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Original research article

Collecting wrappers, labels, and packages to enhance accuracy of food records among children 2–8 years in the Pacific region: Children's Healthy Living Program (CHL)☆

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ABSTRACT

The aim was to describe differences in dietary outcomes based on the provision of food wrappers, labels or packages (WLP) to complement data from dietary records (DR) among children from the US Affiliated Pacific. The WLP were intended to aid food coding. Since WLP can be associated with ultra-processed foods, one might expect differences in sodium, sugar, and other added ingredients to emerge. Dietary intakes of children (2–8 y) in Alaska, Hawai'i, Commonwealth of the Northern Mariana Islands, and Guam were collected using parent/caregiver completed 2-day DR. Parents were encouraged to collect WLP associated with the child's intake. Trained staff entered data from the DRs including the WLP when available using PacTrac3, a web application. Of the 1868 DRs collected and entered at the time of this report, 498 (27%) included WLP. After adjusting for confounders (sex, age, location, education, food assistance), the DRs with WLP had significantly higher amounts of energy (kcal), total fat, saturated fat, added sugar, and sodium. These results suggest the inclusion of WLP enhanced the dietary intake data. The intake of energy, fat, added sugar and sodium derived from processed foods and foods consumed outside the home was better captured in children who had WLP.

Trial registration: NIH clinical trial #NCTT01881373.

1. Introduction

Little is known about the diets of children 2–8 years old living in the Pacific region, specifically, within the US Affiliated Pacific (Wilken et al., 2013). The largest ethnic subgroups of the US Affiliated Pacific include Native Hawaiians, Samoans, Chamorros, Asians and Native Alaskans. Many of these groups are among the world's most obese populations (Hawley and McGarvey, 2015). Data from this region are not included in any large-scale national survey such as the National Health and Nutrition Examination Survey (Murphy, 2003). To date, few studies have occurred in this region (Paulino et al., 2008). The Children's Healthy Living Program (CHL) for Remote Underserved Minority Populations in the Pacific Region represents the first attempt to begin investigating the dietary intakes of children residing across this area. Therefore, a major emphasis was placed on enhancing the dietary assessment methods. In an effort to make identification of processed and ready-to-eat foods easier, a number of research groups have encouraged study participants to collect food wrappers, labels, and packages (WLP) from foods consumed and recorded in their diet records (Stephen et al., 2013; Rosario et al., 2012; Roberts et al., 2016; Flynn et al., 2011). Although not objectively assessed, asking participants to provide these items has been reported to assist with the identification of portion sizes of foods eaten and to improve the accuracy of the dietary information obtained. Parents/caregivers of children in the CHL study were encouraged to collect WLP associated with their child's intake to complement data from dietary records (DR).

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The aim of collecting the WLP was to provide data entry staff additional information to assist food matching when entering dietary data. The primary aim of this study was to describe the differences in dietary outcomes based on the provision of WLP among children 2–8 years participating in CHL. Since WLP are often associated with ultra-processed foods, we hypothesized differences in intakes of energy, sodium, sugar, and common fortification ingredients might emerge. A secondary aim was to describe the characteristics of the participants who provided WLP.

2. Methods

2.1. Study design and sample

The CHL project is a partnership among remote Pacific states and other jurisdictions affiliated with the United States including: Alaska, American Samoa (AS), Commonwealth of the Northern Mariana Islands (CNMI), Guam, Federated States of Micronesia, Hawai'i, Palau, and the Republic of the Marshall Islands. Five of these jurisdictions were selected to participate in an 18-month community randomized environmental intervention trial focused on preventing early childhood obesity by promoting healthy eating patterns and physical activity in young children. In AS, CNMI, Guam, and Hawai'i four communities were selected, while two communities were selected in Alaska due to large distances between sites (Wilken et al., 2013). Recruitment goals were a minimum of 150–180 children with evaluable anthropometry measures and 100 DR per community. This allowed for a manageable workload as the children recruited at community events did not require a follow-up visit. Children recruited at schools (e.g. kindergarten classes, Head Start programs) were preferentially approached for completing the DR as the teacher could be a point of contact for the follow-up needed to schedule return of the DR (Wilken et al., 2013). A cross-sectional sample of children aged 2–8 years in each of the intervention trial communities was assessed for outcomes at baseline and at 24 months. Participant-based measures included demographics, anthropometry, diet, physical activity, sleep, and acanthosis nigricans. This analysis includes only data from the baseline data collection in the 4 jurisdictions including WLP, i.e. CNMI, Guam, Hawai'i, and Alaska; and the DR that were processed through data cleaning at the time of this report (95% of total).

2.2. Dietary records

DRs reported by a surrogate (either a parent or caregiver) were used to assess the energy, nutrient and food group intakes of the children. The design and methods used for the DRs were adapted from previous studies (Fialkowski et al., 2010; Novotny et al., 2013). In CHL, the DR was referred to as a food and activity log (FAL), which was a DR combined with an activity log in an easy-to-carry booklet. Parents/caregivers were instructed to complete the FAL for their children on two randomly assigned non-consecutive days, which included all days of the week. Based on recommendations from Bolland et al. (1990), techniques were used to improve the accuracy of the information recorded in the FAL. All field staff received instruction and a manual for training parents/caregivers to manage DRs and reviewing the DRs with parents/caregivers upon return. The training session for the parent/caregivers in record keeping techniques was complemented with food models, service ware, and utensils. Parents/caregivers were encouraged to ask for assistance from other caretakers or teachers, as appropriate. All parents/caregivers were provided with a tool kit of calibrated utensils (i.e. measuring cups and spoons). Each FAL and Ziploc® (Racine WI) bag for the WLP were pre-labeled with each child's identification number prior to distribution to the parents/caregivers. Research staff reviewed the FAL with the parents during a second visit. The FAL was reviewed for completeness of food entries, portion size estimation, food preparation methods, and accuracy of recorded data.

Fig. 1. Example of a participant's array of a school menu and wrappers, labels, and packages (WLP) provided by parents completing dietary records for two days. Also shown are a Food and Activity Log and Ziploc® bag.

2.3. Wrappers, labels, and packages (WLP) and school/day care menus

Parents/caregivers were encouraged to collect all food WLP and any school/day care menus for both recording days. They were instructed that a WLP was not a substitute for providing a brief description of the food or beverage and amount consumed by the child on the FAL. When the FAL and any accompanying WLP were returned (Fig. 1), staff labeled each menu (if provided) and WLP with successive, pre-numbered labels. After numbering all menus/WLP, staff recorded the numbers next to the corresponding food(s)/beverage(s) in the FAL. Once the menus/WLP were organized, labeled, and recorded in the FAL, they were placed against a black poster board in the successive number sequence and images were taken and saved (Fig. 2). This process allowed the staff to discard the menus/WLP. Data entry staff used the images to supplement the information in the FAL. For the purposes of this paper, WLP includes menus, however no analysis by WLP alone or menus alone was done.

2.4. The pacific tracker 3 and dietary data entry

The Pacific Tracker 3 (PacTrac 3) is a web-based application that is a modification of the MyPyramid Tracker developed by the US Department of Agriculture's Center for Nutrition Policy and Promotion (Martin et al., 2008). All dietary data from the FALs were entered using PacTrac 3. Quality control training was implemented to standardize the dietary data entry. Standardized FALs were created which contained known errors emphasizing common issues encountered during dietary data entry. Prior to entering any participant data, staff had to receive a passing score on a minimum of three of the standardized FALs using the PacTrac 3 application. Among the 4 jurisdictions, 37 individuals passed the dietary data entry quality control and these trained staff entered all dietary data into PacTrac 3. After the first data entry at the jurisdiction sites, the FALs were sent to the Nutrition Support Shared Resource at the University of Hawai'i Cancer Center for second review and data entry correction, as needed. Data from the PacTrac 3 were used to calculate food group, energy, and nutrient intakes using a food composition database developed by the University of Hawai'i Cancer Center for use in the Pacific region (Murphy et al., 2006; Martin et al., 2008).

2.5. Anthropometry

Trained research staff completed measurements of weight and height (Li et al., 2016). Children wore lightweight clothing and were

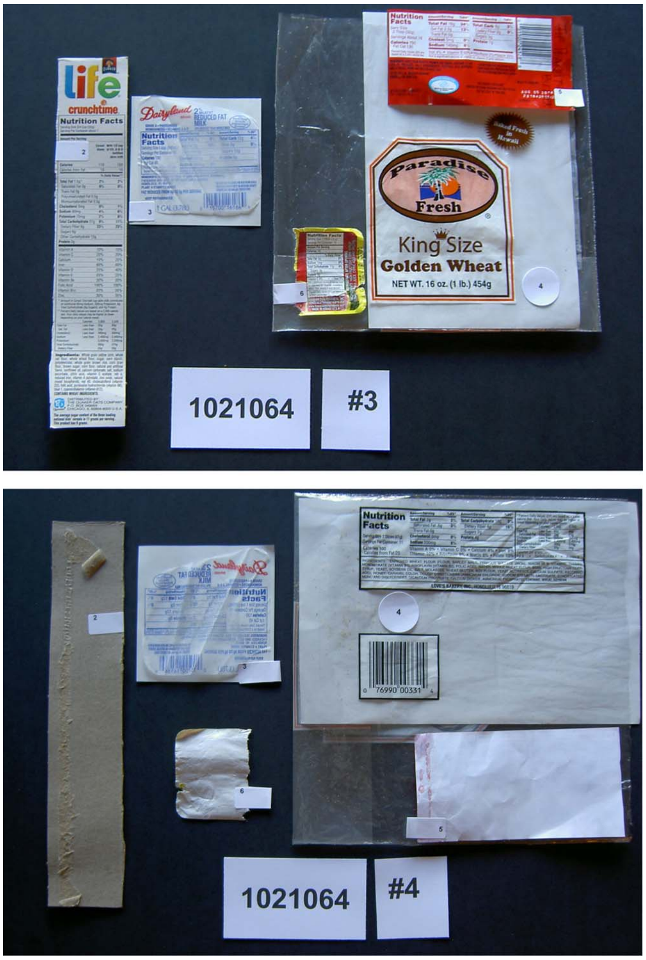


Fig. 2. Example of images to capture the front (image #3) and back (image #4) of wrappers, labels, and packages (WLP) provided by parents completing dietary records for two days. These images represent WLP items #2 through #6 by child ID number.

requested to wear no shoes and empty their pockets. Height was measured to the nearest 0.1 cm using portable stadiometers (Perspective Enterprises, PE-AIM-101; Portage, MI). Weight was measured to the nearest 0.1 kg using portable scales (Seca Model 876; Chino, CA). Every child's weight and height was measured at least three times by each measurer. If no two measurements were within two units (e.g. 0.2 kg for weight and 0.2 cm for height), the CHL staff member repeated the measurements until there were at least two measurements within two units. These measures were used to compute body mass index (BMI) as weight (kg)/height (m)^2.

2.6. Statistical analysis

The Statistical Package for the Social Sciences version 23 (SPSS, Inc., Chicago, IL, USA) was used to carry out all statistical analyses. Descriptive analysis was conducted to describe the population's characteristics. Normal probability plots indicated no variables required transformation. Anthropometric measures outside of the ranges for weight, height or BMI on the Centers for Disease Control growth charts for children aged 2 years and older in the US were removed (National Center for Health Statistics, accessed 2016). Cross tabulations and chi-square tests were used to investigate the differences between categorical variables. The *t*-test for independent samples was used to investigate differences between continuous variables. Multiple linear regression with the dietary components as the dependent variable and WLP (yes or no) as the primary independent variable was conducted. Confounding variables examined as indicator variables in the regression models included education (high school graduate or less and post high school education), location (Hawai'i, Guam, Alaska and CNMI), receipt of food assistance through the Supplemental Nutrition Assistance Program (SNAP) and/or the Supplemental Nutrition Assistance Program for Women, Infants and Children (WIC) in the previous 12 months (yes/no), sex (boy, girl), and age (2–5 y, 6–8 y). Quantitative confounding variables were BMI or total energy (kcal). Total energy was also a primary dependent variable, thus adjusted for BMI. If the adjusted results for the non-energy variables were the same for total energy or BMI in the model, results using BMI were preferentially displayed to allow comparisons. Results were considered significant at $P < 0.05$.

3. Results

Across the four jurisdictions, the initial sample consisted of 3386 children. Among the children with a completed DR, 2.1% of the sample was missing information on the confounders. Among the children that did not have a completed DR, 2.8% of the sample was missing these variables. After exclusions for missing confounders, the total sample was 3304. Of these children, 1868 (56.5%) had a DR that was entered and checked. A higher proportion of the 6–8 yr olds (733/1134 or 65%) completed DRs than the 2–5 yr olds (1135/2170 or 52%) ($P < 0.0001$). Parents/caregivers with a post high school education were less likely to complete a DR than those with a high school education or less (51% compared to 61%, $P < 0.0001$). Those families receiving food assistance ($P < 0.0001$) and families where the parent/caregiver were not employed ($P = 0.002$) were more likely to complete a DR. Guam had a significantly higher proportion of participants completing DRs compared to other jurisdictions. Sex and BMI of the child did not differ between participants who did and did not provide DRs.

Characteristics of the children and parents/caregivers who completed DRs are shown in Table 1. Only 27% of the DRs returned included WLP. Children from Guam had a significantly higher proportion of WLP compared with other locations. There was no significant difference in sex, age, weight, height or BMI of children who did and did not provide WLP. A higher proportion of the parents/caregivers with a post-high school education provided WLP compared to parents with a high school education or less. Those receiving food assistance in the previous 12 months were less likely to provide WLP than parents receiving no food assistance. No significant differences in the proportion of WLP provided were seen between employed and unemployed parents/caregivers.

Table 2 presents the results of the mean difference (group with WLP minus group without WLP) in intakes of total energy, fat, saturated fat, added sugar and sodium between children with WLP and children without WLP. Among the 4 jurisdictions, those who provided WLP had significantly higher recorded intakes of total energy, total fat, saturated fat, added sugar and sodium compared to those who did not provide WLP, after adjustment for covariates. Differences in nutrients covered under the standards of identity as vehicles for fortification of cereal flours, bakery and macaroni products and common voluntary nutrient additives were examined as these are commonly distributed via packaged foods. There were no differences between those children with WLP and children without WLP for thiamin, riboflavin, niacin, folate, and calcium. Iron ($P = 0.031$) and vitamin C ($P = 0.012$) were significantly higher among the children without WLP compared to the children with WLP (data not shown); the opposite of the hypothesized difference. There were no differences in the recording of sugar-sweetened beverages (SSB) between those who provided WLP and those who did not provide WLP.

Of the 498 participants providing WLP, data regarding the number of WLP were available for 480 (96%). The number of WLP provided by participants ranged from 1 to 23. Those with the number of WLP known were divided into tertiles (group 1 = 1-2 WLP, group 2 = 3-4 WLP, and

Table 1
Characteristics of children (2–8 y) from the Children's Healthy Living Program with a parent/caregiver completed dietary record by the provision of food wrappers, labels, and packages (WLP), n = 1868.

	Yes WLP	No WLP	*P*-value[1]
Location	n (%)[2]	n (%)[2]	0.000
Alaska	16 (6)	254 (94)	
CNMI	66 (13)	454 (87)	
Guam	268 (41)	383 (59)	
Hawaíi	148 (35)	279 (65)	
Total	498 (27)	1370 (73)	
Sex			0.840
Boy	256 (27)	697 (73)	
Girl	242 (26)	673 (74)	
Total	498 (27)	1370 (73)	
Age Group, years			0.059
2–5	285 (25)	850 (75)	
6–8	213 (29)	520 (71)	
Total	498 (27)	1370 (73)	
Education[3]			0.008
High school graduate or less	271 (24)	839 (76)	
Post high school education	227 (30)	531 (70)	
Total	498 (27)	1370 (73)	
Income[3]			0.001
< $35,000	260 (25)	790 (75)	
$35,000 to > $75,000	152 (33)	308 (67)	
Total	412 (27)	1098 (73)	
Employment status[3]			0.159
Employed	418 (27)	1111 (73)	
Unemployed	80 (24)	259 (76)	
Total	498 (27)	1370 (73)	
Food assistance in past 12 mo[3]			0.017
No	142 (31)	317 (69)	
Yes	356 (25)	1053 (75)	
Total	498 (27)	1370 (73)	

	Yes WLP[4] Mean ± standard deviation	No WLP	*P*-value
Weight (kg)			
2–5 years (n = 1135)	17.6 ± 4.7	17.4 ± 3.9	0.595
6–8 years (n = 733)	26.6 ± 8.4	26.2 ± 7.6	0.626
Height (cm)			
2–5 years (n = 1135)	102.8 ± 9.1	102.8 ± 8.7	0.939
6–8 years (n = 733)	121.7 ± 8.5	121.5 ± 7.9	0.769
BMI (kg/m2)			
2–5 years (n = 1135)	16.4 ± 2.3	16.3 ± 1.9	0.537
6–8 years (n = 733)	17.6 ± 4.0	17.5 ± 3.4	0.699

[1] *P*-value from chi-square for categorical variables and *t*-test for quantitative variables.
[2] Percentages may not add up due to rounding.
[3] Refers to the parent/caregiver.
[4] Yes WLP, n = 285 for 2–5 years and n = 213 for 6–8 years; No WLP, n = 850 for 2–5 years and n = 520 for 6–8 years.

Table 2
Mean and differences in dietary intakes by provision of food wrappers, labels, and packages (WLP) among children (2–8 y) from the Children's Healthy Living Program (n = 1370 provided no WLP, n = 498 provided WLP).

	Yes WLP	No WLP	Mean difference[1] (95% CI[2])	*P*-value
	Mean ± Standard error[1]			
Energy (kcal)	1666 ± 35	1598 ± 30	67.6 (5.5, 129.6)	0.033
Total Fat (g)	62 ± 1.64	58 ± 1.42	3.3 (0.4, 6.2)	0.026
Saturated Fat (g)	23 ± 0.60	21 ± 0.52	1.5 (0.4, 2.5)	0.007
Added sugar (tsp)	14 ± 0.45	13 ± 0.39	1.1 (0.3, 1.9)	0.006
Sodium (mg)	2533 ± 73	2314 ± 63	218.9 (89.5, 348.3)	0.001

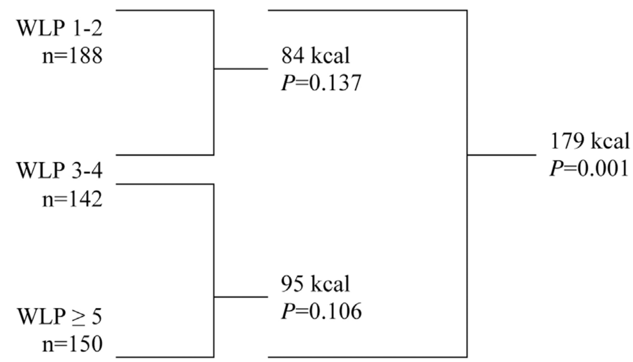
[1] Mean and differences (WLP − no WLP), adjusted for sex, age, body mass index, location, education and financial assistance for food.
[2] CI = confidence interval.

group 3 = ≥5 WLP). The mean total energy intake for group 1 was 1652 kcal, for group 2 was 1706 kcal, and for group 3 was 1807 kcal ($P = 0.023$). Figs. 3 and 4 show the total energy and the added sugar difference, respectively, between children grouped by tertile numbers of WLP provided after adjustment for confounding variables. For both energy and sugar intakes, the differences were significantly greater for the highest tertile compared to the lowest tertile ($P = 0.001$ for both). This pattern was not observed for other dietary outcomes.

4. Discussion

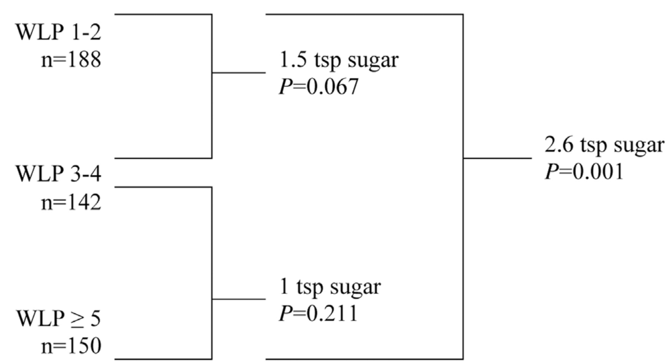
Among the 4 jurisdictions included in this analysis, some important differences in dietary outcomes were observed between those who provided WLP and those who did not. As hypothesized, there were significantly higher intakes of total energy, fat, saturated fat, added sugar, and sodium among those providing WLP as compared to those without, after adjustment for covariates. Although iron and vitamin C were statistically significantly lower in the WLP group compared to the no WLP group, no differences were seen for thiamin, riboflavin, niacin, folate, and calcium. Since WLP are primarily associated with ultra-processed foods (Lv et al., 2011; Martinez Steele et al., 2016), it was hypothesized that differences in sodium, sugar and other commonly added ingredients might emerge between the two groups. The higher amounts of total energy, fat, saturated fat, added sugar and sodium observed in the WLP group suggest asking participants to provide WLP enhanced the dietary intake data. Additionally, the finding that total energy, fat, and added sugar intakes were positively associated with the number of WLP provided suggesting WLP may improve the detail of the dietary information obtained. There was no significant difference between the weight, height, BMI or sex of children with and without WLP. Parents/caregivers of older children (6–8 yrs) were slightly more likely to provide WLP than the parents/caregivers of younger children. The parents/caregivers providing WLPs were more likely to have higher education and income and were less likely to have received financial assistance in the previous 12 months than parents that did not provide WLP. Finally, no significant differences in the proportion of WLP provided were seen between employed and unemployed parents/caregivers.

Provision of WLP by participants in the CHL intervention study may have enhanced the dietary intake data in a number of ways. One possibility is that the presence of WLP during the review of the DR with parents assisted research staff to obtain additional details on the serving/portion size of foods. For example, if a wrapper of a loaf of bread was provided, this may have given staff the opportunity to ask about the quantity of bread consumed if this had not already been documented by the parent/caregiver on the FAL. In addition, it may have prompted further probing regarding what was consumed with the bread e.g. did the child have additional condiments (jam/butter) or meat (chicken/ham). Another possibility is that coding errors (Greenfield and Southgate, 2003; MacIntyre, 2009) associated with the conversion of food consumption data into nutrient intake data were reduced because CHL data entry staff had access to WLP during the entry process. Undertaking a computerized dietary analysis involves reading and interpreting the dietary record, selecting and entering the best-fit item from the available choices in the database, and quantifying the amount of each food or beverage (Webster et al., 2010). Each of these steps can introduce error or variability in the estimation of energy and nutrient intake (Braakhuis et al., 2003). Even though modern databases contain information on a large number of foods it is not possible to maintain a database that incorporates all foods consumed by a population. Major changes in the food supply add to the difficulties encountered with estimating calculated nutrient intakes (Sevenhuysen, accessed 2016). The presence of the WLP during data entry may have



[1] Adjusted for sex, age, body mass index, location, education and financial assistance for food.

Fig. 3. Total energy (kcal) differences[1] by tertiles of food wrappers, labels, and packages (WLP) provided by parent/caregiver completed dietary records of children (2–8 y) from the Children's Healthy Living Program (n = 480).[footnote 1: Adjusted for sex, age, body mass index, location, education and financial assistance for food.]



[1] Adjusted for sex, age, body mass index, location, education and financial assistance for food.

Fig. 4. Total added sugar (tsp) differences[1] by tertiles of food wrappers, labels, and packages (WLP) provided by parent/caregiver completed dietary records of children (2–8 y) from the Children's Healthy Living Program (n = 480).[footnote 1: Adjusted for sex, age, body mass index, location, education and financial assistance for food.]

assisted staff with interpretation of unclear or misspelled written details on the DR. A staff member's ability to choose the food code that best matched the food/beverage reported in the DR was likely enhanced with the additional information. For example, when coding yogurt, it is likely that referring to the actual yogurt container/label enabled staff to choose the most accurate type and flavor (e.g. full fat vs. low fat/plain vs. fruit) from the available options in the food composition database. This may have reduced the likelihood of underestimating the sugar/fat content of the yogurt in this example, but this may have also been the case for other foods/beverages recorded in the DR. As an example, the sodium content contained in one biscuit can vary up to 200 mg depending on the brand chosen (Center for Science in the Public Interest, 2008). Collection of WLP by parents/caregivers may have prompted them to give additional details in the DR regarding brand information or quantity consumed.

A higher consumption of packaged/processed foods among children in the WLP group compared with the no-WLP group cannot be excluded as an explanation for the differences observed in dietary outcomes between the two groups. Children in the no-WLP group may not have had any WLP because they simply did not consume any packaged foods. Even though this could be possible, it is unlikely considering major food sources of energy, fat and added sugars for children have been found to come from processed foods such as grain desserts (e.g. cakes, cookies, donuts, pies), pizza, soda, fruit drinks, and candy (Reedy and Krebs-Smith, 2010). Furthermore, our findings suggest that information about undesirable foods that are commonly under-reported was better captured in the WLP group by asking the participants to provide WLP.

According to Collins et al. (2013), assessing dietary intake in young children is challenging due to factors such as foods and beverages consumed outside the home. As a result, parents can be unreliable reporters of their child's out-of-home food intake (Livingstone et al., 2004). In this study, in addition to WLP, parents/caregivers were asked to collect school/day care menus in an attempt to obtain more information on foods consumed at school or day care. We did not specifically delineate foods from the WLP from foods on the menus available for the children. Thus, the higher amounts of energy, fat, added sugar and sodium in the WLP group may have resulted from provision of these menus assisting with the out-of-home intake of children in this group.

This study also found no significant difference between the proportion of WLP among consumers of SSB compared with those who consumed no SSB. This was surprising as many SSB marketed to families with small children come in single serve pouches. On the other hand, SSB are often sold in large volumes (Popkin and Hawkes, 2016) and it is possible that the large size of the container/packages reduced the amount of WLP provided for this dietary outcome. Therefore, in future studies when giving instructions on collecting WLP, emphasis should be placed on the importance of providing these items.

As an alternative to providing the bottle or package, participants could be encouraged to take digital images of the wrapper or label on the SSB (Aflague et al., 2015).

Previous studies have shown an association between higher consumption of processed food and lower income households (Gutierrez et al., 2012; Aquino and Philippi, 2002; Saldiva et al., 2014). Based on this association, a higher percentage of WLP among children of parents/caregivers in the low-income group was expected. However, parents/caregivers providing WLP were more likely to have a higher income than parents not providing WLP. One could speculate that differences in food purchasing decisions resulted in the differences in WLP provision between the two groups. A number of studies have found that food prices weigh more heavily on purchase decisions made by low-income groups (Dachner et al., 2010; Dowler, 1997; Wiig and Smith, 2009). Supermarkets regularly offer discounts on larger packaged foods such as breakfast cereals, frozen foods, canned products, biscuits, juices and carbonated drinks (Zachary et al., 2013). Due to financial constraints, parents/caregivers in the low-income group may have been more likely to buy larger size packaged items compared with those in the higher income group. Providing the wrapper/label of larger sized items may have been more difficult because one could assume they take longer to finish and were less likely to be empty. Some examples of these larger sized items include frozen 'family sized' packs of chicken nuggets/fish sticks/French fries. These packs give multiple servings and the pack itself acts as the storage container for the food. Providing the package/wrapper from these larger sized items would require the parent/caregiver to transfer any remaining food into another food container. This is a burdensome task and would require high levels of motivation. To overcome this barrier in future studies, particularly in low-income groups, participants could be encouraged to take digital images of these larger wrappers/packages (Aflague et al., 2015).

This study found no difference in weight, height or BMI of the children with WLP compared to no WLP. Previous studies have found that higher body fatness/BMI is associated with under-reporting of dietary intake in children, particularly the intake of sweet and fatty foods (Baxter et al., 2006). Our finding that BMI does not affect parental provision of WLP is encouraging. This suggests that asking participants to provide WLP has the potential to provide information on foods that are usually under-reported in children with higher body fatness/BMI.

An unexpected finding was that parents/caregivers providing WLP were more likely to have higher education than parents that did not provide WLP. Given that WLP are associated with foods that are high in fat or sugar, the expectation was that a higher number of WLP would be provided by children of parents with lower educational levels. This probability was largely based on evidence that has shown a strong association between parental education level and frequency of children's consumption of high fat and high sugar food products, as described by Fernandez-Alvira et al. (2013). However, in this study, parents/caregivers with lower levels of education provided fewer WLP than parents/caregivers with higher levels of education. This observation may be due to differences in nutrition label use and/or comprehension of nutrition label content between the two groups. Parents with less education are more likely to be classified as having low health literacy (Yin et al., 2009) and nutrition label use was found to be lower among parents with low health literacy skills (Speirs et al., 2012). In addition, comprehension of nutrition labels was found to be lower among those with lower education and income (Rothman et al., 2006; Sinclair et al., 2013). Therefore, parents/caregivers with less education may have perceived the task of collecting WLP more challenging if they didn't usually use or consult food labels/wrappers. Additionally, if nutrition label comprehension was poor in this group they may have underappreciated the dietary information derived from WLP and thus may have been less motivated to collect them.

The primary limitation of this study is that it is a secondary analysis of data collected for the CHL intervention study and the study wasn't specifically designed to assess if WLP enhances the collection of dietary data in children. Other limitations include missing income data. Thusthis important variable was not in the regression models examining the relationship between WLP and dietary outcomes. Therefore, it is uncertain whether the differences observed were because of a true difference between the groups or because of some confounder that wasn't included, such as income. Another limitation is that the results only apply to 4 out of the 5 jurisdictions involved in the CHL intervention study. Additionally, there were variations in the dietary outcomes within the jurisdictions that were included, which may have influenced results despite adjustment for jurisdiction. Furthermore, dietary data coding and entry is an expensive and labor-intensive aspect of nutrient analysis. Data on the differences in the amount of time required for data entry staff to enter DRs with WLP versus DRs without WLP were not available. This information would be valuable to assist future studies in balancing the costs and benefits of collecting WLP. Finally, it is unknown if the information gained from the WLP was the contributor to enhanced information or if WLP represent a marker for more conscientious reporters.

5. Conclusion

To our knowledge, this is the first study to describe differences in dietary outcomes based on the provision of WLP among children 2–8 yrs from the US Affiliated Pacific. The results of this study suggest that the accuracy of dietary data may be improved if study participants are asked to collect WLP. They can be used as an aid for probing for additional details about foods/beverages consumed during reviews of DRs. WLP may assist dietary data entry staff with interpretation difficulties associated with DRs by better informing staff when choosing food codes from nutrient databases that best match foods/beverages recorded. Furthermore, this is the first study to describe the characteristics of the children who provided WLP and the characteristics of the parents/caregivers who included WLP. The description of these characteristics may inform future researchers about the types of participants receptive to providing WLP. Conversely, the results draw attention to those participants in need of more encouragement/assistance to collect WLP.

Future research is needed to directly address whether or not the use of WLP augments participants' recording of dietary intake, improves staff review of dietary records, reduces the errors associated with selecting the best food matches, or enhances portion size estimation. Additional investigation of the cost and length of time associated with using WLP as a tool to enhance dietary intake data are also needed. Whether or not their use reduces the amount of the time spent entering food consumption data would also be useful to observe.

Accurate and reliable estimation of nutritional intake in children is central to identifying food intake patterns and eating behaviors that are associated with unhealthy weight and weight gain over time. This information is needed to ensure that appropriate intervention messages and behavioral targets for obesity prevention are developed. However, dietary intake is difficult to measure, particularly in children, and no one method will assess dietary exposure precisely. Despite this, continued efforts to improve the accuracy of dietary intake data are needed to increase the credibility and utility of findings from nutrition epidemiological studies. The findings from this study suggest that the accuracy of dietary data may be improved if study participants are asked to collect WLP. In particular, the findings indicate that the intake of energy, fat, added sugar and sodium derived from processed foods and foods consumed outside the home were better captured in children who had WLP.

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