population studies that assess diet and health because they are easy to administer, inexpensive, and create low respondent burden. FFQs intend to assess long-term intake, food patterns, and potentially disease outcomes, as FFQ have been used to assess associations between diet and disease outcome (Collins et al., 2010). However, FFQs require a relatively high level of literacy and cognitive skills to complete. Additionally, the data collected typically lack details on types and quantity of food consumption (Olukoton & Seal, 2015). FFQs also rely on individuals' memory over a relatively long period of time, e.g. past month or past year. Thus, the risk for error in reporting is high (Collins et al., 2009).

Researchers have suggested that children need to be at least 9 years of age or older to comprehend the retrospective nature of this dietary method and be able to complete a FFQ on their own (Collins et al., 2010).

2.0.3 Food Records

Food records require an individual or proxy-reporter to record in real time details of all the food and beverages an individual consumed over a specified period of time, typically between 3-7 days (Olukoton & Seal, 2015). Details may include timing of meals, method of preparation, portion size, and eating location. Food records can be completed in one of two ways, by weighing food pre- and post- meal or by or estimating portion sizes (Olukoton & Seal, 2015). A benefit to using food records is the ability to help ensure accuracy in record taking through the use of scales, food models, pictures, or measuring cups. These items can be used when measuring food and beverage consumption, which can allow for a more precise and reliable record of intake to be collected (Olukoton & Seal, 2015). Another advantage is that records do not rely on the individual's memory; as other methods do. However, this method does require knowledge and perception skills surrounding food item measuring, such as knowing what 1 cup of rice looks like or understanding how to use food scales (Olukoton & Seal, 2015). The individual requires both numeracy and literacy skills, and the food record may not reflect usual eating patterns as the individual's perceptions of healthy versus unhealthy foods might affect their recording (Collins et al., 2010). Thus, the act of recording might cause the individual to focus on their diet, which may lead to changes in eating patterns (Collins et al., 2010). Collins and colleagues (2010) have suggested that food records are appropriate for use in older children (10 years and older) who are literate and who know food names and brands of various food products (Collins et al., 2010). In addition, weighted food records have been suggested to be the best estimate for younger children's (0.5-4 years) dietary intake (Burrows et al., 2010).

2.0.4 Twenty-four hour recalls

Twenty-four hour recalls ask individuals or proxy-reporters to recall foods and beverages consumed in the previous 24 hours, prior to assessment. Twenty-four hour recalls can be completed during an interview with a trained professional or have the ability to be self-administered (Olukoton & Seal, 2015). Twenty-four hour recalls often use a multi-pass method, which means multiple steps are used to collect detailed information to enhance the accuracy of the dietary recall (Rhodes et al., 2013). This method utilizes memory cues with standardized wording to elicit recall of the all the previous day's food and beverage items (Rhodes et al., 2013). The cues typically include probing for brand names of food products, ingredients, methods of preparation, and portions consumed (Rhodes et al., 2013). A main advantage to this method is that recalls are unannounced, which does not affect eating patterns, this typically allows for a more accurate collection of dietary intake than other self-reporting dietary tools (Collins et al., 2010). Furthermore, it does not require literacy when interview administered. A challenge associated with this method is that is depends on the interviewer's ability to probe for food consumption details appropriately and the respondent's memory of the food consumed during the previous 24 hours (Olukoton & Seal, 2015). Additionally, interview administered recalls are expensive, as research staff is needed to conduct the interview and code the data collected (Collins et al., 2010). An online version could address some of these issues, including reducing expense and increasing time efficiency. This will be discussed in further detail in section 3. An additional positive feature of this dietary assessment method is that mothers have been shown to be accurate reporters on behalf of their young children when using 24-hour recalls (Collins et al., 2010), and it has been deemed the most accurate proxy reporting measure for capturing children's (4-11 years) dietary intake (Burrows et al., 2010). This tool is an optimal choice when using parental proxy reporting to collect dietary data in young children.

Objective dietary assessment

The next two methods (doubly labeled water and direct observation) are objective measures for collecting dietary data, that can be used to assess validity of self-reported methods. The concept of true validity will be discussed in more detail in section 2.2.

2.0.5 Doubly Labeled Water (DLW)

The doubly labeled water (DLW) is considered the gold standard for validating energy intake. DLW can be used to measure total energy expenditure (TEE) over 7-14 days and accounts for physical activity and day-to-day variations (Burrows et al., 2010). The DLW method uses stable isotopes of hydrogen and oxygen to trace the flow of carbon dioxide and water throughout the individual's body over time (Butler et al., 2004). An individual is dosed with an accurately measured amount of DLW at baseline and their urine is collected over a period of time in order to determine carbon dioxide production, which is then used to measure TEE (Burrows et al., 2010). Although this method is considered a gold standard for measuring total energy expenditure in free-living individuals (Gondolf et al., 2012), and is reflective of actual energy intake, this method is rarely used because of its high cost and need for highly technical facilities and skills in order for the analysis to be completed (Burrows et al., 2010). In addition, it only provides information about total energy expenditure and doesn't provide details on the amounts of nutrients consumed, whereas other dietary methods are capable of collecting such information.

2.0.6 Direct Observation

Direct observation with recording of food/beverages consumed is another method that can be utilized for validating dietary assessment tools. Previous studies using this method typically have trained staff to observe and record the child's consumption using a standardized protocol (Baranowski et al., 1991). The protocol typically outlines what meals need to be observed and what type of notes should be taken, e.g. if children exchange food or if a food/beverage spills and the item is not actually consumed. In the direct observation method typically a record is kept of the weight of all items being offered, thus the individual's food and plate waste is collected, weighed and recorded by research staff (Eck et al., 1989, Klesges et al., 1987). The combination of direct observation and the weighed record of dietary intake ensures that an individual's true intake is captured. With direct observation, observers are taught to observe in an unobtrusive manner to minimize any influence on eating behaviour (Diep et al., 2015). This method is expensive as trained observers are required, and it has the potential to cause heightened awareness of particiapnts' dietary intake, as they are aware of observation during mealtime (Eck et al., 1989).

2.1 Review of methods for establishing relative validity in pediatric dietary assessment tools

Relative validity can be established when a "test" dietary method is compared against another "reference" method (Lennernas, 1998). The reference method chosen must measure similar parameters over a similar designated time as the tested method (Lennernas, 1998). For example, many research studies that assess relative validity will compare a FFQ against a 24-hour recall to determine the level of accuracy of dietary data collected from the FFQ. It should be noted that finding good agreement between the two methods does not necessarily indicate relative validity, but instead may indicate similar errors in both methods (Lennernas, 1998). Relative validity is different than true validity as true intake of the individual or group is not being captured. True validity can only be established when the participants' true intake is accounted for. True validity will be discussed further in section 2.2.

Bennett and colleagues (2009) suggested they established acceptable relative validity for an Eating and Physical Activity Questionnaire (EPAQ) by comparing their measurement of dietary intake results to results from an interview administered 24-hour recall. In a pediatric population with parental proxy reporting, relative validity can be a problem as both sources of dietary assessment i.e. EPAQ vs. 24-hour recall are based on parental report and therefore subject to the same limitations; dietary recall is subject to parent's memory, their knowledge of their child's food consumption when they are not with the child, and parent's knowledge of day-care menus (Bennet et al., 2009). Thus, misreporting can occur in completion of both dietary assessment tools, making true validity impossible to achieve. A study by Vereecken and colleagues (2014) investigated the relative validity of a FFQ in young children to assess changes in children's food intake over time. They compared the FFQ to online 3-day food records that were administered at 3 and 7 years of age. They found that in both 3 years and 7 year olds many of the food groups were inaccurately reported using the FFQ compared to the online 3-day food record (Vereecken et al., 2014). When assessing relative validity, it is important to compare the "test" dietary assessment method to a similar "reference method" (Lenneranus, 1998). However, this study utilized two very different methods of dietary assessment, the FFQ evaluates dietary intake over a longer period of time and considers frequency in consumption where as the 3-day food records attempts to capture 3 "typical" days of food/drink consumption. Comparing these methods can therefore lead to errors when attempting to establish relative validity, as the methods are assessing different dietary patterns. Flood and colleagues (2013), also examined the relative validity of a FFQ for 2-5-year-old children against 3-day food records. They found that a range of food consumption habits had moderate to good repeatability (kappa = 0.37-0.85), however good validity was only established for fruit/vegetable servings, and beverage consumption (Flood et al., 2013).

The vast majority of literature that attempts to establish validity of pediatric dietary assessment tools relies on methods of relative validity. However, this poses challenges as both tools are often subject to the same errors (i.e. both rely solely on parental recall). Future research needs to focus on evaluating dietary tools against methods that offer objective measures, for example an observation study which would allow for true validity and reliability to be established (Olukoton & Seal, 2015).

2.2 Review of methods for establishing true validity in pediatric dietary assessment tools

When establishing true validity for dietary assessment tools, true dietary intake must be measured objectively. True dietary intake is the amount of food the individual actually consumed, versus estimation or a self-reported recall of consumption. Assessing validation typically occurs over a specific number of days using various reference measures, including direct observation, feeding studies or recovery biomarkers. For example, DLW is a biomarker, which assesses energy and 24-hour urine for protein, potassium, and sodium intakes (National Cancer Institute, 2014). The information collected from direct observation, feeding studies or recovery biomarkers is then compared to self-reported intake (National Cancer Institute, 2014). The results from direct observation, feeding studies or recovery biomarkers (DLW test) can provide researchers with calculation differences between true versus reported intake of food groups, nutrients, and proportion of food/drinks accurately reported or omitted (National Cancer Institute, 2014). The main goal in validation studies is to use unbiased reference measures that capture the participants' true intake without systematic error (National Cancer Institute, 2014). Known unbiased reference measures are recovery biomarkers, typically through DLW testing and data from direct observation or feeding studies (National Cancer Institute, 2014).

2.2.1 Doubly Labeled Water (DLW) Method

A systematic review by Burrows et al (2010) attempted to identify the best method for pediatric dietary assessment by examining studies that used doubly labeled water as a reference method. The 15 studies reviewed compared FFQ, 24-hour recalls, food records, and tape-recorded food records to DLW. It should be noted that only 3 of the 15 studies focused on dietary assessment in children 0.5-4 years of age, the rest of the studies focused on children older than 4 years of age. Results from the review by Burrows and colleagues (2010), suggest that 24-hour recall methodology using a multi-pass approach conducted over at least a 3-day period (including weekdays and weekends) using parents as proxy reporters is the most accurate method for assessing total energy intake in children 4-11 years old. The difference between energy intake (EI) and total energy expenditure (TEE) varied between 3-11%, indicating validity in 24-hour recalls capturing accurate energy intake of children 4-11 years of age (Reilly et al., 2001, Johnson et al., 1996). Furthermore, weighed food records provided the best estimation for total energy intake in younger children 0.5-4 years old (Burrows et al., 2010). However only one study assessed the validity of weighed food records amongst 1.5-4.5 year olds, and found that there was a 3% group difference in energy intake between weighed food records and total energy expenditure from DLW measurements (Davies et al., 1994). The results from one study is not sufficient evidence to suggest that weighted food records provide the best estimation of totally energy intake for younger children, and due to the dearth of evidence more research is needed to help provide best practice evidence for dietary assessment in preschool aged children. Furthermore, the studies reviewed in the Burrows and colleagues' systematic literature review used different doses of DLW administered to children and collection periods varied; subsequently this limits the ability to directly compare results between studies (Burrows et al., 2010).

A study by Collins et al. (2013) tested that ability of parents to accurately report their toddlers (mean age of 3.2 years) energy intake. The researchers evaluated the accuracy of estimating energy intake using the Australian Child and Adolescent Eating Survey (ACAES) food frequency questionnaire compared with a weighed food record and total energy expenditure (TEE) using DLW. The DLW dose was administered to the toddlers at baseline and urine samples were collected at baseline, 5 hours post dose, and daily for 9 consecutive days. They found that both weighed food records and FFQ can adequately estimate toddler energy intake at the group level; however, the FFQ needed toddler specific portion size estimates in order to determine individual level accuracy (Collins et al., 2013). At the group level all values for both the FFQ and the food records fell within 2 standard deviations of the limits of agreement, indicating fairly good agreement (Collins et al., 2013). The researchers suggest the ACAES FFQ questionnaire and the use of 4-day food records to be valid tools to utilize with preschool aged children using parental proxy reporting. However, one limitation of comparing FFQs to DLW is the period of time over which each method aims to assess dietary intake. In this case, the ACAES FFQ measures dietary intake over a 6-month period, but only 10 days of energy expenditure were compared when using DLW as the reference method. Thus results may not be reflective of dietary intake over the long-term (Collins et al., 2013), making the ACAES food frequency questionnaire's validity debatable.

A study by Reilly et al. (2001) assessed the accuracy of a multiple pass 24-hour recall in children 3-4 years old using DLW as a comparison. The oral dose was administered at baseline, urine samples were collected at baseline and on days 1 and 7 after the dose was administered (Reilly et al., 2001). This method allowed for true energy intake information to be collected and valid at the group level, however they did not find validity in the multi-pass 24-hour recalls for 3-4 year olds at the individual level (Reilly et al., 2001). They found the 24-hour recall produced significant overestimation of energy intake (11%), with difference in calories ranging from +/- 660. Additionally, they did not find the overestimation to be associated with bias related to diet consumption or parent/child's weight status (Reilly et al., 2001).

A study by Johnson et al. (1996) examined the accuracy of a multi-pass 24-hour recall in estimating energy intake in children 4-7 years old when compared to DLW. Together, mother and child completed three interview administered, 24-hour recalls over 14 days. Total energy expenditure was calculated over 14 days and 4 urine samples were collected, 2 the morning after the DLW dose was administered and 2 on day 14 (Johnson et al., 1996). Their findings suggested the multi-pass 24-hour recall gathered accurate energy intake for young children at the group level, however it was not accurate at the individual level with a difference of approximately 11% between energy intake and total energy expenditure (Johnson et al., 1996).

A study by Bornhorst et al. (2014) examined the accuracy of 24-hour recalls in collecting dietary intake information from children 4-10 years using parent proxy reporting, when compared to DLW. Total energy expenditure was calculated over a 9-day period; each child was given a single oral dose of DLW based on their body weight/height. Urine samples were collected several minutes before ingesting the DLW oral dose on days 1, 4, and 8. Energy intake was assessed using a computerized 24-hour recall, SACINA (self administered children and infant's nutrition assessment), and at least 2 recalls were collected per child. Findings revealed good agreement between energy intake (EI) and total energy expenditure (TEE), with almost exact comparisons at the group level (EI= 1500 kcal/day, TEE = 1523 kcal/day). However, the greatest differences were identified when parent proxies reported for children 6 years of age and under (Bornhorst et al., 2014). Additionally, differences between EI and TEE were large at the individual level, which may be explained by day to day variation of intake. The high level of agreement was potentially influenced by school meal observations, in which parents recall data was merged with data from school meal observers to enhance the completeness of dietary intakes (Bornhorst et al., 2014).

It appears that dietary assessment methods available for use in a pediatric population are able to produce unbiased results at a group level. However, there is limited literature to support valid dietary assessment tools that provide accurate dietary intake data for young children on an individual level. Furthermore, the DLW method is a feasible but expensive approach that provides an accurate objective comparison for validity testing against various dietary assessment methods (FFQ, 24-hour recalls etc.).

2.2.2 Direct Observation Method

Direct observation, along with keeping a weighed record of food items has the ability to capture a child's true intake more objectively and therefore can be used as a gold standard reference measure when compared to other dietary recall methods. Trained research staff observe individuals during mealtime and take note of all foods and portions consumed (National Cancer Institute, 2014). The observer usually has access to the menu, weighed portions being served, and the participants' plate waste.

Klesges et al. (1987) examined the accuracy of 24-hour recalls in preschool aged children (2-4 years old) when compared to direct observation. All participating families choose a "typical day" for the research team to visit their homes, where at least one parent was available and present. An observer arrived at the participant's home in the morning before the breakfast meal. All food for the child was weighed and notes were taken by the observer, all plate waste was collected. On day 1 observers were not in the home to weigh foods and recalls were collected before lunch, on day 2 observers were in the home to weigh foods and the recall was collected later in the evening following the full day observation (Klesges et al., 1987). The majority (29/30) of recalls were obtained from mothers and portion sizes were estimated using measuring cups and spoons (Klesges et al., 1987). They found close agreement between recalls from day 1 and 2. They also found close correspondence between the recall on day 2 and the observation data ($r = 0.65$), with only sugar intake being noted as significantly different between true and recalled. When errors occurred they appeared to be related to difficulties in recalling portion size estimates (Klesges et al., 1987). In addition, parents correctly recalled (96%) of the foods their children ate, suggesting that parents present during meal time could accurately identify items consumed by their child. Their results suggested that direct observation is a feasible approach in assessing the validity of dietary assessment tools, and furthermore parents can be accurate reporters of their young children's intake.

Eck et al. (1989) examined the accuracy of interview administered 24-hour recalls by comparing 24-hour recalls completed by the mother, father, or family group (including the 4-9-year-old child) to unobtrusive observation. In this study, families were invited to enjoy a free lunch in a local cafeteria, where all items were portion controlled and served a la carte. Trained observers were positioned within the cafeteria before the families arrived; there was a minimum of one observer per family (Eck et al., 1989). Families were instructed to leave all of their plates on the table when finished; plates were then collected, weighed, and recorded. Plate waste was subtracted from the recorded selections to obtain true intake. On the following day, research personnel, who were not involved in the direct observation, went to the families' homes to administer three 24-hour recalls, one to the mother alone, one to the father alone, and one to both parents and the child. They used a multi-pass approach where parents were prompted to recall amounts, preparation method, and condiments used (Eck et al., 1989). They found that the combination of both parents and the child allowed for the most accurate report for total energy intake (mean $r = 0.86$). The mean correlation among mothers alone was mean $r = 0.63$ and among fathers it was $r = 0.77$. Although parents along with their child had the most accurate report for total energy intake, the results suggest that both mothers and fathers have the ability to be accurate proxy reporters for their child's dietary intake. However, it should be noted that the meal was consumed outside the home, which may be more easily remembered, as it is atypical. Additionally, the meal that was recalled was also consumed together, which doesn't necessarily reflect typical family meals or take into account parents ability to recall their child's dietary intake when they are absent i.e. child is in childcare. Their findings suggest that direct observation can be a feasible approach to determining true validity of dietary assessment methods in pediatric populations.

Baranowski and colleagues (1991) also compared interview administered 24-hour recalls for children 3-5 years old against direct observation. Daily observation took place in the families' homes, from 7am (when the child woke) until 7pm that evening. All observers were trained and used a standardized protocol for daily observations, two observers alternated every two hours to minimize chance of fatigue, error, and allow for inter-observer reliability checks (Baranowski et al., 1991). Observers followed the child where he/she went, i.e., to school, day-care, friends' homes etc. Observers noted all foods eaten by the child including the method of preparation, served portion size, consumed portion size, etc. (Baranowski et al., 1991). However, it should be noted that the food items were not weighed, and therefore observers made estimations based on their training. This could have lead to bias and estimation errors made by the observers. A nutritionist not involved in observation went to the families' home on the next day to administer the 24-hour recall with the child's mother; the nutritionist brought food models and used household measuring instruments to help mothers estimate portion sizes (Baranowski et al., 1991). Their findings suggest that mothers who are at home are able to more accurately recall their child's dietary intake (93% could accurately recall most food/beverage items their child consumed) in comparison to mothers who are not at home with their children (48% could accurately recall some items consumed). Some of the difference between observed intake and actual intake may be attributable to observer error, thus keeping record of weighed food/beverage items in conjunction with direct observation is a more ideal approach when attempting to validate a dietary assessment tool (Barnowski et al., 1991).

It is evident that direct observation along with keeping records of weighed food/beverage items is a feasible approach to establishing true validity of dietary assessment tools in pediatric populations. This is a less costly approach than DLW and allows researchers to test the accuracy of parental recall when the parent is with or away from their child, i.e., periods when the child is in childcare. Although direct observation involves onerous tasks, it is known as a useful approach for assessing true intakes over short periods of time (National Cancer Institute, 2014) and is a gold standard measurement that can allow for true validity of a self-report tool such as, the 24-hour recall to be evaluated.

2.3 Parents and Proxy Reporting

As outlined above, it is well known that young children have limited cognitive abilities, making it difficult for them to conceptualize their dietary intake (Livingstone et al., 2004). It has been suggested that before the age of 10, children have poor recall skills, poor ability to estimate and indicate portion size, and their knowledge of food items is limited (Livingstone et al., 2004). Thus, parental reports are required when attempting to assess young children's dietary intake. Additionally, proxy reporting is routinely used to collected dietary data from children in large-scale surveillance studies, such as the Canadian Community Health Survey (CCHS) the National Health and Examination Survey (NHANES). For example, NHANES collects data on dietary behaviour including topics regarding dietary modification due to dietary supplement use and/or health issues. Additionally, 24-hour recalls and a FFQ is administered. The 24-hour recalls use the United States Department of Agriculture's (USDA) automated multiple pass approach where trained interviewers conduct dietary interviews with proxy reporters (NHANES, 2014). Proxy reporting is utilized for children 5 years and younger or for those who are incapable of self-report. Additionally, proxy-assisted interviews are conducted for children 6-11 years old (NHANES, 2014).

Although parents have the ability to somewhat accurately report their young child's dietary intake (Eck et al., 1989, Baranowski et al., 1991, Klesges et al., 1987, Jonhson et al., 1996, Reilly et al., 2001, Montgomery et al., 2005, Bornhorst et al., 2014), there are several limitations related to the accuracy and reliability of their report. These limitations include parents' limited knowledge of their children's intake when away from the parent, i.e., at childcare, parents' tendency to overestimate and underestimate their child's total energy intake, and recall difficulties based on the type of food/beverage item consumed (Linneman et al., 2004).

2.3.1 Parents being away from child

Over the past 3 decades, the need for childcare in Canada has significantly increased due to the rise in employment rates among women and the increase in dual-earning families. In 2011, more than half (54%) of parents with children 4 years old or younger reported utilizing child care (Statistics Canada, 2014); which suggests that this may be an important factor to consider when assessing parents' ability to accurately recall their child's dietary intake (Bornhorst et al., 2013). Many of the foods served to a child may not be under parents' control and therefore parents may not be aware of what and how much food their child eats while at child care, this increases the risk of unintentional misreporting (Bornhorst et al., 2013). A study conducted by Baranowski et al. (1991) considered mother's ability to recall their 3-5-year-old children's dietary intake using direct observation and 24-hour recalls. The analysis was stratified based on whether or not the child was *at home* or *not at home* (away from home for at least 4.5 hours of the day). Of the 66 mothers, 10 in the *not at home* group were unable to provide a recall for their child's dietary intake, meaning they did not accurately recall most of the items consumed by their child on the day prior, and were excluded from further analysis. Only 13 of the 27 mothers in the *not at home* group were able to accurately recall a majority of their child's dietary intake for the previous day; whereas, 27 of 29 mothers in the *at home* group provided accurate recalls (Baranowski et al., 1991). The level of accuracy was determined by comparing mothers report in terms of nutrient intake to observers. This was then compared against whether the mother was around the child for the whole day, more than 50% of the day, or less than 50% of the day (Barnowski et al., 1991). A study conducted by Bornhorst and colleagues (2014) tested the validity of repeated online 24-hour recalls for assessing total energy intake in young children (4-10 years), using proxy reporters, with totally energy being compared to TEE from the DLW method. Results indicated good agreement between energy intake (1500 kcal) and total energy expenditure (1523 kcal) at the group level (Bornhorst et al., 2014). Their findings suggested that two proxy reported 24-hour recalls are valid tools in assessing young children's dietary intake on a group level. However, it should be noted that in the Bornhorst study, 18/36 participants had school meals observed, where research personal recorded approximate portions and items consumed, these recordings were then supplied to the parents to allow for more accurate recalls (Bornhorst et al., 2014). Thus, good agreement between total energy expenditure and energy intake may have been influenced by the additional school meal assessment, which likely reduced proxy-reporting errors and enhanced the completeness of each collected recall (Bornhorst et al., 2014). These findings highlight the need to explore whether parent-reported dietary recall methods can effectively assess children's dietary intake regardless of whether the child is at home or in childcare. There is a dearth of research that specifically assesses whether parents are indeed accurate reporters of their preschool aged child's intake whether they are with or away from their child during mealtime. The current research study will be assessing the difference in parental reporting accuracy based on the parents' presence during mealtime.

2.3.2 Overestimation of total energy intake

Overestimation occurs when a parent's estimates of intake dietary recall is significantly greater than the child's actual intake. The literature examining parental recall of young children's dietary intake suggests that overestimation of total energy intake is prevalent regardless of the dietary assessment tool used (FFQ, 3-day food records, and 24-hour recalls) (Olukoton & Seal, 2015, Burrows et al., 2010, Bornhorst et al., 2013, Fisher et al., 2008). Over reporting may be associated with inaccuracies in portion size reporting of dietary recall using self-reporting measurement tools (Olukoton & Seal, 2015). Many dietary assessment tools that are tested on pediatric populations have been developed for adults, based upon data on consumption among adults. Therefore, when tools are created for adult usage and used to assess dietary intake patterns in young children, it often becomes challenging for parents to identify appropriate portion sizes for their young child. This is because the images or other portion size aids are typically created for adults, thus a young child may not be consuming ¼ cup of spinach however that may be the lowest portion size available for selection. This often leads to issues with portion size estimation, and can lead to over estimation of children's energy intake (Reilly et al., 2001, Burrows et al., 2010, Bornhorst et al., 2013). A study by Bornhorst and colleagues (2013) studied the effect of misreporting in children's dietary assessment. The study was conducted within the framework of multi-centre identification and prevention of dietary and lifestyle induced health effects in children and infants (IDEFICS). Specifically, the study was based on 6101 European children aged 2-9 years with complete covariate information and 24-hour recalls (Bornhorst et al., 2013). They identified parent proxy reporters to over report their child's intake by 3.4 percent. They found that over reporting was negatively associated with children's BMI z-score, which suggests that the child's weight status may have influenced parental report (Bornhorst et al., 2013). They found that correlates of over reporting included concern about their child becoming underweight (Bornhorst et al., 2013). Additionally, the relationship between over reporting and BMI z-scores was more apparent for girls compared to boys (Bornhorst et al., 2013). Over reporting of children's intake has also been associated with overall number of items reported by the parent; thus, greater overestimation is found when a greater number of food/drink items are reported (Fisher et al., 2008). Again, this reflects portion size estimation issues, as parents who are reporting more items may slightly overestimate the portions their child consumed of each item (Fisher et al., 2008).

It is evident that there is a need for dietary assessment tools that support parents in completing a dietary recall for their child and takes into consideration errors that may lead to parental over reporting. Dietary assessment tools created for adults are commonly utilized with pediatric populations, and thus issues with portion size estimation occur (Burrows et al., 2010). Future tools need to consider the best way to represent portions for young children to allow parents to best estimate their child's intake. Furthermore, it should be noted that many of the studies assessing dietary assessment methods in children specifically look at the ability of the tool to accurately assess the child's total energy intake rather than specific diet details.

2.3.3 Underestimation of total energy intake

Underestimation occurs when a parent's dietary recall for their child is significantly less than their actual dietary intake. In general, underestimation is less prevalent in children as the recall is completed by parents/caregivers and this is associated with a lower risk of under reporting when compared to adults (Bornhorst et al., 2013). A study conducted in Germany by Sichert-Hellert et al. (1998), looking at under reporting of total energy intake in children found that approximately 1 percent of proxy reporters under reported for children between 1-5 years of age, and this percent increased with age (Sichert-Hellert et al., 1998). Bornhorst and colleagues (2013) conducted a study using 2-9-year-old European children using data from IDEFICS and found that 8 percent of parents under reported their child's dietary intake and the risk of under reporting increased with parental age, and child BMI z-score. They also discovered that under reporting was most prevalent in low to medium income groups compared to high-income groups, where as education level was not associated with either under or over reporting (Bornhorst et al., 2013). Additionally, when adding dietary variables to their model they identified the under reporting group selected socially desirable answers, meaning food items commonly perceived as unhealthy (i.e. sugary products and soft drinks) were negatively associated with under reporting. Conversely, fruit and vegetable intake showed a positive association with under reporting (Bornhorst et al., 2013). A recent Australian based study conducted by Rangan et al. (2014), examined the amounts and types of misreporting of children's energy intake occurred when using a dietary survey. They found that parental proxy reporters for children 2-9 years tended to under report consumption of many different types of food including, bread, milk, cheese, yogurt, fruit juice, processed meats, vegetables, cakes. Based on the results, there was no obvious food or food group bias towards selective under reporting. These results suggest that the source of the under reporting may not be due to social desirability bias, but simply due to error in recalling their child's true intake (Rangan et al., 2014).

The literature suggests that under reporting may occur when parents report dietary intake on behalf of their child, however this occurs much less frequently than over reporting. It appears that under reporting may be associated with various characteristics such as, parent income level, and child age. Under reporting may also occur based on the child's BMI z-score (Bornhorst et al., 2013). Future studies assessing dietary intake in children with parent proxy reporters should note over reporting and assess whether parental age, income level or child BMI z-score influences their dietary recall.

2.3.4 Portion size estimation

Portion size estimation is a major challenge in dietary assessment. Estimating amounts of foods/beverages consumed rather than weighing or measuring items can be a main source of error amongst both children and adults (Kaur Grewal et al., 2014). A study conducted by Klesges and colleagues (1987) identified portion estimation as the main source of error in dietary recall for parental proxy reporters, as they were able to correctly identify the majority (96%) of the foods eaten by their child. Klesges and colleagues (1987) findings are similar to other studies that also found error in parents' ability to accurately report portion sizes on behalf of their young child. The identified errors in portion size estimation led to overestimation of the child's dietary intake (Montgomery et al., 2005, Reilly et al., 2001). Furthermore, a recent study identified that overestimation when using 24-hour recalls was predominately driven by errors in portion size estimation, suggesting that portion size errors are likely a major source in parent proxy over and under reporting (Fisher et al., 2008). A possible reason for portion size errors is that children's dietary intake is not constant over time, making it difficult for parents' to account for changes in portion frequencies and sizes (Livingstone et al., 2000). In addition, adult studies have identified certain food items being of greater challenge to report, for example poor portion size estimation was found for breads, spread, mixed dishes, snacks, mixed greens, and sweets/cakes (Ovaskainen et al., 2008, Trolle et al., 2013). This indicates that parent proxy reporters may experience greater challenges when estimating portions of amorphous shaped foods and multi-component dishes. Furthermore, many dietary assessment tools for young children have been developed for use in adults, this may also contribute to inaccuracies in portion size estimation. However, more research is needed to help validate such findings and improve quantification tools available for parent proxy reporters (Trolle et al., 2013).

The use of photo images has been considered a good tool to help estimate portion sizes when used in adolescents, adults, and in proxy reporters (Trolle et al., 2013, Ovaskainen et al., 2008, Lillegaard et al., 2005, Kaur Grewal et al., 2014). However, research suggests that there is a large variability in an individuals' ability to correctly choose the photograph that depicts the appropriate portion size, suggesting questionable accuracy on an individual level but small group error (Lillegard et al., 2005). Further development in the methods of measuring volume of foods is needed to help improve estimation at the individual level (Trolle et al., 2013). In addition, validation studies are need to test the accuracy and usability of photographic booklets in estimating actual consumption (Kaur Grewal et al., 2014).

2.3.5 Recall difficulties based on food/beverage items

Recall difficulties occur when an individual or proxy reporter faces challenges during dietary recall. Often times these challenges may be associated with the type of food and/or beverage that is consumed. An Australian-based study by Flood et al. (2014) tested the relative validity of a FFQ against 3-day food records for children 2-5 years using parents and preschool teachers as proxy reporters. They found a range of consumption habits to have moderate to good validity, with fruit/vegetable and fruit juice consumption being most accurately recalled. However, the other dietary intake items such as snack foods, take-away foods, red meats etc. had poor validity. In addition, water and sugar-sweetened beverages (SSBs) were most poorly reported in terms of absolute quantities of intake with larger intakes being reported using the FFQ compared to the food record. (Flood et al., 2014). Another study based out of Australia by Bennet et al. (2009) tested the relative validity of the Eating and Physical Activity Questionnaire (EPAQ) against interview administered 24-hour recalls for children aged 2-5 years. They found that parents tended to significantly underestimate their children's beverage consumption, which was accurately captured with the 24-hour recalls (Bennett et al., 2009). The researchers identified that parents had trouble recalling milk consumed with cereal, or flavoured milks unless they were probed further (Bennett et al., 2009). Parents also expressed having difficulties knowing exactly how much water their child had consumed, as they often use reusable bottles that can be filled up.

A review by Linneman et al. (2004), looked at parents' ability to report their young child's (2-5 years old) fruit and vegetable consumption using a FFQ. They found that parents can be accurate reporters of their child's fruit and vegetable consumption, however they experienced difficulty recalling fruits or vegetables that may be included in mixed dishes (i.e. raisins in raisin oatmeal cookies); parents may have difficulty recalling the exact portion of items in mixed dishes (Linneman et al, 2004).

The literature suggests that parents have the most difficulty recalling their child's beverage consumption and reporting different proportions of food group items when they are used in mixed dishes (Linneman et al., 2004). Pediatric dietary assessment tools that probe proxy reporters on their child's beverage consumption and details regarding food items consumed in mixed dishes (e.g. did the cookie have raisins or chocolate chips?) could potentially help improve parent's ability to accurately report their child's dietary intake. Future pediatric dietary assessment tools need to ensure the appropriate probing questions and portion size estimates are utilized in order to enhance parent's ability to accurately report their child's dietary intake.

2.4 Where does dietary assessment stand for preschool aged (2- 5 years) children?

Currently, there is no known gold standard tool for dietary assessment in preschool aged children. In adult populations there has been extensive evidence to suggest that 24-hour recalls provide the highest quality and least bias to dietary data (National Cancer Institute, 2016), however this has yet to be established within a pediatric population. It should be noted that very few validity studies assessing the use of 24-hour recalls have been conducted for children 1-4 years of age (Baranowski et al., 1991, Basch et al., 1990, Bornhorst et al., 2014, Eck et al., 1989, Johnson et al., 1996, Klesges et al., 1987, Reilly et al., 2001). Most of these studies are quite dated and therefore future research should attempt to validate a modern approach in administering a 24-hour recall to parent proxy reporters.

There have been two recent systematic literature reviews, Burrows et al. (2010) and Olukotun and Seal (2015), which reviewed dietary assessment tools for young children. The findings from Burrows et al. (2010) suggest that weighed food records provide the best total energy estimated for children up to 4 years of age. However, multi-pass 24-hour recalls conducted over at least 3 days using parents as proxy reporters is the most accurate way to measure total energy intake in children 4-11 years of age (Burrows et al., 2010). The review by Olukoton and Seal (2015) suggest the FFQ as the best approach to capturing accurate dietary intake data from children. Thus, the reviews present very contradicting messages as to which method is most suitable for young children. A major limiting factor to the Olukoton and Seal (2015) review was the utilization of only 9 articles, which included studies that used methods of true validity, e.g. comparing against DLW and relative validity, e.g. comparison between FFQ and 24-hour recalls (Olukotun & Seal, 2015). Both reviews highlighted the lack of consistency in the dietary assessment tools utilized with pediatric populations, indicating a lack of evidence to support one tool as best practice for assessing children's dietary intake (Burrows et al, 2010; Olukotun & Seal, 2015). More research is needed to help establish accurate and valid methods of dietary assessment tools for preschool aged children. Future tools need to consider participant involvement, for example using food records may result in changes to eating habits (reactivity) and therefore lead to greater misreporting.

All self-report dietary assessment tools have their challenges including; memory issues, the lack of attention to fine details of food content, challenges estimating portion size, and issues regarding participant burden (Thompson et al., 2010). Over the past decade, numerous technology-based tools have emerged (Brent et al., 2010), and research suggests that web-based programs have the potential to reduce participant burden of dietary intake recording, while allowing the analysis of dietary intake to be less burdensome and more efficient for researchers (Brent et al., 2010). Additionally, these technological tools are able to reduce costs in both the collection and processing of dietary data (Thompson et al., 2010). Furthermore, technology based self-report methods have the potential to allow for improved validity and reliability of dietary self-report. This improved accuracy can potentially be correlated to the use of imaging to help participants estimate portion sizes of food/drinks consumed with greater accuracy (Brent et al., 2010).

Future research should focus on identifying what factors contribute to intake misreporting, in order to help reduce parent proxy reporting errors and improve the accuracy of dietary assessment methodology for pediatric populations. Additionally, more research is needed to test the feasibility of using modern technology for dietary assessments in young children, as it’s an innovative and cost-effective approach to dietary assessment.

3.0 ASA24 (Automated Self-administered 24-hour Recall)

There has been evidence to suggest that among adults, 24-hour recalls can provide the highest quality and least bias form of self-report dietary data. However, they were previously expensive and impractical for large-scale studies (National Cancer Institute, 2016). This is because 24-hour recalls required trained personal to conduct the interview and this usually takes multiple administrations in order to capture an individual’s usual intake (National Cancer Institute, 2014). Additionally, the data collected needs to be interpreted by trained research personal (National Cancer Institute, 2016). These challenges led investigators at the National Cancer Institute (NCI) to create the Automated Self-administered 24-hour Recall system (ASA24), a freely-available web-based tool that can be used in a range of research studies (National Cancer Institute, 2016). The ASA24 uses a respondent website to collect dietary recall data and a researcher website to allow researchers to obtain and manage study logistics (National Cancer Institute, 2016).

3.0.1 Navigating the respondent website

Respondents are guided through the 24-hour recall using a modified version of the United States Department of Agriculture (USDA's) Automated Multiple-Pass Method (AMPM) (National Cancer Institute, 2016). The AMPM method utilizes 5 steps designed to enhance accuracy and completeness of food recall, while reducing respondent burden (USDA, 2016). The ASA24 goes through 8 passes, which include a meal-based quick list, a meal gap review, a detail pass, forgotten foods, final review, last chance, usual intake question, and an optional supplement module (National Cancer Institute, 2016).

During the first pass (meal-based quick list), the respondent is asked to provide a list of all the foods/beverages consumed during the previous 24 hours. They do this by browsing through food group categories to find their item or they can directly search for the item in the system (National Cancer Institute, 2016). During this first pass, they are also asked to select the eating occasion (breakfast, lunch, dinner, snack) and eating time. The researcher can also decide to collect additional information including where meals were eaten (i.e., restaurant, cafeteria), if there was television or computer use during the meals, and if the meal was eaten alone or with others (National Cancer Institute, 2016). When respondents are finished their quick list, they are provided with a meal gap review. During the meal gap review, respondents are asked if they consumed anything during any 3-hour gaps between each of their reported eating occasions. If the respondent answers yes, they are returned to the quick list to add the appropriate beverage or food item consumed (National Cancer Institute, 2016). The third pass (detail pass) probes respondents for details of their reported quick-list items. Details include preparation methods (i.e., fried or roasted), amount eaten, and additions (i.e., sugar in coffee, salad dressing). Researchers also have the option to query respondents regarding the source of products (i.e., farmer's market, grocery store) to capture where food/beverages were obtained (National Cancer Institute, 2016). Participants then move onto the fourth pass (forgotten foods). A pop up window appears after the respondents complete the detail pass with a list of questions that probe the respondent regarding frequently forgotten food items (i.e., snack foods, vegetables, cheese, water etc.). If the respondent answers yes, they are re-directed to the quick list (first pass) to add the forgotten item(s) (National Cancer Institute, 2016).

The fifth pass is also known as the final review and prompts the respondent to review a list of all the food/drinks they reported. At this time, they will have the ability to make any edits to their list. During the sixth pass (last chance), a pop up window appears asking the respondent if they have forgotten any food or drink items. If yes, they are re-directed to the quick list; otherwise, they move on to the final pass (usual intake question). The usual intake question asks the respondent if their previous 24-hour intake was usual, more than usual, or less than usual than their typical daily intake (National Cancer Institute, 2016). The entire 8-step ASA24 process typically takes a respondent 30 minutes to complete (National Cancer Institute, 2016). Additionally, researchers have the option to add a supplement module, which asks respondents to provide detailed information about any supplements they may take, including vitamins, minerals, and other prescription supplements (National Cancer Institute, 2016).

3.0.2 Navigating the researcher website

ASA24 is freely available to researchers, clinicians, and teachers; they can utilize this dietary assessment tool to obtain output files and manage data collection (National Cancer Institute, 2016). The website is customizable, allowing researchers to add their own introduction and conclusion textual scripts as well as study logos (National Cancer Institute, 2016). Researchers also have the flexibility to choose how much detail they require from their respondents. For example, the researcher can choose whether to query the respondents regarding television use during meal times (National Cancer Institute, 2016). Researchers can request various output analytical files, including my selections (names of food and supplements reported and probe and answers for each respondent by recall day) and individual foods and nutrients based on the Food and Nutrient Database for Dietary Studies (FNDDS) for US versions and the Canadian Nutrient File for the Canadian version (National Cancer Institute, 2016). Additionally, researchers can gather output information on individual foods and My Pyramid Equivalents for each food reported by each respondent and daily total nutrients from all foods reported by recall day (National Cancer Institute, 2016).

3.0.3 Available ASA24 tools

There are multiple versions of the tool available, including ASA24-2011, ASA24-2014, and ASA24- 2016. ASA24-2014 added new features that allowed researchers to include modules that query respondents on the source of food/beverage item (i.e. grocery store, vending machine), and query two 24-hour time frames (i.e., yesterday from midnight to midnight and the 24 hours prior to the initial login to complete the recall) (National Cancer Institute, 2016). ASA24- 2016 has an updated responsive design, meaning this version can be used on smartphones and tablets in addition to desktops and laptops. With the newest version, respondents are also able to complete single or multi day food records in addition to 24- hour recalls (National Cancer Institute, 2016). New portion images have been added and the software no longer requires a plug-in and therefore can be used on all popular web browsers. All versions are designed for the US and are available in English and Spanish (National

Cancer Institute, 2016). The evaluation of these tools will be discussed in detail in section 3.1.

There are also two versions of ASA24-Kids (2012 and 2014) tools, with the 2014 version being the only one currently available. ASA24-Kids was adapted based on earlier work by Dr. Tom Baranowski to develop a self-administered 24-hour recall for children 10 years and older (National Cancer Institute, 2016). The tool is similar to the adult ASA24 and utilizes the same methodology and features, i.e., multiple passes query options regarding mealtime and television use. Some of the features that make this version conducive for use in a child population include, an animated avatar to guide and maintain the respondent's interest, and the inclusion of common misspellings to minimize issues when the child is searching for their food/beverage items (National Cancer Institute, 2016). Some food and beverage items that are not reported among children 8-15 years of age in national U.S. surveillance have been removed and certain questions children could not be expected to answer were removed (e.g., what kind of oil was used to prepare the French fries?). Formative research conducted in the early stages of the ASA24 adaption found that 8-9-year-old children lacked the cognitive ability to accurately complete a self-administered web-based recall (Baranowski et al., 2012). Thus far the ASA24-kids has not been validated.

An English version of ASA24-Canada has also been adapted based on work by Health Canada's Food Directorate and is freely available to Canadian researchers. Modifications were made to the respondent website to reflect the Canadian food supply, foods unique to Canada were added and those not available were removed. As well, metric measurements for portion size options were added (National Cancer Institute, 2016). There is currently no child version for this tool and the 2016 version is expected to be ready in fall 2016. In addition, there is no food group database associated with ASA24-Canada, however the development is in works (National Cancer Institute, 2016). The Canadian adaption of the ASA24 is exciting as it allows for dietary intake data to be collected in a range of studies, where the tool has been tailored for a Canadian context (National Cancer Institute, 2016). As it stands, the ASA24-Canada has yet to be validated.

In addition, an Australian version is under development, which is expected to be ready in the near future. The National Cancer Institute collaborated with Australian researchers to adapt the ASA24 to an Australian context in order to account for variations in portion sizes and nutrient composition in the foods consumed (National Cancer Institute, 2016). The various version of ASA24 provide the ability to conduct similar studies across countries using consistent methodology, thus allowing for direct comparability of results.

3.1 Evaluation and Validation of ASA24 in the United States

3.1.1 ASA24 Development

The ASA24 development team conducted many small-scale usability and cognitive tests to guide the development of the respondent website (National Cancer Institute, 2016). This included formative research to inform the quick list. A pilot test involving 18 adults in a self-administered computer environment was conducted to test two versions of a quick list (the first pass in the automated multiple pass method) for eliciting foods and beverages consumed the previous day (Subar et al., 2007). In the unstructured version, respondents had the ability to search for any food or drink items they consumed the previous day. In the meal-based version, they first selected a meal (i.e., breakfast, lunch, dinner, or snack) and then searched for each item they consumed during those classified meal times (Subar et al., 2007). Respondents showed a strong preference for a meal-based quick list, with 72% of the participants preferring this version (Subar et al., 2007). The meal-based version was utilized moving forward when developing the ASA24 and its various versions.

They found that the output from recalls completed using ASA24 suggested acceptable face validity for items such as, calorie, food estimates and nutrients (National Cancer Institute, 2016).

Subar and colleagues (2010) conducted a study to assess the accuracy of portion size reports using computer based food photograph aids, during the development of the automated self-administered 24-hour recall. Two observational feeding studies were conducted where each participant selected and consumed foods for each meal. They served themselves portions from nine different food items, where serving containers were unobtrusively weighed before and after selection of items (Subar et al., 2010). The following day participants used a computer program to select photographs representing the portion sizes they consumed the previous day. In the first study (n=29) participants had four different image options (aerial photographs, angled photographs, images of mounds, and household measures). Additionally, they had two screen presentations options including simultaneous images versus an empty plate that was filled with images of food portions when selected (Subar et al., 2014). In the second study (n=20) the images were presented in two ways, large and small as well as 8 versus 4 images. The researchers identified that no specific image type was most accurate, however the use of 8 images versus 4 images lead to more accurate responses (Subar et al., 2010). However, there was a strong preference for presenting images simultaneously versus sequentially. For some food forms images of mounds or household measures are as accurate as images of food, therefore they can be cost-effective alternatives to food photographs (Subar et al., 2010). Their findings supported the use of aerial photographs in the ASA24 (Subar et al., 2010).

3.1.2 Evaluation of ASA24

Kirkpatrick et al. (2014) conducted a true validation study to test the performance of the ASA24, using a feeding study in which the true intake for 3 meals was unobtrusively documented. The study included 83 men and women between 20-70 years who lived in Washington, DC. Participants were scheduled to visit a study center to consume 3 meals, and then were asked to return to the center the following day. The following day they were asked to complete a 24-hour recall, a health behavior survey, and a brief demographic questionnaire (Kirkpatrick et al., 2014). On the observation day (day 1), participants arrived at the center in the morning and completed informed consent; participants were told that they were participating in a study that is considering methods for what Americans eat. They were invited to chose and consume food and drink items from a buffet, this buffet was available for breakfast, lunch, and dinner meals (Kirkpatrick et al., 2014). Items were served in communal containers. There were also some single serve items such as; yogurts and small bags of chips. The buffet was designed to mimic how the participants might encounter food/beverage items at home or in other eating environments (Kirkpatrick et al., 2014). The items offered included lasagna, sandwiches, cereal, coffee, juice, pop, sweeteners and any other food item condiments. There were also several prepared multicomponent items available, e.g., salads and tuna sandwich filling. Participants served themselves one at a time in 10 minute intervals and each food item container was discretely weighed before and after in order to determine how much of each item was taken by the participant (Kirkpatrick et al., 2014). Plate waste was also weighed to determine the actual amount of food and drink consumed by the individual. Participants were allowed to leave the center between meals and there were no restrictions placed on eating or drinking items outside the center (Kirkpatrick et al., 2014). Participants were not made aware that they were going to be asked to recall the food and drink items consumed the following day (Kirkpatrick et al., 2014). The next day, half of the participants completed the ASA24 online and half completed an interview administered multi-pass 24-hour recall over the telephone (Kirkpatrick et al., 2014). Researchers found that respondents completing the ASA24 reported 80% of items truly consumed, whereas those completing the interview administered recall reported 83% of items truly consumed. Based on these results, the researchers concluded that the ASA24 performed well relative to both true dietary intake and to interview administered recalls. Thus, the ASA24 tool has the potential to collect accurate dietary intake information from large scale studies at a low cost. This information can help contribute to research aimed at describing the diet of populations, assessing diet effect from various interventions, and interpreting the relationship between health and diet (Kirkpatrick et al., 2014).

Thompson and colleagues (2015) compared the interviewer- administered 24-hour recall with the ASA24 in 3 diverse integrated health systems (Wisconsin, Detroit, and Northern California). Each participant was asked to complete two recalls, following one of four protocols, which differed by the type of recall and order of administration. A total of 1081 individuals completed at least one recall and of those, 90% completed two recalls. The majority were women (53%) and ages varied between 20-70 years. Additionally, three races were included, whites, blacks and Hispanics (Thompson et al., 2015). According to the four protocols, each participant could have completed either two ASA24 recalls, two interview-administered 24-hour recalls, the ASA24 followed with an interview administered recall, or the interview administered recall followed by the ASA24 (Thompson et al., 2015). The researchers found that total energy mean intakes were quite similar between the interview administered and the ASA24 dietary recalls (difference of +/- 30-51 calories) (Thompson et al., 2015). They also found that the ASA24 was preferred by 70% of the participants over the interview administered 24-hour recall and attrition was lower in those who completed the ASA24 recall first or only completed 2 ASA24 recalls (Thompson et al., 2015). Their results suggest that the ASA24 has potential to collect high quality dietary data at a low cost and may result in lower rates of attrition than studies utilizing the interview administered approach (Thompson et al., 2015).

A recent study by Diep et al. (2015) examined the relative validity of ASA24-Kids-2012 by comparing the ASA24 tool to interview administered 24-hour recalls with children 9-11 years old. Trained research staff members observed school lunches and recorded food and drink portions obtained, consumed and any food spillage or exchange. They also recorded the amount of plate waste left on the plate. The food weights were not taken. The next day the children completed both the ASA24-Kids-2012 and the interviewer-administered 24-hour recall in a randomized order (Diep et al., 2015). They found that the ASA24-Kids-2012 was less accurate than the interviewer-administered 24-hour recalls, when compared to observation notes. However, both ASA24-Kids and the interviewer-administered 24-hour recalls performed poorly and reflected substantial error (Diep et al., 2015). Their results suggest that further research is needed to help determine what age children may accurately report on their own and what methods are available to help children offer more accurate dietary intake self-reports (Diep at al., 2015). Furthermore, it may be beneficial to have parents and/or caregivers involved in the dietary recall of their child if children do not have the ability to accurately report intake on their own. It should be noted that the ASA24 has not been validated using younger children or with parents as proxy reporters.

4.0 Rationale and Study Purpose

A fundamental part of nutrition research and clinical practice is an accurate measurement of a child's diet, which can allow for the development of interventions and education to improve nutrition in children.

Currently, there is an increasing prevalence of childhood obesity worldwide. For instance, in developed countries in children 5 years and younger the rates of obesity have increased from 7.9% in 1990 to 10.6% in 2005. Childhood obesity is continuing to rise and rates are expected to reach an all-time high of 14.1% by 2020 (te Velde et al., 2012). Early childhood is a critical period for preventing obesity, as children are learning how, when, and what to eat during this period. They begin to develop food preferences that influence eating patterns and these patterns are often carried into adulthood. (Fox et al., 2010, te Velde et al., 2012). (te Velde et al., 2012). Thus, accurately assessing dietary intake during childhood can help inform individual and population level nutrition interventions that promote good nutrition and healthy habits.

Literature has suggested that children 10 years old and younger lack the cognitive abilities to recall their dietary intake accurately, making parental recall necessary when wanting to capture young children's intake (Diep et al., 2015). Previous research has suggested that parents have the ability to accurately assess their young children's (2-5 years) dietary intake (Baranowski et al.; 1991, Bennett et al., 2009, Bornhorst et al.; 2013, Eck et al.; 1989, Flood et al.; 2013, Johnson et al.; 1996, Linneman et al.; 2010). However, a large majority of the validation studies only assess relative validity, thus for most available instruments, data on validity are limited. Research is needed to determine if parents can be accurate reporters of their young children's dietary intake whether they are with or away from their child during meal times. Furthermore, research is needed to explore whether parent or child BMI scores can influence the accuracy of parental report.

The two systematic literature reviews (Okouton & Seal, 2015, Burrows et al., 2010) report inconsistent findings regarding which method is the gold standard for assessing dietary intake in young children, with one study suggesting a FFQ (Okouton & Seal., 2015) and the other suggesting 3-day food records (Burrows et al., 2010). It is clear that more research is needed to determine reliable and valid approaches to dietary assessment, especially in young children. As well, researchers have suggested utilizing innovative technological approaches in dietary assessment, as it may reduce participant burden and improve the accuracy of reports (Okouton & Seal, 2015).

The ASA24 is a new innovative technological approach to assess dietary intake, which has proven true validity when compared to direct observation in an American adult population. The Canadian version has yet to be validated. However, validating the ASA24 is a valuable research endeavor to understand the tool within a Canadian context. Additionally, there is a need for valid pediatric appropriate dietary assessment tools, making ASA24-Canada an ideal dietary assessment method to test parental recall on for preschool aged children (2 -5 years).

Currently, there is scarce literature to support parental dietary recalls amongst this age group, and many children begin to attend day cares by the age of 18 months. Additionally, there is a dearth of research that considers the validity and reliability to dietary assessment tools amongst this age group. This study assessed whether using an online self-administered

24-hour recall can be a useful dietary assessment tool in a preschool aged population using parents as proxy reporters. Results from this research will provide an understanding of whether parents can be accurate reporters when they present or absent during meal time, and whether parent or child BMI, parent or child sex, or child age influences the accuracy of parental dietary report.

4.1 Objectives

The primary objective of this study was to assess the validity of the Canadian version of the Automated Self-administered 24-hour recall (ASA24-Canada) for capturing the true dietary intake among preschool aged children (2-5 years), using parents and/or guardians as proxy reporters.

The secondary objective was to explore how individual factors such as parent/child BMI, parent/child sex, or child age influence the accuracy of parental reports.

4.2 Hypotheses

We hypothesized that parents would be accurate reporters of their preschool aged (2-5 years) children's intake using ASA24-Canada. We also expected that parent proxy reporters would be more accurate in recalling the dinner meal when they are present with their child compared to the daytime meals, which were provided by the child care and learning center (CCLC). There were no hypotheses for the secondary objective, as we simply wanted to explore the potential influence of such variables on parental accuracy.

5.0 Methods

5.0.1 ASA24-Canada Validation Study Design

To assess the accuracy of parental dietary report using ASA24-Canada, a direct observation feeding study was conducted with 40 parent-child dyads. The study aimed to assess whether criterion validity could be established by examining the percent of food/beverage matches found between parental report and true intake, and the mean differences between true and reported intake for total energy and several nutrients. The data were obtained and documented through direct observation and food/beverage weighing. It should be noted that our procedure was adapted from a previous ASA24 validation study (Kirkpatrick et al., 2014).

5.0.2 Recruitment and Eligibility

From November 2015 and January 2016, preschoolers aged 2 to 5 years of age and their parents/guardians were recruited through the Child Care and Learning Centre (CCLC) at the University of Guelph in Ontario, Canada. Participants were recruited from eight toddler and preschool classrooms within the center, which included over 100 children. Recruitment posters were emailed to all parents/guardians whose children were in these classrooms. The poster included general information about the study purpose, participant eligibility criteria, and the research coordinator's contact information (email and phone number) (see appendix A). Parents who participated agree to participate in a nutrition study focusing on early childhood eating behaviours. The purpose of the study was described as a study testing different ways to measure what young children eat. Parents were not aware that they would be required to complete a 24-hour recall the following day, instead it was presented as a survey that assessed their child's eating patterns. The study coordinator held four in-person recruitment sessions at the CCLC during child drop-off and pick-up times. If parent/guardians had more than one child within the desired age group, the child with the closest birthdate was selected to participate.

Inclusion criteria included the parent being able to read and write English, having a child in the CCLC between 2 and 5 years of age, and willingness to participate in the study for designated time periods on two consecutive days. Exclusion criteria included food allergies or dietary preferences that would be difficult to accommodate for study purposes (e.g. halal requirements, allergy to seafood) in the child or parent, and prior nutrition training in the parent. An eligibility screener was administered over the phone or email when interested individuals contacted the study coordinator for further details (see appendix B). The study coordinator emailed consent forms and study details to eligible families. All study procedures were administered at the University of Guelph after the parents provided written, informed consent (see appendix C). This study was approved by the University of Guelph's Research Ethics Board (REB), 15JN028 (see appendix D).

5.0.3 Procedure

Observation of meals were staggered over the fall and winter months (between November 2015 - March 2016) on one day each week, either a Tuesday or Wednesday, with parental recalls conducted on the following Wednesday or Thursday. Parents were given the option to select the date that best suited their schedules. Data collection did not occur over the December 2015 holiday period.

Data collection took place in the CCLC at the University of Guelph during lunch, afternoon snack, and dinner meals. The CCLC provides all registered children with their lunch and snacks for the day based on a 4-week cycled menu. Each lunch meal consists of a grain product, meat and alternative, a vegetable/fruit, and a milk product as per Canada's Food Guide and Ontario Public Health recommendations. All parents had access to the CCLC menu; the menu was sent home with the children at the beginning of each month and posted in visible locations throughout the center, as well as online. Additionally, parents had access to a Hi Mama app (Hi Mama Inc. 2016, Canada) that was being tested within the CCLC. The app provides parents with information on their child's eating, washroom, and sleeping behaviours throughout the day. For each meal, parents could access information regarding how much their child consumed with options being all, most, some, none or N/A. During the data collection period for this study, the information was consistently uploaded to the app, as it depended on the teacher's time. Whether parents participating in the study accessed this app throughout the day is unknown. Parents were neither encouraged or discouraged to access the CCLC menu or Hi Mama app during the study day.

Breakfast is not included at the CCLC and was not included in the analyses, as it would have been difficult to have parents and young children arrive at the University earlier than normal given parental time constraints. All data were collected in 2-day cycles.

Day 1:

During lunch and afternoon snack meals the child was unobtrusively observed by a trained research assistant at the CCLC. The research assistant made note of what the child consumed, if any items spilled or if there was any exchanging of food/drink items. The observer was responsible for observing no more than 2 children at any given time. The child participant was served foods and drinks from a set menu developed by the research coordinator and CCLC chefs (see appendix E). The meals were existing meals that the CCLC was currently offering on their monthly menu rotation. They were chosen based on several considerations including child preferences, accommodation of food allergies, ease for chefs and teachers, and availability of foods. For consistency purposes, all meals were the same for each round of observations in this study.

Prior to the child being served their lunch meal, each food/beverage item was unobtrusively weighed twice by a trained research staff member using a digital food scale (My Weigh WR-12K waterproof scale, Canada) to ensure accurate amounts were recorded. If the two measurements were not the same, a third measurement was taken, and an average of the two closest weights was used. All weights were taken in grams. The participant's ID coded plate and cup were brought into the classroom with their classmates' food. The CCLC served their meals using a family style approach, where the child was able to pick their food items and the teacher placed such items on their dish. This approach was modified for children participating in our study, as food items needed to be weighed beforehand. Thus, the child participant received all food items on a pre-plated plate while the other children were receiving their food. Based on researcher observations this caused no issues or concerns for the child participants. As is typical at the CCLC, child participants were allowed second servings. If a child participant wanted a second serving, the teacher serving the meal was instructed to place the additional serving of food/beverage in the provided standardized dish or cup and a research staff discreetly weighed the food item before it was placed on the child's plate. The additional weights were recorded. Once the child was finished their meal, the plate was removed by a research staff and plate waste was weighed. The same protocol for weighing food items was utilized in the weighing of plate waste (see appendix F for protocol). The true intake (based on weight consumed) was calculated using the weight of food items served minus the plate waste. Amounts consumed of each item were recorded.

On the same day, a parent joined their child for a buffet style dinner at the CCLC. The food was prepared by the CCLC chef, who was hired through the research team for the preparation of the dinner meal. The dinner room had two buffet lines, one specifically for the children (buffet 1) to choose items from and one specifically for the parents and other family members (buffet 2). All food and beverage items were identical in both buffet lines. Buffet items served included family friendly options (see appendix E for menu), which were served in communal containers. Some pre-portioned food items were also offered such as cookies, garlic bread, and beverages (water, milk, and juice boxes) and some multicomponent items such as mixed green salad and fruit salad.

Before the evening meal, the study coordinator described the study protocol, which required that each family member obtain food from their designated buffet line (1 or 2), that sharing of food and additional servings were not permitted, and that all dishes were to be left on the table as research staff were responsible for clean-up.

The parent-child dyads were escorted by a research staff member to the buffet. The parent first walked through the child buffet line (buffet 1) and collected the food the child had selected to consume, afterwards the child's plate was taken to the dining area in the CCLC and placed at the family's dining table. The child's plate had an ID sticker at the bottom. The parent and other family members then walked through the parent buffet (buffet 2) and filled their plates with desired food and drink items.

Each buffet was staffed by a trained research staff member who was available to answer any food related questions the family may have. After the parent finished plating their food, the food item containers selected from buffet 1 (child buffet) were discreetly weighed by trained research staff to determine the amount of each food item served to the child participant. Weights were recorded. The serving container weight was then subtracted from the weights collected by research staff to get the amount taken by the child participant. The classroom in which the dinner was served specifically had no garbage bins, as researchers were attempting to eliminate the risk of food being accidently disposed of. After the family left the dinning room, the child's plate and beverage was removed from the dinning room, labelled, and placed in a designated kitchen area until all families from that evening were finished. Afterwards, all plate waste was weighed and recorded. In an observation booth attached to the classroom, members of the trained research team discreetly observed the parent-child dyad to note any spills or exchanging of food items. Any spills or exchanges were recorded. One observer was responsible for two parent-child dyads at any given time.

At the end of the meal, the research coordinator provided the parent with pertinent details regarding the protocol for day 2 including time allotted for survey completion (the following morning), location in which laptops would be set up, and that weight and height measurements would be taken for both parent and child.

A maximum of 5 participants and their families participated on any given study day. This number was a feasible amount per study day based on CCLC chef's capabilities, research staff availability, and classroom space for the dinner buffets.

Day 2:

On day 2, the parent (proxy reporter) and child returned to the CCLC. Trained research staff obtained heights and weight from both parent and child using a stadiometer and a digital scale (see section 5.0.4 for additional details). The study coordinator received verbal child assent for the collection of weight and height, by briefly explaining what measurements were being taken. This process took approximately 5 minutes to complete. Dividers were placed in the room to ensure privacy during measurements, however, in all cases the room was empty and only occupied by one family at a time for measurements. After measurements were taken, children were taken to their classroom. Parents then completed a brief demographic questionnaire, which assessed parent gender, cultural background, level of education, and household income.

Upon completing the demographic questionnaire, parents signed into ASA24-Canada (respondent website). The ASA24-Canada took parents 30-45 minutes to complete. Parents were prompted to recall everything their child consumed in the previous 24 hours (breakfast, lunch, dinner, and snacks). For validation purposes, only the items reported for lunch, afternoon snack, and dinner were compared to true intake, as those were the only meals being observed and documented by research staff.

Despite ASA24-Canada being accessible anywhere with internet access, we chose to have the proxy reporters return to the University to ensure the 24-hour recall was completed the following day. Research staff were available to provide support for any technical difficulties or to answer any computer related questions. At the end of the study visit, the study coordinator asked parents not to discuss the study with other parents of the CCLC so that all parents have the same experience in reporting their child's dietary intake.

Some difficulties were experienced with parents' schedules and completing the survey the following morning at the CCLC, therefore the coordinator did make some exceptions for parents (n= 12) to complete the online 24-hour recall the following day from a different location (e.g. work, home etc.). For parents who were completing the ASA24-Canada off-site, the study coordinator emailed the parent the demographic questionnaire, the ASA24 link, and their username and password. In addition, their weight and height measurements were taken during the evening of day 1. If they hadn't completed the ASA24 by midday a reminder email was sent. The parent/guardian was also provided with a $25 grocery gift card as a token of appreciation for their participation in the study and a thank you for their time.

5.0.4 Assessment of height and weight

Height

Trained research staff assessed parent and child height using a stadiometer (Shorr productions, LLC, Olney, Maryland, USA) where the child and parent were in a standing position, measured to the nearest 0.1cm. Participants were in sock feet or flat slipper styled shoes. Minimal clothing was worn i.e. any heavy sweaters or jackets were removed. Participants stood with heels together, arms at the side, legs straight, shoulders relaxed, and head in Frankfort horizontal plane position.

Weight

Child and adult weight measures were performed using a digital scale (Seca, the Netherlands), with children and adults standing, with arms at the side, in sock feet or flat slippers. Child and parent weight and height measures were used to calculate BMI by taking weight in kilograms (kg) and dividing that by height in meters squared (m^2). Body mass index values were then converted to BMI z-scores to capture children's overall weight status using WHO Anthro 3.2.2 software (2011). BMI z-scores were used as they account for the child's weight while adjusting for age and sex. Child's weight status was determined using the recommended cut-off criteria from WHO. Normal weight status for a child is defined by BMI-for-age between the 15^{th}-85^{th} percentile (>-2<1 SD) (Dietitians of Canada, 2014). Parent's weight status was determined using the recommended classification for adults' weight-for-height from WHO (WHO, 2016).

5.0.5 Sample Size for Validity

G-power 3.1.9.2. statistical power analysis program (Heinrich Heine, 2016) was used to calculate the approximate sample size required to compare true and recalled intake values.

A paired t-test was used with a power of 0.80, a significance level of 0.05, and Cohen's d (effect size) of 0.05, resulting in a required sample of 34 participants. A paired t test was used because of its use in comparing two population means where the two samples in which observations were made can be paired (Laerd Statistics, 2013).

6.0 Statistical Analysis

6.0.1 True Intake

Nutrient information for each menu item was determined using the Canadian Nutrient File (CNF) (Government of Canada, 2016). All menu items nutrient information per 100 grams was entered into an excel workbook. Each participant's true intake (amount consumed) for every food/beverage item was previously recorded. The CNF codes were merged with the nutrient data per participant to determine energy and nutrient content of all items consumed by each child participant.

6.0.2 Recalled intake: ASA24 files

All available ASA24 files were downloaded from the researcher's website. Study meals were identified based on eating occasion (e.g. lunch, afternoon snack or dinner), time reported, and foods reported, all other meals or eating occasions were excluded. The excluded meals included breakfast, morning snack, or evening snacks, as these meals were not observed at the CCLC. A list of all foods and beverages reported by all parent participants was generated and sorted by meal occasion. Two Registered Dietitians reviewed the list to determine whether each item recalled could be considered a match for any of the food or beverages offered during the observed meal occasions. Matches were identified as exact, close, or far. For example, apples were served as the lunch fruit, therefore apple was considered an exact match, a similar fruit such as a pear was considered a close match, but fruit (not sure as to type) or fruit salad were considered far matches for that meal occasion. In order to determine matches, all reported intake was compared to the menu of items served, the true intake files were not utilized during this process (Kirkpatrick et al., 2014). Through this procedure a match key was developed.

6.0.3 Comparing the true intake and ASA24 files

The true intake data was compared to the recalled intake data to determine whether each parent participant recalled a match for the food and beverage items truly consumed by the child. The match key was used to identify, 1) matches (both offered and recalled-exact, close, far), 2) intrusions (not consumed but recalled), and 3) exclusions (consumed but not recalled) for each study participant by meal occasion (Kirkpatrick et al., 2014). Two Registered Dietitians reviewed match identifications for accuracy and consistency (see appendix G for chart used to help ensure consistency in match identifications). Intrusions were further identified as being either internal or external confabulations; internal being an item offered at the CCLC but not truly consumed by the child participant and external being an item not offered at the CCLC and also not consumed by the child participant (Kirkpatrick et al., 2014).

6.0.4 Data Analysis

All statistical analyses were conducted using SPSS, version 23, statistical software for Mac (PASW, IBM, New York, USA). Frequencies were calculated to determine percent matches as well as means and ranges of children's energy and nutrient intakes. Paired t-tests were used to compare true and reported energy and nutrient intakes as well as portion sizes for all food and beverage items. Linear regression models were used to determine whether the accuracy of parental report of total energy, protein, carbohydrate, fat, and portions size differed by parent weight status, parent sex, and child age. Child BMI was also intended to be examined, however, it was not examined as there were no children classified as overweight/obese. A larger sample with greater weight diversity was needed to categorize this variable and therefore, child weight status was not included in analyses. Separate models were run for each dependent variable, i.e., difference between true and recalled intake for total energy, macronutrients (carbohydrates, protein, fat), and portion sizes. Lastly, poison regression models were used to assess whether the number of items reported influenced the number of intrusions (item recalled but not truly consumed) reported. This was done to account for that fact that participants recalling more items may have had a more difficult time in reporting each item. A p value of <0.05 was considered significant.

7.0 Results

7.1 Sample Size

There were a total of 42 completed recalls following study completion, which resulted in an attrition rate of 4.5%. Two recalls were removed from analyses, as one was completed based on parent's dietary intake (rather than the child's), as the mother contacted the study coordinator to make her aware of the error she had made. The other recall did not include any of the foods provided on the observation day, thus it was assumed that the recall was completed for the wrong period of time. Therefore, the study's final sample size was 40 parent-child dyads. The majority of recalls (n=29) were completed for all observed meal occasions (lunch, afternoon snack, dinner), however, 11 parents only reported the dinner meal (e.g. when the parent was present with the child). All statistical tests were run separately for those that reported all meals and those that reported only the dinner meal; however, results did not differ substantively between the groups. Thus, the full sample (n=40) was used for all analyses, except those that examined results by meal occasion. Lunch and afternoon snack were reported by 29 and 27 parents, respectively.

7.2 Parent and child demographics

Parental participant demographics are outlined in **Table 1.** The majority of parents were mothers (84%), and 86% were married. Overall, 53% of parents in the study were normal weight; 38% were classified as overweight, and 6% classified as obese. A majority of the participating families (65%) had an average household income ranging from $100,000-$150,000 or more. This is above the average household income in Canada, where the majority of families (60.8%) have an average income below $100,000 (Statistics Canada, 2016). Additionally, 89% of parents reported having a university graduate degree or having post graduate training. The majority (86%) of the parent-child dyads identified as white, however 22% percent of parents reported not being born in Canada.

The majority (69%) of child participants were female, with a mean child age of 3.5 years **(see Table 2).** Most children (83%) had a normal BMI z-score, 12% were at possible risk for overweight, and 5% were classified as underweight or wasted.

Table 1

Demographic data for parent proxy reporters including sex, level of education, income, race/ethnicity, country of birth, and BMI

Relation to Child	**N=40**
Mother	83.7%
Father	16.2%
Maternal Marital Status	**N=37**
Married	86.4%
Not married, but living with partner	5.4%
Single, never married	2.7%

Divorced	2.7%
Separated	2.7%
Parent Weight Status	**N=36**
Normal Weight	45.0%
Overweight	32.5%
Obese	7.5%
N/A (Pregnant)	15.0%
Total Household Income	**N=37**
$10,000-29,999	5.4%
$30,000 - $49,999	5.4%
$50,000 - $69,999	8.1%
$70,000 - $99,999	16.2%
$100,000 - $150,000 +	64.8%
Level of Education	**N=37**
Post graduate degree or training	72.9%
University graduate	16.2%
College graduate	10.8%
Race-Ethnicity	**N=37**
White	86.4%
Black	2.7%
Chinese	5.4%
Latin American	2.7%
South Asian	2.7%
Born in Canada	**N=37**
Yes	78.3%
No	21.6%

*3/40 did not complete demographic questionnaire

Table 2

Child participant characteristics including, sex, age, and BMI z-score

Child sex	**N=40**
Female	68.8%
Male	31.2%
Child age, years	**N=40**
2.0-2.9	18.2%
3.0-3.9	40.6%
4.0-4.9	39.2%
5.0-5.9	2.0%
Child weight status	**N=40**
Normal	82.5%
Possible risk for overweight	12.5%
Underweight/wasted	5.0%

7.3 Percent matches between true and recalled food/drink items

An overview of exact, close, and far matches for all meals combined is shown in **Table 3.** There were a total of 79.2% matches (exact, close, and far) for all observed meals combined.

An overview of exact, close, and far matches for each meal occasion during the study day (lunch, afternoon snack, and dinner) is shown in **Table 4.** The total proportion of matches was 82.3% for lunch, 81.2% of afternoon snacks, and 77.4% for dinner. Results from paired t-tests suggest no significant differences between percent matches by meal occasion.

7.4 Intrusions and Exclusions

In this study intrusions were identified as any item recalled by the parent proxy but not truly consumed by the child participant. An intrusion was further classified as either an internal confabulation or an external confabulation (Kirkpatrick et al., 2014). An internal confabulation referred to an item that was not consumed, but was a food that was typically offered at the CCLC or was offered during other meal occasions that day. An external confabulation was identified as an item not consumed and never offered within the CCLC (Kirkpatrick et al., 2014). The mean number of intrusions for all meal occasions was 1.2 **(see Table 3).** The highest proportion of intrusions was observed during the afternoon snack meal **(see Table 4).** Internal confabulations were greater than external confabulations for each meal occasion. In addition, the dinner meal had no external confabulations and the intrusions for the dinner meal came solely from internal confabulations **(see Table 4).** Poisson regressions found a significant difference (p=0.001) between total number of items reported and intrusions, suggesting that as the total number of items increases, there is an expected increase of 0.13 intrusions.

Exclusions were items the child consumed that the parent proxy reporter did not recall (Kirkpatrick et al., 2014). The percent exclusions for all meal occasions was 20.8% **(see Table 3).** The highest proportion of exclusions (22.6%) was observed for the dinner meal **(see Table 4).** The most common exclusions were additions to meals or multi-component items **(see Table 5),** for example the apple at lunch or components of the fruit salad at dinner.

Table 3

Mean proportion of exact, close, far matches and exclusions and intrusions reported by parents (n=40) using ASA24-Canada in relation to true (observed) intakes

Exact Matches	60.8%
Close Matches	14.6%
Far Matches	3.8%
All Matches Combined	79.2%
Exclusions (%)	20.8%
Mean Intrusions (n)	1.2
Mean Items Reported (n)	16.8

Table 4

Mean proportion of exact, close, and far matches and exclusions and number of intrusions reported by parents (n=40) using ASA24-Canada for each meal occasion, in relation to true (observed) intakes

Matches	**Lunch (child not with parent) (n=29)**	**Afternoon Snack (child not with parent) (n=27)**	**Dinner (child with parent) (n=40)**
Exact Matches	61.6%	78.8%	57.3%
Close Matches	15.3%	2.4%	17.5%
Far Matches	5.4%	0.0 %	2.6%
All Matches Combined	82.3%	81.2%	77.4%
Exclusions (%)	17.7%	18.8%	22.6%
Mean Intrusions (n)	0.8	0.9	0.3
Mean Items reported (n)	5.5	3.5	10.0

* Two children did not consume afternoon snack

Table 5

Counts of most common exclusions for all meals reported by parents (n=40) using ASA24-Canada in relation to true (observed) intakes

Items	**Count**	**Percent %**
Apple	7	5.0%
Garlic Bread	11	7.9%
PC Maple Balsamic Dressing	7	5.0%
Mandarin Oranges	12	8.6%
Pineapple	11	7.9%
Tomato Sauce with Beans	8	5.7%
Red peppers	8	5.7%

7.5 Mean nutrient intakes and differences between true and recalled dietary intake

The mean and range of energy (kcal) and nutrient intakes for both true and recalled intake are shown in **Table 6.** The mean differences between true and recalled intakes for energy and selected nutrients is shown in **Table 7.** Results indicate significant differences between true and recalled total energy and most nutrient intakes (carbohydrates, protein, fat, saturated fat, monounsaturated fat, polyunsaturated fat, vitamin A, vitamin D, folate, calcium, magnesium, sodium). The negative numbers are indicative of overestimation by the parent proxy reporter. The positive numbers indicate underestimation by the parent proxy reporter. Results suggest that for all significant differences, parent proxy reporters overestimated their child's intake for those nutrients **(see Table 7).** There were no significant differences between true and recalled intakes for, fibre, sugar, and vitamin C **(see Table 7).**

Table 6
Mean true and reported energy and nutrient values with ranges (n=40)

Nutrient	True intake mean	True intake range	Recalled intake mean	Recalled intake range
Energy (kcal)	618.9	210.0-1073.3	860.9	160.6-1491.5
Carbohydrates (g)	85.3	33.9-128.9	110.0	26.8-194.9
Fibre (g)	8.8	1.9-13.2	8.6	1.5-18.0
Sugars (g)	44.5	4.8-575.3	42.5	9.5-107.5
Protein (g)	25.2	6.5-49.2	40.8	4.5-79.2
Fat (g)	20.5	5.1-41.3	30.1	4.0-65.0
Saturated fat (g)	7.0	1.1-16.3	10.8	1.2-22.4
Monounsaturated fatty acids (g)	4.7	0.8-9.2	9.6	1.1-26.2
Polyunsaturated fatty acids (g)	3.5	0.6-7.6	6.1	0.8-14.0
Vitamin A (RAE)	187.9	21.8-399.6	346.6	10.5-685.0
Vitamin C (mg)	85.5	3.7-173.8	84.1	1.0-192.7
Vitamin D (mg)	3.8	0.0-9.9	8.6	0.1-22.5
Folate (ug)	84.8	11.9-177.1	205.7	37.8-461.4
Iron (mg)	3.0	1.4-6.1	4.8	1.3-9.5
Magnesium (mg)	87.3	15.8-160.9	144.6	18.5-329.2
Calcium (mg)	298.9	31.1-753.1	490.8	17.8-1198.6
Sodium (mg)	509.1	153.9-859.0	1347.8	146.5-2483.8
Portions (g)	714.4	265.5-1180.0	902.9	136.3-1653.7

Table 7

Mean true and reported energy and nutrients (n=40)

Nutrient	Difference between true and reported (CI)	P value
Energy (kcal)	-242.0 (-355.0,-129.0)	<0.001
Carbohydrates (g)	-24.6 (-39.8, -9.5)	0.002
Fibre (g)	0.21 (-1.2,1.6)	0.76

Sugars (g)	2.0 (-27.2, 31.2)	0.89
Protein (g)	-15.6 (-21.9, -9.2)	<0.001
Fat (g)	-9.5 (-14.4, -4.6)	<0.001
Saturated fat (g)	-3.8 (-5.8, -1.8)	<0.001
Monounsaturated fatty acids (g)	-4.9 (-6.5, - 3.3)	<0.001
Polyunsaturated fatty acids (g)	-2.6 (-3.7, - 1.5)	<0.001
Vitamin A (RAE)	-158.4 (-219.4, -97.4)	<0.001
Vitamin C (mg)	0.4 (-13.5, -14.4)	0.95
Vitamin D (mg)	-4.8 (-6.9, -2.6)	<0.001
Folate (ug)	-120.8 (-151.1, -90.5)	<0.001
Iron (mg)	-1.7 (-2.5, -1.0)	<0.001
Magnesium (mg)	-57.2 (-80.4, -34.0)	<0.001
Calcium (mg)	-191.9 (-290.2, - 93.5)	<0.001
Sodium (mg)	-838.6 (-1054.6, - 622.6)	<0.001

7.6 Portion intakes and differences

For foods for which a match (exact, close, or far) was recalled the mean difference between true and recalled portion size for all meal occasions was examined. **Table 8** provides the mean and range of both true and recalled portion sizes for all foods and beverages. Portion size of recalled intake was significantly greater (188.5 grams) as compared to true intake **(see Table 8).** A repeated measure ANOVA with sphericity assumed determined that mean portion sizes differed statistically significantly between meal occasions (F (2) = 3.20, P = 0.05). Post hoc tests by meal occasion revealed that a statistically significant difference (P = 0.02) existed between differences in true and recalled portion size estimation for the lunch and dinner meal. Results suggest that there was a larger difference in mean portion estimation (23.4 g) between true and recalled intake for the lunch meal occasion compared to dinner. Additionally, a paired t-test was used to examine mean differences between food and drink portions for entire study day (true and recalled). Results indicate a significant difference (P = <0.001), suggesting that beverage portions had a larger difference in estimation when compared to food portions. **Figure 1** below represents the mean portion amounts of all food and beverage items per child for the entire observation day. The mean portions suggest that on average the mean portion of food items consumed was larger then the mean portion of beverages consumed.

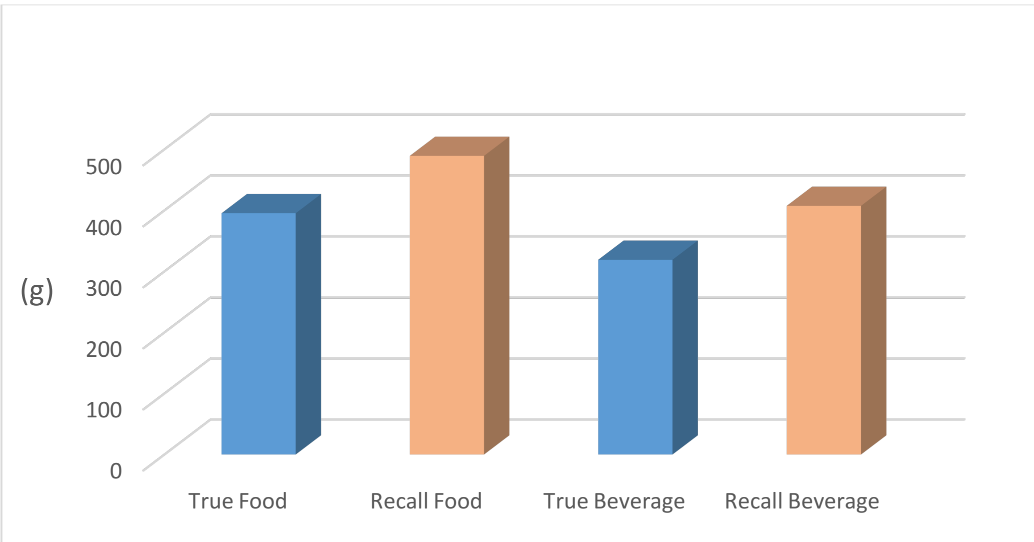

Figure 1: Mean portion intakes for true and recalled food and beverage items

Table 8

Mean and range of portions (g) based on true and recalled intakes (n=40)

True Intake		**Recalled Intake**			
Mean	**Range**	**Mean**	**Range**	**Difference between true and reported (CI)**	**P-value**
714.25	265.5-1180.0	902.9	136.3-1653.7	-188.5 (-322.0, -55.0)	< 0.001

7.7 Adjusting for parent/sex, child age, and parent/child BMI

Linear regressions were used to examine whether the accuracy of parental report differed by parent sex, parent weight status (BMI) or child age. The regression models were conducted for total energy, macronutrients (carbohydrates, protein, fat) and total portions for all food and beverages consumed. Results (see **Tables 9-14**) suggest that the difference between true and recalled intake of total energy, carbohydrate, protein, fat, and portions did not differ significantly by parent sex, parent weight status, or child age. Although not significant, results suggest that the difference between true and parent-reported intake for energy, carbohydrate, and portion size appeared to decrease as child age increased, whereas for protein and fat the difference between true and reported intake increased as the child age increased. Results also suggest that the difference between true and recalled energy intake was larger, and therefore over reported, by parents who were classified as overweight or obese; similar results were found for carbohydrate, protein, and fat intake as well as portion size. The difference between true and recalled energy, carbohydrate, protein, fat intake and portion sizes appeared to be greater when reported by males (fathers) in comparison to females (mothers).

Table 9

Regression estimates for difference in true and recalled energy intake (kcal) by child age, parent BMI, parent sex

Model	Unstandardized B	95% Confidence Interval for B	P-Value
Constant	253.14	-37.66, 543.94	0.09
Child age	-12.60	-276.95, 251.74	0.92
Parent BMI classification (overweight/obesity)	140.94	-125.17, 405.76	0.29
Parent sex (mother)	-103.19	-406.91, 200.52	0.49

N=40

Table 10

Regression estimates for difference in true and recalled carbohydrate intake (g) by child age, parent BMI, parent sex

Model	Unstandardized B	95% Confidence Interval for B	P-Value
Constant	26.31	-9.75, 62.37	0.15
Child age	-2.28	-35.39, 30.83	0.89
Parent BMI classification (overweight/obesity)	26.59	-6.66, 59.84	0.11
Parent sex (mother)	-15.65	-53.46, 22.16	0.41

N=40

Table 11

Regression estimates for difference in true and recalled protein intake (g) by child age, parent BMI, parent sex

Model	Unstandardized B	95% Confidence Interval for B	P-Value
Constant	21.72	6.56, 36.89	0.01
Child age	12.28	-1.75, 26.32	0.08
Parent BMI classification (overweight/obese)	0.83	-13.67, 15.03	0.91
Parent sex (mother)	-13.26	-29.21, 2.69	0.10

Dependent variable = PRO difference (the difference between true and recalled total protein)
N=40

Table 12

Regression estimates for difference in true and recalled fat intake (g) by child age, parent BMI, parent sex

Model	Unstandardized B	95% Confidence Interval for B	P-Value
Constant	13.02	0.43, 25.61	0.04
Child age	4.00	-7.56, 15.56	0.49
Parent BMI classification (overweight/obese)	1.22	-10.39, 12.83	0.83
Parent sex (mother)	-6.31	-19.51, 6.89	0.34

N=40

Table 13

Regression estimates for difference in true and recalled portion size intake (g) by child age, parent BMI, parent sex

Model	Unstandardized B	95% Confidence Interval for B	P-Value

Constant	211.45	-120.88, 543.77	0.20
Child age	-37.01	-342.16, 268.15	0.81
Parent BMI classification (overweight/obese)	159.62	-146.82, 466.06	0.30
Parent sex (mother)	-87.42	-435.93, 261.09	0.61

N=40

8.0 Discussion

Among this sample of parents of preschool aged children, we found that parent proxy reporters can report what food and beverage items their children consume; this was true for meals where the parents were present with their child and for meals when parents were absent. Results also suggest that parent proxy reporters significantly overestimated their children's total energy and nutrient intake, including carbohydrates, protein, fat, saturated fat, monounsaturated fat, polyunsaturated fat, calcium, magnesium, folate, vitamin A, vitamin D, and sodium. Errors in estimating portion size appeared to be a key contributor, as parents significantly overestimated portions consumed.

On average, 79% of the food items reported by parents were close, exact or far matches to the items consumed. This level of percent matches is slightly lower than previous work that attempted to validate an interview administered 24-hour recall amongst preschool children (Klesges et al., 1987). In their study with 30 parents (29 mothers) of preschool age children, Klesges and colleagues found that parents accurately recalled 96% of the items their child consumed (Klesges et al., 1987). This higher level of match accuracy may have been influenced by parental presence during mealtimes. In Klesges' study the children were observed within their home where a parent was present during all meal occasions; thus, they did not examine parents' ability to recall intake when they were absent during the meal. In addition, the 24-hour recall was administered at the end of the observation day compared to our study in which the 24-hour recall was self-administered the following day. Administering a recall for the current day is atypical of a 24-hour recall and potentially created a higher than usual level of matches due to a shorter retention interval and therefore less opportunity for memory decay (Klesges et al., 1987).

While some parents (n= 11) did not report their child's intake for meals when they were not with their child, results from our study suggest that level of accuracy between parent-reported intake and true intake did not differ based on presence during mealtime, as the highest level of matches was found for the lunch meal and the lowest level of matches for the dinner meal. However, it should be noted that the menu items offered during these meals differed, for example the dinner meal consisted of additions (e.g. salad dressing) and multi-component items (e.g. salad and fruit salad) whereas, the lunch meal consisted of only single entity items such as, salmon, broccoli and brown rice. Thus, the difference in the level of matches may have been a result of the items offered during that eating occasion rather than the parents' presence during mealtime. Additionally, it is not known whether the level of matches would be lower for the lunch and snack meals if the 11 parents who only recalled for the dinner meal provided dietary intake data for all observed meals.

Our finding that parents were able to recall their children's food and beverage items regardless of their presence during mealtime differ from Baranowski and colleagues (1991), who found significant differences in accuracy of recall based on mother's presence or absence during meal times. Baranowski and colleagues compared intake accuracy among mothers who were home with their children with mothers whose children were in child care and found that level of accuracy was significantly higher for mothers who were home with their children (Baranowski et al., 1991). The children in Baranowski's study (aged 3-5 years) were similar in age to our child participants (aged 2-5 years), however many other differences existed. In our study, all meals were prepared by kitchen staff at the child care centre. In the study by Baranowski and colleagues (1991) the mothers from the "at home group" prepared meals for their child and therefore likely had an easier time recalling the foods their child consumed. It was unclear whether mothers of the "not at home" group had access to menus or nutrition information from their child care services, whereas the current study's participants had access to this information. It is possible that the availability of menu information contributed to a greater level of accuracy for meals in which parents were absent. Baranowski and colleagues (1991) also had a more diverse sample, with greater variability in socioeconomic status and ethnic background (Caucasian, Mexican, Black). They did not find any differences regarding accuracy of recalls by socioeconomic status, however they did find differences among racial subgroups, with Caucasians and Mexicans consistently under reporting and Blacks over reporting their children's intake (Baranowski et al., 1991). Thus, differences between our findings and those of Baranowski and colleagues (1991) may be due to differences in the racial diversity of study populations.

Our study identified parents having greater difficulty recalling items from multi-component dishes, such as an item from the mixed green and fruit salad, or items that were addition to meals, such as the apple, garlic bread, and salad dressing. Our findings are similar to an ASA24 validation study among adults, which found a high proportion of exclusions being ingredients or additions to multi-component dishes (Kirkpatrick et al., 2014). Our results also coincide with findings from Linneman and colleagues (2004) that suggest that parent reporters have difficulty recalling food items from mixed dishes. While the majority of exclusions from multi-component dishes, such as an item from the mixed green salad, would have little effect on estimates of overall intake, as they are consumed in such small amounts, our results suggest that identifying strategies that could help parents identify items/ingredients in multi-component dishes, e.g., obtaining recipes, may increase the accuracy of parent proxy report.

Parent proxy reporters overestimated their children's dietary intake by an average of 242 calories (28%) across all observed meal occasions. Our findings are similar to previous 24-hour recall validation studies using parental proxy reporting that found significant overestimation in recalled intake compared to true intake, with overestimation ranging from 7-29% (Basch et al., 1990, Fisher et al., 2008, Montgomery et al., 2005, Reilly et al., 2001). These studies also found an overestimation of most nutrients and all food groups (Basch et al., 1990, Fisher et al., 2008), which is similar to our findings that indicate an overestimation of most nutrients except vitamin C, fibre and sugars. The reason for such substantial overestimation is unknown, however our findings suggest that it may have been influenced by errors in portion size estimation.

Our findings indicate error in portion size estimation by parental report, with portion size amounts being substantially overestimated. Other studies reflect similar findings, suggesting that overestimation of young children's dietary intake may be directly influenced by errors in portion size estimation (Basch et al., 1990, Fisher et al., 2008, Klesges et al., 1987). Portion size estimation error can be influenced by multiple factors, including the type of food requiring estimation (Trolle et al., 2013, Lillegaard et al., 2005). Our study found that there was a significantly greater overestimation in beverage items as compared to food items, suggesting that parents experienced more difficulty determining portion sizes for beverages. Our findings are similar to Flood and colleagues (2014) who tested the relative validity of a FFQ and found that parent reporters had difficulty recalling absolute intakes of water and sugar sweetened beverages (SSBs) amongst their 2-5-year-old children. They estimated larger amounts of water/SSB intake using the FFQ compared to the food records (Flood et al., 2014). Bennett and colleagues (2009), in their study that assessed the relative validity of the Eating and Physical Activity Questionnaire (EPAQ) against three 24-hour recalls using parental proxy reporting, found that parents underestimated their children's beverage consumption. Parents also expressed having difficulty estimating their child's water consumption when in childcare, as most children are sent with reusable bottles that are filled up throughout the day (Bennett et al., 2009). Although results are somewhat mixed across studies, taken together, the results suggest that parents may have difficulties in accurately reporting their child's beverage intake. It is possible that parents experience difficulty conceptualizing volume amounts, leading to over- or under estimation. Ad libitum consumption of water at child care may make estimating water intake particularly difficult among children who attend child care. Limited research has examined the accuracy of recall based on the type of food/beverage item consumed in this population. Additional research among preschool aged children is needed to further understand whether certain foods, beverages or food groups influence the accuracy of portion size estimates for parental proxy reporters.

Our study found that parents had a significantly larger error in portion size estimation for the lunch meal as compared to dinner. For the dinner meal, parents served their child their foods from the buffet line and were present with their child at the meal. Parents' portion size estimation for the lunch meal when they were not present with their child may have reflected what they typically serve their child at home compared to what they were served at the child care centre. The atmosphere in which the child eats may also influence their intake; the child may typically consume more or less at home versus at childcare and therefore parents estimation of intake may be influenced by what is typical in their home environment. In addition, preschool children typically eat small portions. Conceivably, parents may experience difficulty in estimating such small portions (e.g. 2 slices of cucumber), which, requires greater conceptualization and perception. Another potential reason for portion size errors could be the portion images used in ASA24-Canada. Although many portion sizes are available with the tool; the tool was not specifically developed for use with preschool aged children using parental proxy reporting. Thus, the portion sizes provided may be larger than typically eaten by young children, which may have led to overestimation in portion size (Olukoton & Seal, 2015). Future research is needed to identify strategies to help improve accuracy of portion size estimates for parent proxy reporters, including possibly providing parents with 3D food and beverage visuals and training on portion size estimation prior to self-administration of the 24-hour recall.

The accuracy of reporting of percent matches, energy, macronutrients and portion size did not differ by parent weight status, parent sex, or child age. However, it should be noted that the current study's sample size was small and not powered for such analyses. The small small size created limitations in detecting subgroup differences in reporting. However, the analyses was conducted for exploratory purposes. Although some studies identified accuracy of recall being influenced by child weight status (Bornhorst et al., 2013, Fisher et al., 2000), we were unable to examine such influences as only 12% of the children in our sample were classified as at risk for overweight or obese and no children were classified as overweight or obese.

Some literature supports our findings that overestimation of dietary intake is not influenced by parent weight status (Reilly et al., 2001, Johnson et al., 1996). However, others have found parent BMI influences the accuracy of parent proxy report (Bornhorst et al., 2013). For example, Bornhorst and colleagues (2013) found that parent BMI was higher in those who underestimated their 2-9-year-old child's intake using a computerized 24-hour recall (Self Administered Children and Infants Nutrition Assessment – SACINA). They also found that parents who reported being very concerned about the child becoming overweight were less likely to over report (Bornhorst et al., 2013). Bornhorst and colleagues' results suggest that accuracy of dietary intake report may be influenced by the parents' BMI as well as their perception of the dietary information being collected to be a reflection of their child's weight (Fisher et al., 2000). Our study found that the difference between true and parent-reported intake was not significantly influenced by parent weight status (BMI). Future research, with a larger sample size and greater diversity in weight status subgroups should explore whether accuracy of parent report is influenced by parent and child weight status.

Although not significantly different, we found greater differences between true and recalled intakes when reported by fathers. Few studies have compared mother and father's ability to report children's dietary intake. Eck and colleagues (1989) directly observed one meal among families with 4-9-year-old children in a study set cafeteria. All foods were weighed and recorded to obtain true intake. The following day, nutritionists conducted interviewer-administered 24-hour recalls with each parent individually and with the parents and the child together. They found higher correlations between true and recalled intake for fathers (0.77) compared to mothers (0.63), with fathers having greater levels of misreporting based on the food item (e.g. significantly over reported fruit intake and underreported bread intake). It is possible that our study did not include an adequate number of fathers to identify any differences in reporting by sex of the parent. Future research with larger samples of fathers is needed to elucidate whether sex of the parent influences ability to report child's intake. It would also be interesting to explore how level of engagement in child's feeding, which may differ by parent sex, is associated with ability to report child's intake.

Our study did not find that parents' ability to accurately report their children's intake differed significantly by child age; however, we did find a non-significant association suggesting that the difference between true and recalled intake decreased for total energy and carbohydrate intake and portion size decreased as child age increased. Montgomery and colleagues (2005), identified child age as an influential factor in parental accuracy of dietary intake. They found significant energy overestimation (11%) using parental proxy reporting for children 3-4 years and non-significant energy overestimation (4%) in children 5-7 years (Montgomery et al., 2005). Other studies have shown similar results, suggesting that parent report of intake improves with child age (Burrows et al., 2010, Burrows et al., 2013, Eck et al., 1989, Livingstone et al., 2000). This improvement as child ages may be due to the fact that their child's intake also increases, perhaps making portion size easier to estimate. Research has also found that older children are able to provide input on their dietary intake in conjunction with parent report (Burrows et al., 2010, Burrows et al., 2013, Eck et al., 1989, Livingstone et al., 2000), which may increase accuracy in reporting. Our sample had a relatively narrow age range, from 2.0-5.9 years of age making it difficult to assess any differences in reporting based on age. However, results from previous studies suggest that parents' ability to report child's intake does improve as the child ages.

Overall, overestimation is a common finding amongst various 24-hour recall studies assessing preschoolers' dietary intake, suggesting that parents reporters tend to over report their young children's intake (Burrows et al., 2010). Specific factors that contribute to this overestimation are not fully clear and should be examined in future studies.

In summary, our results suggest that parents can report the majority of food and beverage items their preschool children consume, as indicated by 79% matches between true and recalled items. Our results suggest that parents have a reasonable concept of what their preschool children consume when using ASA24-Canada, this was further supported by the minimal intrusions identified. However, it appears that parent reporters have the most difficulty recalling items from multi-component dishes or additions to meals. Additionally, our study identified significant overestimation of total energy, nutrient, and portion intakes thus making the tool only accurate at the group level. Furthermore, the significant overestimation appeared to be due to errors in portion size estimation, with portion estimation having poorer accuracy for beverage items compared to food items and when the parent was absent during the meal occasion.

8.1 Strengths

Our study had several strengths. To our knowledge, it is the first study to assess the validity of an online 24-hour recall in North American preschool aged children using parental proxy reporting. Recent literature has expressed a need for valid dietary assessment methods that utilize modern technology. Our use of modern online technology to capture detailed dietary intake data in preschool children using parental proxy reporting is novel. A systematic review by Olukotun and Seal (2015) highlighted the need to test the appropriateness of adult dietary assessment tools for estimating children's intake. Our study addresses this need by testing ASA24, which was previously validated among adults (Kirkpatrick et al., 2014), for use in preschool children using parental proxy reporting. Our study also builds on previous parent-proxy 24-hour recall validation research (Baranowski et al., 1991) by assessing parents' ability to recall preschool children's' dietary intake when they are present and absent during meal occasions.

Our study used direct observation to allow for true validity to be tested. Direct observation is a known 'gold standard' method for collecting and comparing dietary intake data. However, many recent dietary assessment studies have focused on establishing relative validity by comparing one dietary assessment tool to another, for example a FFQ to a 24-hour recall. Findings from these studies are limited given that the methods don't allow for true validity to be established.

Our choice to conduct this study in a child care setting allowed us to minimize reactivity through the use of unobtrusive observation and increase generalizability of our findings, as a large amount (46%) of Canadian children are in some form of child care in which parents are absent during meal time (Baxter et al., 2009, Statistics Canada, 2015).

8.2 Limitations

When interpreting our results, several limitations should be considered. First, the parent participants were of high socio-economic status (65% reported annual household incomes of $100,000 or more) and the majority were well educated (73% reported completing post graduate training or degrees). Similarly, the majority of our sample identified as 'white'

(86%). Thus, the results may not be generalizable to more socioeconomically and ethnically diverse populations. Second, eleven of the forty participants only recalled for the dinner meal, which was the meal occasion in which they were present with their child. Although the level of matches for the dinner meal did not differ between parents who only reported for dinner and those that reported for both lunch and dinner, it is unknown whether this study's results would have differed if all forty parents reported for all study meals. It is possible that parents felt uncomfortable reporting what their child ate when they were not present or perhaps parents need more explicit instructions on how to report child's intake than what is currently provided in the tool. When using the ASA24 to assess children's dietary intake, practitioners or researchers may need to prompt parents to recall child's intake for all meals. Fourth, our sample had little diversity in both parent and child weight status, as classified through BMI, making it difficult to explore whether parent/child weight status influenced reporting. Future research should include a larger sample size among families with diverse weight statuses to thoroughly explore such associations. Lastly, our study population had reasonably good access to dietary intake information at the childcare centre, as weekly menus were visible in multiple locations and parents had the potential opportunity to access personal intake information from the HiMama app (Hi Mama Inc. 2016, Canada). The extent to which this information was accessed was not assessed; thus, the influence of this information on study results is unknown. Future research should explore how often such information is available and accessed by parents and the influence of this information on parents' ability to accurately report their child's intake.

8.3 Implications for future research

While this research aimed to fill gaps in existing literature by testing an online self-administered 24-hour recall for use in children, it also serves as foundation for future research. Future research in this area should focus on improving portion size estimation for preschool aged children. Different techniques in improving portion size estimation error should be assessed, which may include exploring the effects of brief training on portions prior to tool administration and/or use of 3D food models or measuring cups in conjunction with online images. Existing research with parents of preschool aged children suggests that these strategies may improve the accuracy of 24-hour recalls in estimating intake of preschool children (Fisher et al., 2008). Additionally, future research should explore whether accuracy of parent report differs by certain foods, beverages, or food groups. Finally, it would be important to assess whether these results can be replicated among populations with different socioeconomic and race/ethnic backgrounds and among different subgroups (e.g. weight status subgroups).

8.4 Implications for Practice

As shown in previous research assessing dietary assessment tools using parent proxy reporters (Basch et al., 1990, Reilly et al., 2001, Montgomery et al., 2005), this study's results suggest that while parents can report what food and beverage items their child consumes, they tend to over estimate total energy and nutrient intake. Therefore, the ASA24 tool, similar to other dietary assessment tools, is appropriate for use in research settings where group level nutrient data is collected. Clear instructions regarding how to complete the tool and portion size training prior to the 24-hour recall administration may be needed to help ensure parents report for all their child's meals (even when not with their child) and help improve portion size estimation. Given our finding that parents overestimate their child's intake, the ASA24 tool may not be suitable for evaluating a child's individual level intake, for example in a healthcare setting.

9.0 Conclusion

In summary, this study assessed the validity of an automated self-administered 24-hour recall (ASA24-Canada) for capturing the true dietary intake among preschool aged children (2-5 years) using parent proxy reporting. It also explored whether parent/child characteristics (BMI, gender, age) influenced the accuracy of parent report. This was a direct observation feeding study that was completed amongst 40 parent-child dyads, recruited from the Child Care and Learning Centre (CCLC) on the University of Guelph campus. ASA24-Canada was found to be valid at the group level, as these findings suggest that parents are reliable sources of information about what food and beverage items their children eat and drink.

The tool may not be valid at the individual level, as there was significant overestimation of total energy and most nutrient intakes, as well as portion sizes. Accuracy of reporting did not appear to differ based on parent and child characteristics (BMI, sex, age); thus, substantial errors in portion size estimation appeared to be the main contributor to parent proxy over reporting. Future research should explore approaches to help improve portion size estimates for parent proxy reporters.

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Appendices:

Appendix A – Recruitment Poster

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Families with Preschoolers Needed!

What is the purpose of this study?
Our research team is interested in testing ways to measure what young children eat.
Participant details:
We are looking for 40-50 families with children age 2-5 years to participate in this observation study.

What is involved with the study?
We will need your participation for 2 hours over 2 consecutive days at the CCLC. On day 1 a research assistant on our research team will observe your child during their typical lunch meal and afternoon snack. On that same day you will be invited to join your child for a buffet styled dinner at the CCLC, **all beverages and food will be provided.** A research assistant will discreetly observe you and your child eat dinner. This will take approximately 1 hour or your time.
On day 2 we ask you join us back at the CCLC to complete a 30-minute online survey that asks questions about what your child eats. You can discuss what time on day 2 would be most convenient for you with the study coordinator. You and your child's height and weight will also be taken on day 2 in a private area and you will be asked to complete a brief demographic questionnaire. This will take approximately 20 minutes of your time.
Payment for Participation
To thank each family for their time and participation, they will receive a **$25 grocery store gift card.**

To participate or ask questions

If you would like to participate or have any questions, you can contact Angela Pavarin – De Luca, Project Director, at (416) 527-3106, or via email at pavarina@uoguelph.ca
You can also contact Jess Haines, the Principal Investigator, at (519) 824-4120 ext. 53780, or via email at jhaines@uoguelph.ca

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Appendix B – Screening Questionnaire

Screening Questionnaire: Child Meal Time Observation Study

1. Are you 18 years or older?

    ☐1 Yes
    ☐2 No

2. Do you have child(ren) who are between 18 months and 5 years old?

    ☐1 Yes
    ☐2 No

3. Do you feel comfortable writing and reading in English ?

    ☐1 Yes
    ☐2 No

4. Do you or your child have any food allergies or dietary restrictions?

    ☐1 Yes → Please describe: ________________________________
    ☐2 No

5. Have you had any formal education or training in nutrition?

    ☐1 Yes → Please describe: ________________________________
    ☐2 No

Appendix C – Consent Form

Department of Family Relations and Applied Nutrition
College of Social and Applied Human Sciences

Consent Form: Young Children's Meal Time Behaviours – Observational Study

Project Director: Dr. Jess Haines, PhD, RD. Department of Family Relations and Applied Nutrition, University of Guelph, 519-824-4120 ext. 53780

Research Assistants: Angela Pavarin – De Luca (MSc Candidate)

You are being asked to participate in a study that involves our research team observing your child for a lunch, snack, and dinner meal. Researchers at the University of Guelph are interested in testing ways to measure what young children eat. Read this form carefully as it tells you important information about the study and your rights as a subject if you choose to participate. A member of the research team will also talk to you about the study and answer any questions you may have. You should not sign this form unless you understand what is written and have all of your questions answered.

What is the purpose of this study?

Our research team is interested in testing ways to measure what young children eat. We hope that by observing your child's mealtimes at the CCLC we can learn more about how to effectively measure dietary intake in young children.

Why am I being asked to participate? To help us test ways to measure what young children eat. You are also being asked to participate in this study because your child is between the ages of 2 and 5 years.

How long will I take part in this research study?

In total, this study will take approximately 2 hours to complete.

What will happen in this study?

This study will take place over 2 days.

On day 1 of the study a research assistant will observe your child over lunch and snack times at the CCLC. That same evening (Day 1) you will be asked to join your child for dinner at the Child Care and Learning Centre (CCLC). The dinner meal will also be observed by a research assistant. All food and drink will be provided for your family. This will take approximately 1 hour of your time.

On day 2 you will be asked to return to the University to complete an online survey that asks questions about what your child eats. This survey will take approximately 30 minutes of your time. Our research assistant will also be taking the weight and height of you and your child in a private room and you will be asked to complete a small demographic questionnaire about you and your child. This will take approximately 20 minutes of your time.

What are the possible risks and discomforts of taking part in this study?

Your child will be observed during their lunch and snack time meal at the CCLC and you and your child will be observed during the buffet dinner at the CCLC by our research team. We are doing this in order to explore ways to measure what children eat. Your child's or your name will not be used during any of the observations and a participant ID number will be used to identify your child.

On day 2 of the study you will be asked to complete an online survey that asks you about what your child eats. Some of the questions asked on the survey may make you uncomfortable, such as questions about your child's personal eating behaviours and eating habits. You can choose not to answer any questions that make you feel uncomfortable.

On day 2 a research assistant will also be taking you and your child's weight and height. This may make you feel uncomfortable; however, please note that this will be done in a private room. You can choose not to have you or your child's weight and height taken. You will also be asked to complete a short demographic questionnaire about you and your child. You can choose not to answer any questions that make you feel uncomfortable.

There is a small risk that someone other than research staff will see your completed survey. Federal law requires us to protect the privacy of health information that identifies you. To protect your privacy, your completed surveys and your child's observation notes will only have code numbers on them instead of your names. The online survey data will be kept on an encrypted password protected laptop that only researchers will have access to. Any forms will be stored in a locked filing cabinet in a locked research office. All data will be stored for 5 years.

Federal or Provincial law may require the study team to give information to government agencies, for example, to prevent harm to you or others, or for public health reasons. If you tell us or we learn something from the observations that makes us believe that your child or others have been or may be physically harmed, we may be required to report that information to the appropriate agencies.

What are the benefits of participating in this study?

There are no direct benefits to participating in this study. Other researchers who are interested in measuring children's diet to identify how diet is related to health outcomes may benefit from the better understanding of how to measure children's diet.

Upon completion of project, you will have the ability to receive a summary of the findings of the current study, should you wish to know the results. Interested participants can provide the study coordinator with their name and email if they wish to receive a summary of the study's findings. The study coordinator will contact interested participants in the future describing the overall findings of the study.

What happens if I decide not to take part in this research study?

Your participation in this study is completely voluntary. If you decide not to participate in this study, it will not affect any current or future relations you or your child may have with the University of Guelph or the CCLC.

Do I have the right to withdraw from the study?

If you agree to participate in this study, you are free to withdraw at any time. The decision to withdraw will not affect any current or future relations you or your child may have with the University of Guelph or the CCLC. You may also remove your data from the study so we cannot use any of your data in our analyses.

You can withdraw from this study at any time by writing to the Principal Investigator, Jess Haines, at The Department of Family Relations and Applied Nutrition, Room 226, Macdonald Stewart Hall, University of Guelph, 50 Stone Road East, Guelph, ON N1G 2W1 or by calling her directly at 519-824-4120 ext. 53780.

Will I be paid to be in this research study?

If you decide to participate in this study, you will receive a $25 dollar grocery store gift card on day 2, after completing the online survey.

Will it cost me anything to participate in this study?

There will be no charge for you or your family to participate in this study.

If I have questions or problems, whom should I contact?

The principle investigator for this study is Jess Haines, PhD, RD, in the Department of Family Relations and Applied Nutrition at the University of Guelph. If you have any questions, please feel free to contact her now, or at any time during the study. Her phone number is (519) 824-4210 ext. 53780. You can also contact the project coordinator, Angela Pavarin – De Luca at (416)-527-3106 or at pavarina@uoguelph.ca

If you want to speak with someone not directly involved in this study, please contact Sandra Auld, Research Ethics Officer at 519-824-4120 ext. 56606 or at sauld@uoguelph.ca. You can talk to her about:

- Your rights as a research participant
- Concerns about the research
- A complaint about the research
- Any pressure you feel to take part or continue in the research study

REMOVE THIS SHEET FROM THE BACK OF CONSENT FORM & FILE IN PARTICIPANT FOLDER

If you understand the information we have given you, and would like to take part in this research study, then please sign below:

PLEASE SIGN HERE FOR YOUR PARTICIPATION IN THE STUDY:

Consent for ADULT Participation (parent 1):

I wish to participate in this project.

Print name: ____

____
Signature

____
Date signed

Consent for Child Participation:

I wish to participate in this project.

Print name: ____

____
Parent Signature

____
Date signed

<u>Witness</u>

____
Printed Name

____
Signature

____
Date

Appendix D – Ethics Certificate

UNIVERSITY of GUELPH

RESEARCH ETHICS BOARDS

Certification of Ethical Acceptability of Research Involving Human Participants

APPROVAL PERIOD:	July 23, 2015
EXPIRY DATE:	July 23, 2016
REB:	G
REB NUMBER:	15JN028
TYPE OF REVIEW:	Delegated Type 1
PRINCIPAL INVESTIGATOR:	Haines, Jessica (jhaines@uoguelph.ca)
DEPARTMENT:	Family Relations & Applied Nutrition
SPONSOR(S):	Ministry of Economic Development and Innovation
TITLE OF PROJECT:	Validation of ASA24-Canada (automated self-administered 24 hour dietary recall) in children aged 2-5 years old using proxy reporters

The members of the University of Guelph Research Ethics Board have examined the protocol which describes the participation of the human participants in the above-named research project and considers the procedures, as described by the applicant, to conform to the University's ethical standards and the Tri-Council Policy Statement, 2nd Edition.

The REB requires that researchers:

- Adhere to the protocol as last reviewed and **approved** by the REB.
- Receive approval from the REB for any **modifications** before they can be implemented.
- Report any **change in the source of funding.**
- Report **unexpected events or incidental findings** to the REB as soon as possible with an indication of how these events affect, in the view of the Principal Investigator, the safety of the participants, and the continuation of the protocol.
- Are responsible for **ascertaining and complying with all applicable legal and regulatory requirements** with respect to consent and the protection of privacy of participants in the jurisdiction of the research project.

The Principal Investigator must:

- Ensure that the ethical guidelines and approvals of facilities or institutions involved in the research are obtained and filed with the REB prior to the initiation of any research protocols.
- Submit a **Status Report** to the REB upon completion of the project. If the research is a multi-year project, a status report must be submitted annually prior to the expiry date. Failure to submit an annual status report will lead to your study being suspended and potentially terminated.

The approval for this protocol terminates on the **EXPIRY DATE**, or the term of your appointment or employment at the University of Guelph whichever comes first.

Signature: Date: July 23, 2015

L. Kuczynski
Chair, Research Ethic Board-General

Page **1** of **1**

Appendix E – Study Menu

Lunch

- Baked Salmon Filets
- Tofu *
- Brown Rice
- Steamed Broccoli
- 2 % milk
- Water *
- Apples

Snack

- Cheddar cheese slices
- Premium plus crackers
- Hummus *
- Cheecha puffs *
- Water

Dinner

- Pasta ** with tomato sauce and ground meat
- Pasta ** with tomato sauce and red kidney beans
- Mixed green salad (with cucumber, carrots, red and green peppers)
- Garlic bread
- Fruit salad (pineapple, mandarin oranges, and red grapes)
- Snikerdoodle cookies
- Chocolate chip cookies
- 2% milk
- Water
- Orange juice (box)
- Apple juice (box)
- Mixed fruit juice (box)

* Substitutions made available for those with allergies and dietary restrictions
** Gluten free options

Appendix F – Validation Protocol

ASA24- Canada Validation Protocol

Initial documents:
What to email participants:

→ Participant File, which includes:
- Consent Form
- Time sheet with details for day 1 and day 2

Day before scheduled observation commences:
- Email parent/guardian and remind them that their child will be discretely observed during the lunch hour the following day
- Remind parent of dinner time and where the RA will be meeting them

Day 1 → Observation of lunch meal:
What To Bring:
- Excel spreadsheet (contains participant ID and columns for food item weights, plate waste weights, and true intake calculation)
- Participant ID stickers
- Observation note taking form

What To Do:

1) **Measurements**
    - Weigh (using a digital food scale) each food item being plated for child participant prior to serving
    - Record measurements on excel spreadsheet – 2 measurements taken per food item to ensure accuracy. If the 2 measurements significantly differ take a third and use the average of the 2 closest values.
    - Place participant ID sticker on bottom of their plate
2) **Observation**
    - RA to observe child during lunch meal and take note of any spillage or food/drink item exchange that may occur between peers – observation notes will be tracked on observation note taking form
3) **Plate collection**
    - RA to collect child's plate when finished and measure plate waste using digital food scale

- Record measurements on excel spreadsheet – 2 measurements taken per food item to ensure accuracy
- RA to calculate true intake of child participant: weight of food item served - amount of food item left over (plate waste)
- Record true intake of each food item for each child participant on excel spreadsheet

Day 1 → Observation of afternoon snack
What To Bring:

- Excel spreadsheet (contains participant ID and columns for food item weights, plate waste weights, and true intake calculation)
- Participant ID stickers
- Observation note taking form

What to do:

1) **Measurements**
   - Weigh (using a digital food scale) each food item being plated for child participant prior to serving
   - Record measurements on excel spreadsheet – 2 measurements taken per food item to ensure accuracy. If the 2 measurements significantly differ take a third and use the average of the 2 closest values.
   - Place participant ID sticker on bottom of their plate
2) **Observation**
   - RA to observe child during snack time and take note of any spillage or food/drink item exchange that may occur between peers – observation notes will be tracked on observation note taking form
3) **Plate collection**
   - RA to collect child's plate when finished and measure plate waste using digital food scale
   - Record measurements on excel spreadsheet – 2 measurements taken per food item to ensure accuracy
   - RA to calculate true intake of child participant: weight of food item served - amount of food item left over (plate waste)
   - Record true intake of each food item for each child participant on excel spreadsheet

Day 1 → Observation of dinner meal
What To Bring:

- Excel spreadsheet (contains participant ID and columns for food item weights, plate waste weights, and true intake calculation)

- Participant ID stickers
- Observation note taking form

What to do:

1) **Measurements**
    - Weigh (using a digital food scale) each food item tray to be placed in child buffet line prior to serving
    - Record measurements on excel spreadsheet – 2 measurements taken per food item to ensure accuracy. If the 2 measurements significantly differ take a third and use the average of the 2 closest values.
    - Place ID stickers on each child participant plate and set dinning room table for participant and their parent

2) **Greet Families**
    - Parents to be greeted by research assistant (RA) and walked to their dining room table
    - RA will explain to the parent that there are 2 buffet lines – 1 for the child and 1 for the parent to take food from. The parent will be asked to assist their child first and then collect their food items afterwards

3) **Observation**
    - RA to observe child and parent during dinner meal and take note of any spillage or food/drink item exchange that may occur between families – observation notes will be tracked on a observation note taking form

4) **Between meal measurements**
    - After each parent helps their child collect their dinner the food items tray's they selected food from will be discretely removed from the buffet line and weighed (this is necessary to measure how much of each food item was selected by the child participant)
    - Record measurements on excel spreadsheet – 2 measurements taken per food item to ensure accuracy
    - After measurements are taken the tray will be returned to the buffet line and ready for the next parent-child dyad (a different family will be walking through the buffet lines every 10-15 minutes to allow for weighing time)

5) **Plate waste collection**
    - RA to collect child's plate when finished and measure plate waste using digital food scale
    - Record measurements on excel spreadsheet – 2 measurements taken per food item to ensure accuracy

- RA to calculate child participants true intake: weight of food item served - amount of food item left over (plate waste)
- Record true intake of each food item for each child participant on excel spreadsheet

6) **Day 2 reminders**
   - RA will escort family out and remind parent/guardian of timing for online survey completion the following day
   - Parent is to return to the CCLC to complete survey online (using a laptop from the research team).

Day 2 → ASA24-Canada online completion:

What to Bring:

→ Participant file, which includes:

- Consent form
- Demographic questionnaire (online)
- Participant incentive form
- Height/weight intake forms (for parent and child)

1) **RA to greet parents/guardians (proxy reporters)**
   - RA will meet parent/guardian at CCLC after they have dropped of their child and bring them to a private room with laptops where the ASA24-Canada will be completed

2) **RA to introduce ASA24-Canada**
   - RA will explain to parents/guardians (proxy reporters) that we are testing an online tool developed by the National Cancer Institute (NCI) that is designed to allow individuals to recall the foods they ate the day prior
   - The parents/guardians are to report all meals (breakfast, lunch, dinner) and snacks for their 2-5 year old child participating in the study – to the best of their abilities

3) **RA to take child and parent/guardian height and weight**
   - Height to be taken on stadiometers and recorded on participant height/weight form in a private area
   - Weight to be taken on digital scale and recorded on participant height/weight form in a private area
   - If child is having difficulties remaining still, measurements need to be taken twice to ensure accuracy – if both values are not similar, take a third measurement and use average of the 2 closest values
   - Child assent to be collected prior to weight and height measurements being taken

* Weight and height to be measured in private area within the CCLC

4) RA to provide incentive

- The RA will provide parent/guardian with $25 grocery store gift card and thank family for taking time to participate in the study
- RA to collect signature that incentive was received – form to be inserted into participant file

5) RA to discuss confidentiality

- RA to explain to parent participant that the research team wants everyone participating in the study to have the same experience they did on day 2 when completing the online survey (ASA24 – Canada), therefore they are asked not to discuss the study with any other parents in the CCLC for the next 30 days to ensure everyone has the same experience.

Appendix G – Coding Chart

Menu Item	Exact Considerations	Close Considerations	Far Considerations
Salmon, baked with mustard and maple sauce	-Salmon, baked or broiled (SautÌ©ed; saltwater trout) -Salmon, cooked, NS as to cooking method -Salmon, steamed or poached (Saltwater trout) -Salmon, baked or broiled W/ VEGETABLE OIL, NFS (INCLUDE OIL, NFS) -Fish, salmon, pink (humpback), baked or broiled	-Cod, baked or broiled (Sauteed)	N/A
Brown rice, cooked	-Rice, brown, cooked, regular, fat added in cooking	-Grains, rice, white, long-grain, regular, cooked	-Rice with vegetables, tomato-based sauce (mixture)
Broccoli, steamed with garlic	-Broccoli, cooked, from fresh, NS as to fat added in cooking (Broccoli, NFS) -Broccoli, cooked, from fresh, fat not added in cooking	Any cooked green vegetable -Spinach, cooked, from fresh, NS as to fat added in cooking (Spinach, NFS) -Peas, green, cooked, from frozen, NS as to fat added in cooking	Other cooked vegetable, raw vegetables considered no match -Carrot, raw
2% milk * same for afternoon snack and dinner meals	Milk, fluid, partly skimmed, 2% M.F.	Milk, fluid, whole, pasteurized, homogenized, 3.25% M.F. Milk, NFS Milk, fluid, partly skimmed, 1% M.F.	No far matches identified for milk
Goat's milk (for one child)	-Milk, fluid, goat, enriched, whole	N/A	N/A
Tofu	-Tofu, regular; soft or firm, prepared with magnesium chloride (nigari)	N/A	N/A
Water (for those who	Water, municipal	Water, mineral,	N/A

couldn't have milk) *same for afternoon snack and dinner meals		POLAND SPRINGS"	
Macintosh apple with the skin	-Apple, raw, with skin	-Fruit salad, fresh or raw (Fruit salad, NFS) -Fruit, NS as to type -Pear, raw, with skin	N/A
Cheese – cheddar	-Cheese, cheddar -Cheese, processed product, cheddar, slices	-Cheese, Swiss	N/A
Premium plus crackers	-Cracker, standard snack-type -Cracker, saltine (also oyster, soda, soup), whole wheat (includes multigrain) -Cracker, wheat -Cracker, saltine (also oyster, soda, soup)	-Cracker, whole-wheat -Crackers, rice (Rice paper)	N/A
Hummus, homemade	-Hummus, homemade	N/A	N/A
Che cha puffs (potato puffs)	-Nothing noted as exact- would have accepted potato puffs	-Potato puffs, cheese-filled	N/A
Fruit muffin, homemade (for one classroom snack)	-Nothing noted as exact, would have accepted muffin, fruit	-Muffin, bran with fruit, low fat	N/A
Chocolate chip cookie, homemade (for one classroom snack)	-Cookie, chocolate chip, commercial, regular, higher fat -Cookie, chocolate chip, made from home recipe or purchased at a bakery	-Cookie, sugar, commercial	N/A
Pasta (spaghetti)	-Spaghetti with tomato sauce and meatballs or spaghetti with meat sauce or spaghetti with meat sauce and meatballs -Macaroni, cooked, NS as to fat added in cooking -Spaghetti, cooked, NS as to fat added in cooking	N/A	-Soup, mostly noodles (Spaghetti soup, oriental noodle soup) -Macaroni, creamed Macaroni, creamed W/O FAT

Tomato sauce with ground beef – veggies in sauce (onion, mushroom, carrots)	-Spaghetti sauce (Marinara, cacciatore or pizza sauce, spaghetti sauce with mushrooms) -Ground beef or patty, cooked, NS as to regular, lean, or extra lean -Carrots in tomato sauce - Tomato products, canned, sauce	N/A -if they broke down the sauce contents i.e. tomato sauce, ground beef, pasta, each item was considered exact	N/A
Tomato sauce with kidney beans – veggies in sauce	-Red kidney beans, dry, cooked, NS as to fat added in cooking -Spaghetti sauce (Marinara, cacciatore or pizza sauce, spaghetti sauce with mushrooms) - Carrots in tomato sauce -Tomato products, canned, sauce	-Stewed red beans, Puerto Rican style -Beans, snap (Italian, green or yellow), canned,	-Beans, string, green, from fresh, cooked, NS as to fat added in cooking
Garlic Bread – sliced and white	-Bread, garlic, toasted -Bread, garlic	-Bread, white, made from home recipe or purchased at a bakery -Bread, 60% whole wheat, commercial Butter, regular	-Cornbread, made from home recipe
Garlic pita – GF option	-Bread, rice bran, gluten free	N/A	N/A

Fruit Salad	-Fruit salad, fresh or raw (Fruit salad, NFS)	-Fruit cocktail, cooked or canned, NS as to added sweetener -Tropical fruit cocktail, cooked or canned, in light syrup -Fruit cocktail (peach, pear, apricot, pineapple, cherry, grape), canned, light syrup pack, solids and liquid	
Fresh pineapple	-Pineapple, raw	-Pineapple, canned, juice pack, solids and liquid	
Fresh red grapes	-Grape, red or green (European type, such as Thompson seedless), adherent skin, raw		
Mandarin oranges in juice/syrup	-Tangerine (mandarin), canned, light syrup pack, solids and liquid	-Orange, all commercial varieties, raw -Tangerine (mandarin), raw -Fruit, NS as to type	
2% milk			
Fruit punch/mixed fruit juice	-Drink, fruit punch, vitamin C added, ready-to-drink -Fruit juice blend, 100% juice, with added Vitamin C	Juice drink, fruit, ready-to-drink -Fruit flavored drink, low calorie, with high vitamin C -Fruit juice, NFS (Mixed fruit juices)	
Orange juice	-Orange juice, chilled, includes from concentrate		
Apple juice	-Apple juice, canned or bottled, added vitamin C	-Peach nectar, canned -Juice, apple and grape, with added vitamin C	
Mixed Salad	-Mixed salad greens, raw		
Iceberg lettuce	-Lettuce, butterhead (Boston, bibb)		-Endive, chicory, escarole, or romaine,

	-Lettuce, iceberg		raw -Radicchio, raw
Red cabbage	-Cabbage, red, raw		
Carrots, shredded	-Carrot, raw		
Cucumber, sliced	-Cucumber, raw		-Avocado, raw, all commercial varieties
Red pepper, diced	-Pepper, sweet, red, raw	-Pepper, sweet, green, raw	-Tomato, red, ripe, raw, year round average
PC Maple Balsamic Dressing		-Salad dressing, italian, commercial, regular -Salad dressing, NFS	
Snikerdoodle/molasses cookie	-Cookie, molasses	-Cookie, sugar, commercial	
Chocolate chip cookie	-Cookie, chocolate chip, commercial, regular, higher fat -Cookie, chocolate chip, made from home recipe or purchased at a bakery	-Cookie, sugar, commercial	

*Lunch items
*Afternoon Snack items
*Dinner items