Determining the Effectiveness of an Adult Food Literacy Program Using a Matched Control Group

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ABSTRACT
Objective: To determine the effect of Food Sensations for Adults on food literacy behaviors and selected dietary behaviors.

Methods: A quasi-experimental design using preprogram and postprogram questionnaires over 4 weeks with a control group (n = 75) matched for sex, age group, and socioeconomic disadvantage to program participants (n = 867). General linear mixed models assessed change in food literacy behavior frequency in 3 self-reported domains (plan and manage, selection, and preparation) and fruit and vegetable servings.

Results: Postprogram, Food Sensations for Adults participants reported modest yet statistically significant score improvements in 2 of the 3 domains of food literacy behaviors in the plan and manage (12.4%) and preparation (9.8%) domains, as well as servings of vegetables (22.6% or 0.5 servings).

Conclusion and Implications: Quasi-experimental designs indicate food literacy programs can produce modest short-term changes across a range of food literacy and dietary behaviors.

Key Words: food literacy, nutrition education, cooking, evaluation (J Nutr Educ Behav. 2023;000:1–8.)

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nutrition education programs.\textsuperscript{13} Although randomized controlled trials are considered the gold standard for recruitment,\textsuperscript{13} they are challenging to implement alongside community programs with participants in free-living conditions because of funding constraints and the inability to randomize. For example, it is not feasible to account for the reality of people’s needs, such as being supported by a friend or carer.\textsuperscript{14} Evaluation needs to be rigorous and robust but also practicable.

Quasi-experimental designs are useful for determining the evidence of programs, emphasizing external validity.\textsuperscript{15} In nutrition education, quasi-experimental study designs have been used to compare curricular effectiveness\textsuperscript{16} or determine impact evaluation at the individual\textsuperscript{17–20} or community\textsuperscript{21} levels. There are advantages and limitations to alternative study designs and control groups. It may not be possible to recruit a similar control or comparison group because of voluntary participation,\textsuperscript{22} nor would it be ethical in certain population subgroups. In practice, not randomly assigning to conditions is likely to result in groups that may be different before the program delivery. Therefore, matching techniques allow researchers to evenly distribute important characteristics between groups. Normative group matching requires participants in the control group to be matched on specific variables to participants in the program group\textsuperscript{23} to demonstrate that program participants improved more than the controls by adjusting for other differences using statistical analysis.

Foodbank Western Australia’s Food Sensations for Adults (FSA) program is a free, 4-week food literacy program delivered by dietitians and nutritionists to adults from households with low- to middle-income who want to improve their food literacy. The impact and outcome evaluation of the FSA program in Western Australia (WA) has indicated that the program is effective. The evaluation design uses a self-reported, preprogram, postprogram, and follow-up questionnaire that includes a food literacy behavior checklist with published validity assessment.\textsuperscript{24} Since 2016, FSA has been funded by the WA Department of Health and has reported positive improvements in food literacy behaviors and selected dietary behaviors directly after the program\textsuperscript{25} and sustained changes documented at 3-month follow-ups.\textsuperscript{26} However, there is a need to test this effectiveness with a quasi-experimental design.

This study aimed to determine the effect of FSA on food literacy and selected dietary behaviors. We hypothesized that FSA program participants who completed at least 75% of the program would report statistically significant improvements in food literacy behaviors and fruit and vegetable intake compared with non-participants.

METHODS

Evaluation Design

We applied a quasi-experimental repeated measures design with a matched control group for the FSA evaluation. Data from program participants were collected at the start (T1) and the end (T2) of the program. The control group participants did not receive any program content and completed a T1 and T2 questionnaire 3 weeks apart, corresponding to the beginning and end of the 4-week program.

Program

The FSA comprised 4 sessions, each running for 150 minutes (2.5 hours). The first hour of each session involved interactive and experiential nutrition education activities and discussions (for a breakdown of the full program structure, see Figure). The first 3 sessions had a set curriculum and comprised 3 core modules covering the Australian Dietary Guidelines, portion size, label reading, food budgeting, and meal planning. The program participants selected the final week’s module topic, enabling the content to be contextualized to the needs of a wide range of demographic and social groups. Optional topics included reviewing discretionary food serving size, tips for eating out of the home, a supermarket tour, packing healthy lunchboxes, and mindful eating. The remaining time each week was allocated to hands-on cooking and food safety skill development following the nutrition education component. The participants then tasted and shared the food that they had prepared. All recipes used by the program were nutritionally analyzed and focused on including vegetables with main meals and snacks.

The FSA curriculum was mapped to the 4 domains (ie, planning and management, selection, preparation, and eating) of the Australian Food Literacy and Context Model.\textsuperscript{1} In addition, aspects of the Canadian Food Literacy Contextual Factors were considered to ensure lesson content provides opportunities to practice all food literacy skills identified in the peer-reviewed literature.\textsuperscript{27} The FSA applied the Social Cognitive Theory and Health Belief Model,\textsuperscript{28} to support behavioral change. These models were used to ensure that the program moved beyond the dissemination of knowledge to include strategies to build confidence, self-efficacy, perceived control, and motivation. As a critical behavior change technique, goal setting was built into the first session lesson plan and reviewed by participants at each program session. All lesson content and resources were designed to be accessible to people with low literacy and were primarily pictorial.

As multiple facilitators delivered the FSA, program fidelity was maintained through lesson plans with extensive facilitator notes, ensuring the same key messages and activities were delivered. Facilitators used reflective practice, co-facilitation, and weekly meetings to maintain program consistency. The mode of delivery was controlled by implementing a time-specific program structure and lesson plans.

The program was delivered via 2 different mediums: face-to-face and web conference. The program duration, dose, and curriculum were the same regardless of the mode of attendance. However, some lesson content was adapted for online purposes, and resources were posted to the web conference participants. Cooking was included in the web conference version of the program, encompassing cooking in small groups in
Recruitment

We used convenience sampling to recruit the control group. The group was recruited from among adult (aged > 18 years) volunteers and staff at the Foodbank WA warehouse in Perth and during a Foodbank WA promotion stall at a public exposition from August to October 2020. Participants were approached to participate in the study on different days and times. They were provided with research information sheets outlining the study requirements, including information concerning confidentiality and the ability to withdraw at any stage. Those who chose to participate in the study provided written informed consent. The control group was not provided with program components. For this study, the control group could self-enroll in the program after 3 weeks if they were interested.

The program participants were recruited for evaluation from the FSA program delivery to established community groups and advertised programs to the public for self-enrolment across WA. The participants were provided with a verbal explanation of the purpose of the research in their first session and a written research information sheet. Consent was assumed if the participants opted to complete the questionnaire. Not all programs were evaluated for various reasons, including limitations related to mental health, disability, and low English language proficiency, and some participants did not consent.

Data Collection

The program evaluation used version 2 of a food literacy behavior checklist (FLBC). The initial version of FLBC was developed using content, face and construct validity. The FLBC questions required responses about behaviors in the past month (ranging from never, rarely, sometimes, most of the time, or always), with response scores ranging from 1 to 5. An exploratory factor analysis identified 3 factors using 14 questions (plan and manage, selection, and preparation) using data from 2016 to 2018.24 A second round of Department of Health (WA) funding supported the revision of the FLBC to capture lesson plan revisions, cognitive interviewing to test comprehension and additional exploratory factor analysis using evaluation data from July 2018 to December 2019. The 3 food literacy domains remained evident in version 2 (plan and manage, selection, and preparation).29 The factor loading cutoff used was 0.4, which resulted in 13 components loading on ≥1 factor. Plan and manage included 6 components: planning meals ahead of time, planning meals to include all food groups, cooking meals at home using healthy ingredients, making a list before you go shopping, feeling confident about cooking a variety of healthy meals, and feeling confident about managing money to buy healthy foods. The selection included 3 components: comparing prices of healthy foods, feeling confident about managing money to buy healthy foods, and feeling confident about choosing low-cost healthy foods. The preparation score was calculated using 7 components: thinking about healthy choices when deciding what to eat, using a nutrition information panel to make food choices, cooking meals at home using healthy ingredients, trying a new recipe at home, changing recipes to make them healthier, feeling confident about cooking a variety of healthy meals, and feeling confident about making at least 1 positive change.

The control group questionnaires for T1 and T2 contained 17 questions from the evaluation questionnaire, including the FLBC (see Supplementary Data for questionnaires). Questionnaires took 5–10 minutes to complete and included 15 questions on food literacy behaviors and confidence; 2 questions on servings of fruit and vegetables, treated as continuous variables; 8 categorical demographic questions on sex (male, female, other), age group, postcode, household composition, highest education level, employment status, and country of birth (were you born in Australia and do you identify as Aboriginal or Torres Strait Islander). A participant’s postcode was converted into a socioeconomic index.
for areas (SEIFA) as determined by the Australian Bureau of Statistics from population census data. The SEIFA ranks geographic areas according to relative socioeconomic advantages and disadvantages and is used in research to assess the relationship between socioeconomic disadvantages and health outcomes. Postcodes were converted to SEIFA deciles for FSA evaluation and then categorized into deciles. Deciles 1–4 were classified as disadvantaged, 5–7 as moderate, and 8–10 as advantaged. The control group participants could enter a prize draw for a $200 supermarket voucher when they completed both time points.

The FSA facilitators were trained to administer preprogram and postprogram questionnaires using an evaluation protocol to maintain consistency and ethical requirements. The same evaluation protocol was used to train a student dietitian to administer to control participants. Control group recruitment and completion of the T1 questionnaire were conducted face-to-face. An email was sent 3 weeks after the completion of T1, with up to 3 reminder emails or phone calls within the following week. Qualtrics XM was used to administer the T2 online version of the questionnaire. A hyperlink was sent by email, or participants could elect to complete the T2 questionnaire on the phone. The control group participants were considered withdrawn if the T2 questionnaire was not completed 4 weeks after T1 completion. The program participants selected for matching were drawn from program delivery over 16 months (between June, 2018 and September, 2019) to provide maximum variation for matching control participants. During this period, 1,261 participants provided some evaluation data; of these, 881 attended 75% of the program (69.5%), and 867 (68.7%) provided pre-T1 and post-T2 data, which were used for matching to controls.

### Data Analysis

The sample size was calculated at 80% power to detect differences in the 3-factor domain scores with 0.05 significance using the factor with the least discriminatory domain (selection). Participant data collected from 2016 to June 2018 with previous factor analysis published were used to assess the medium effect size. The power calculation indicated that a minimum of n = 64 was required in each group (N = 128). The medium or moderate effect size is a half SD difference between groups, calculated using the program data.

Demographic data from our control group participants were matched to the program participants to create similar pairs without confounding results. Participants were selected from the evaluation database using equivalence matching for 3 co-demographic characteristics—sex, age group, and SEIFA, as these were considered characteristics that would influence the results. Program data were used from the time of control group recruitment (from August to September, 2019) and then retrospectively for 1 year to obtain a sufficient sample to complete the matching process within a comparable time frame. Only participants who attended ≥75% of the program, considered completers, were selected for matching. Program participants were matched on sex, age group, and SEIFA index, using nearest-neighbor matching, selecting the closest eligible participant to be paired with the control. The program data were sorted into individual sex, age group, and SEIFA groups ordered by ID number. For example, males aged 18–25 years were placed in 3 different SEIFA groups. A total of 36 different groups were created. Control group characteristics were matched to the specific program group directly if there was only 1 possible match or a random ID was selected from the list midpoint. In 1 case, in which there was no match for sex, age group, or SEIFA, the program participant from the next age group down was matched.

Factor scores for each of the 3 food literacy factors were calculated for the program and control participants at T1 and T2, respectively. Responses were scored from 1 (never) to 5 (always), and this score was multiplied by the factor loading for each question. The factor score was then calculated by summing the values for each included question to generate an overall score. The difference between the preprogram and postprogram factor scores and the servings of fruits and vegetables was used to measure food literacy and improvements in dietary behaviors. The initial analysis demonstrated higher preprogram scores in the matched control group. As a result, the scores were adjusted for fixed factors of education level (ie, high school, trade/diploma, and bachelor’s degree or higher) and employment status (ie, full-time, part-time/casual, unemployed, or not working/retired). To assess the change over time, generalized linear mixed models were used to compare the T2 values using the T1 values as a covariate with the addition of education and employment as the 2 other covariates. The results were considered statistically significant at P < 0.05. The analysis was performed using SPSS (version 25, IBM, 2017).

### Ethics

The control study was approved by the Human Research Ethics Committee of Blank University (HRE2019-0450), and the program evaluation had approval by the same institution (RDHS-52-16). Both ethics approvals were assessed as low risk and approved with expedited review. Control group participants provided written consent, and consent was assumed when program participants completed the evaluation.

### RESULTS

#### Response Rate

One hundred ninety-one potential control group participants were approached, with 128 completing the preprogram questionnaire and 80 completing the postprogram questionnaire, providing 62.5% matched data. Five participants were excluded from the analysis because of incomplete demographic information required to complete the matching.

#### Demographic Characteristics

Table 1 shows the matched sex, age group, and socioeconomic index area for the study.
Table 1. Demographic Characteristics

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Program Participants, n = 75</th>
<th>Control Group, n = 75</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>34 (45.3)</td>
<td>34 (45.3)</td>
</tr>
<tr>
<td>Male</td>
<td>41 (54.7)</td>
<td>41 (54.7)</td>
</tr>
<tr>
<td>Age group</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18–25</td>
<td>4 (5.3)</td>
<td>4 (5.3)</td>
</tr>
<tr>
<td>26–35</td>
<td>18 (24.0)</td>
<td>18 (24.0)</td>
</tr>
<tr>
<td>36–45</td>
<td>21 (28.0)</td>
<td>21 (28.0)</td>
</tr>
<tr>
<td>46–55</td>
<td>15 (20.0)</td>
<td>15 (20.0)</td>
</tr>
<tr>
<td>56–65</td>
<td>8 (10.7)</td>
<td>8 (10.7)</td>
</tr>
<tr>
<td>≥ 66</td>
<td>9 (12.0)</td>
<td>9 (12.0)</td>
</tr>
<tr>
<td>SEIFA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>13 (17.3)</td>
<td>13 (17.3)</td>
</tr>
<tr>
<td>Middle</td>
<td>20 (26.7)</td>
<td>20 (26.7)</td>
</tr>
<tr>
<td>High</td>
<td>42 (56.0)</td>
<td>42 (56.0)</td>
</tr>
</tbody>
</table>

SEIFA indicates socioeconomic index for areas.

Note: Values are presented as n (%).

Effect of the FSA Program

Table 2 results indicate that the program group had statistically greater improvements in plan and manage (P = 0.003) and preparation (P < 0.001). The selection scores were not statistically different. The servings of vegetables significantly improved, rising by 0.5 serving (P = 0.01) in the program participants, with no statistically significant difference in the servings of fruit between the program and matched control groups.

DISCUSSION

This study offers the first empirical evaluation of the effectiveness of the FSA program using a quasi-experimental design. This study examined the effect of food literacy behaviors in 3 domains: plan and manage, selection, and preparation, in addition to serving fruits and vegetables. The FSA is an effective program, as we hypothesized; the program participants showed modest but statistically significant improvements in plan and manage and preparation scores and reported servings of vegetables.

The program’s results are similar to those of other quasi-experimental studies showing modest but significant improvements in behavior, confidence, and self-reported vegetable intake. There are limited quasi-experimental studies investigating the effectiveness of food literacy programs within a community setting. Of the 4 similar program studies identified, 1 Australian and 3 international demonstrated positive outcomes attributed to the program. An increase in cooking confidence was the primary criterion measured; however, improvements in other food literacy behaviors and self-reported vegetable and fruit servings have also been indicated.

An Expanded Food and Nutrition Education Program (EFNEP) review found differences in food resource management variable changes but as a total checklist score reported significant improvement after the program and that fruit and vegetable consumption significantly increased from between 0.3 and 1.6 cups post-program. The FSA program is the second Australian food literacy program study to use an experimental design for assessing effectiveness. Jamie’s Ministry of Food Australia 10-week program found that all cooking confidence measures between T1 and T2 statistically improved in addition to 0.52 servings daily vegetable intake. More recently, a 7-week version of Jamie’s Ministry of Food Australia program found improvements in cooking confidence but not dietary intake between participants and controls.

There is variability in the types of quasi-experimental designs used to assess the effectiveness of food literacy and cooking programs. This is partly attributable to the practical challenges of research in populations with low income or disadvantaged populations. Commonly, control or comparison group methods recruit individuals generally not fully equivalent to the program group regarding age, socioeconomic position, and other characteristics. This is the case for programs such as Cooking Matters, Healthy Choices for Every Body, and Good Affordable Food Program for Adults. There are a few studies with active groups participating in different programs, such as Cook Well; or randomization in Nutrition and Culinary in the Kitchen Program; or randomization at the program level for the EFNEP. Several researchers compared regions or state data between different curricula, such as the EFNEP. Despite the variability in experimental designs, programs are mostly reported to improve outcomes.

Differing program dosage and duration also makes cross-program comparisons challenging, as they are tailored to different target groups. A systematic review of this area found that food literacy program durations varied between a 1-off session to multiple sessions lasting over a series of months. Behavioral change takes time to establish. Participants may be unable to change all food literacy and dietary behaviors quickly, so unsurprisingly, programs lasting over 5 months were deemed the most effective. The FSA is a short program, delivered over 4 weeks but found effective with demonstrated sustained behavioral change in line with other similar published programs.

This study had several limitations. Self-reported behaviors are subject to social desirability bias, and the control group participants might have been highly motivated. Program data are subject to a response shift bias, in which, because of the program, respondents interpret questions differently on the basis of their experiences in the program at different times. However, the US program Cooking Matters did not find evidence...
of response shift bias, but the potential for these effects warrants further consideration. The analysis period was 3 weeks, so we did not introduce a secular trend bias in which the control group reacted to another program, as the control group did not demonstrate any statistically significant change. We compared program participants who completed 75% of the program randomly selected retrospectively over 16 months, but facilitator training ensured the quality and fidelity of the FSA delivery.

Funding that only enables program evaluation and the challenge of recruitment in community groups limited the use of a randomized experimental design in which participants could be randomly assigned to groups to produce structurally equivalent control and program groups. A full randomized control experimental design would have required a larger sample size, which was impossible under the program’s current operation in real-world conditions. However, studies funded to provide evidence-based public health information is pertinent to government policymakers in decision-making for funding of food literacy programs. Continued research is needed to clarify the possible effect size and whether changes are maintained in the long term. Given the evidence that a short food literacy program has the potential to demonstrate effective outcomes, this information is pertinent to government policymakers in decision-making for evidence-based public health investment. Our study explored the pre-post changes without examining the conditions and processes through which these changes were achieved. Further research is needed to elucidate how these nutrition education programs achieve the desired food literacy, dietary behavior changes, and the factors that moderate and mediate outcomes.

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**SUPPLEMENTARY DATA**

Supplementary data related to this article can be found at https://doi.org/10.1016/j.jneb.2023.06.001.

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