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Research Paper

A school salad bar increases frequency of fruit and vegetable consumption among children living in low-income households

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Abstract

Objective To measure change in fruit and vegetable (F&V) consumption among elementary-school children after the introduction of a salad bar programme as a lunch menu option in the US Department of Agriculture's (USDA) reimbursable lunch programme in Los Angeles Unified School District (LAUSD).

Design A cross-sectional sample of children was interviewed before and after a salad bar intervention (1998 and 2000, respectively) utilising a 24-hour food recall questionnaire. Frequencies of F&V consumption were calculated.

Setting The evaluation took place in three LAUSD elementary schools participating in the salad bar programme and the USDA reimbursable lunch programme.

Subjects Three hundred and thirty-seven children in 2nd–5th grade (7–11 years old).

Results After the salad bar was introduced, there was a significant increase in frequency (2.97 to 4.09, $P < 0.001$) of F&V consumed among the children studied. The increase in frequency of F&V consumed was almost all due to an increase during lunch (84%). Mean energy, cholesterol, saturated fat and total fat intakes were significantly lower in the children after the salad bar was introduced in the schools compared with the intakes in the children before the salad bar was introduced.

Conclusion A salad bar as a lunch menu option in the USDA reimbursable lunch programme can significantly increase the frequency of F&V consumption by elementary-school children living in low-income households.

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Key Words: Salad bars; School lunch programme; Overweight; Low income; Elementary school; Children

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List of Figures and Tables

Fig. 1

Fig. 1 Power for one-sided 5% test of no effect, sample size of 65 per school

Fig. 2

Fig. 2 Mean daily total frequency of fruit and vegetables (F&V) consumed by elementary-school students living in low-income households before (1998) and after (2000) a salad bar lunch menu intervention in three elementary schools in Los Angeles Unified School District. *Mean daily F&V consumption significantly higher compared with pre-intervention: $P < 0.001$

Table 1

Table 1 Demographics of the cross-sectional samples in the years 1998 and 2000

Table 2

Table 2 Mean (standard deviation) daily consumption of energy, cholesterol and saturated fat, and percentage of energy from fat, in elementary-school students living in low-income households before (1998) and after (2000) a salad bar lunch menu option was introduced in the federal school lunch programme

Diets high in a variety of fruits and vegetables (F&V) not only help in weight management but also help reduce the risk of some cancers, cardiovascular diseases, stroke and type 2 diabetes mellitus^{1,2}. The World Health Organization estimates that 19% of gastrointestinal cancer, 31% of ischaemic heart disease and 11% of stroke worldwide are attributable to low intake of F&V. Each year, this results in 2.7 million (4.9%) deaths and 26.7 million (1.8%) disability-adjusted life years attributable to low F&V intake. F&V intake is associated with these positive health outcomes primarily through the resultant higher intakes of vitamin C, phytonutrients, potassium and fibre, and the displacement of energy-dense fatty foods³⁻⁵.

Because of these positive health outcomes from F&V consumption, the US Department of Agriculture (USDA) recommends eating a sufficient amount of F&V while staying within energy needs. For example, 1.5 cups of fruits and 2.5 cups of vegetables are recommended for a reference 1800-kcal intake⁶. Current US childhood food intake patterns, however, tend not to follow this recommendation and this contributes to the high rates of childhood overweight in the USA: the rates of overweight among children and adolescents have almost tripled over the past 30 years^{7,8}. The California Children's Healthy Eating and Exercise Practices Survey found that only 21% of California children aged 9-11 years ate five or more servings of F&V per day; daily servings averaged 2.7, excluding fried potatoes⁹. The USDA 1989-91 Continuing Survey of Food Intakes by Individuals reported that only 36.4% of US children aged 2-19 years eat the recommended three to five servings of vegetables per day, and only 26% of children eat the two to four recommended daily servings of fruit¹⁰.

A review of the determinants of F&V consumption among 6-12-year-old children and effective interventions to increase consumption identified availability and accessibility of F&V and taste preferences as the factors most consistently and positively related to consumption¹¹. Increasing availability and accessibility to healthy foods is indeed one strategy to improve children's diets overall¹² and has been identified by the Institute of Medicine as a goal to assess progress towards reduction of obesity through policy and system changes¹³. In addition, increasing access and availability of F&V will set up opportunities for children to have repeated exposures to F&V and impact on preferences¹⁴. Studies suggest that food preferences in children can be influenced by repeated exposures, sometimes requiring up to 10-15 taste exposures to a food^{15,16}. In addition, studies have demonstrated that a child's food choices from the school lunch programme can be modified by offering a variety of different foods at school and by providing nutrition education within the school curriculum^{11,17,18}.

In order to address the low F&V consumption in California children and the high rates of childhood overweight in Los Angeles¹⁹, a pilot project was launched offering F&V on a salad bar as a lunch menu option in the 1999-2000 school year in the Los Angeles Unified School District (LAUSD). An evaluation of the pilot project is reported here. The purpose of the evaluation was to measure the change in F&V consumption among a cross-sectional sample of 7-11-year-old children resulting from the introduction of the salad bar programme as a lunch menu option in the USDA reimbursable lunch programme. The primary hypothesis was that elementary-school children from low-income families in the combined schools participating in the salad bar lunch programme would increase their frequency of F&V consumption by an average statistically significant compared with baseline.

• [TOP](#)

Design and methods

- [Results](#)
- [Discussion](#)
- [Acknowledgements](#)
- [References](#)

Sample

In 1998, 24-hour food recall data were collected from a cross-sectional sample of children in the 2nd–5th grade (7–11 years old) attending 14 schools, as part of a larger study evaluating the nutritional status of children in LAUSD. A description of the recruitment and sampling of the children in 1998 has been published previously¹⁹. The 24-hour food recall data were collected prior to the introduction of the salad bar lunch programme. Three of the 14 schools participating in the 1998 study were approached after the original data collection, and agreed to pilot a salad bar lunch programme. This programme was launched in the 1999–2000 school year in these three pilot schools in LAUSD. This convenience sample of three schools was based on the willingness of the school to introduce a salad bar, the availability of physical space at the school to fulfil the food service requirements of a salad bar²⁰, and the school being a part of the original study in 1998.

In the year 2000, after the pilot salad bar lunch programme was introduced in the three LAUSD schools, children were recruited from the 2nd–5th grades (7–11 years old) and their diet was assessed with a 24-hour recall interview. The same tools and strategies were used in 2000 as were used in 1998 to recruit the children and to interview the children during the 24-hour food recall within the three pilot schools¹⁹. There was no attempt to interview the same children as those interviewed in 1998 primarily because of the high annual transience rate of 30% in the LAUSD student population; however, it may have happened by chance that we interviewed some of the same children.

Participation criteria included: (1) children attending the 2nd to 5th grade (7–11-year-olds); (2) attendance at one of the three LAUSD elementary schools participating in the salad bar pilot programme in the year 2000 and the school having participated in the 1998 survey when there was no salad bar programme; and (3) attendance at a school where all children were eligible to participate in the USDA's reimbursable school lunch programme.

This research was approved by the LAUSD Office of Evaluation and the General Campus IRB Committee of the Office for Protection of Research Subjects at the University of California – Los Angeles. Each of the three principals agreed to participate in the 1998 baseline study as well as the 2000 evaluation. Additionally, each school voluntarily participated in the evaluation. Written parental consent and child assent were obtained before participation in the study.

Intervention

The introduction of the salad bar lunch menu option included teaching all the children during an all-school assembly about the proper etiquette of serving themselves salad, picking a well-balanced lunch, placing children's artwork in the cafeteria to advertise the programme, and participating in field trips to a farmers' market and/or a farm. In addition, the cafeteria manager prepared F&V that were perceived as culturally acceptable to the student population they served. The salad bar pilot programme was developed together by LAUSD Food Services and Occidental College; more details are given elsewhere²⁰.

Sample size

It was anticipated that a sample size of 65 from each of the three participating schools would provide adequate power to detect any increase in consumption of F&V judged important. The power calculations were based on the following model for consumption:

$$Y_{ijk} = \mu_i + \beta_j + E_{ijk},$$

for $i = 1, 2$ time periods (before, after), $j = 1, \dots, 3$ schools and $k = 1, \dots, n_{ij}$ students sampled from school j in period i . We already know that $n_{11} = 46$, $n_{12} = 48$ and $n_{13} = 52$, and we assume that $n_{21} = n_{22} = n_{23} = 65$. In this model, Y_{ijk} represents the consumption in servings per day for the k th student sampled from the j th school during period i , μ_i represents the mean consumption at time i , β_j is a random effect for school j (which allows for the different ethnic/racial make-up of each school), and E is an error term with variance σ_E^2 .

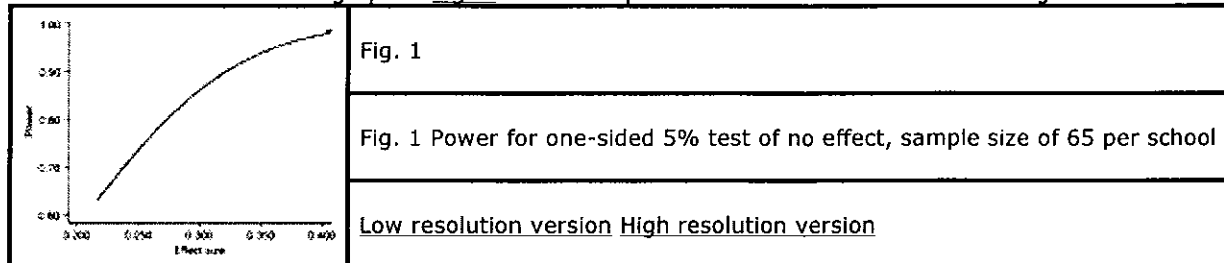
Although it is reasonable to assume the error terms are independent and identically distributed, they cannot be

normally distributed. The hypothesis of interest is:

$$H_0: \mu_1 = \mu_2$$

$$H_A: \mu_1 < \mu_2.$$

This was tested at $\alpha = 0.05$ with a test statistic, W , calculated from the mean difference in consumption for each school between period 1 and 2. This test statistic neatly side-steps the problem of correlated observations within schools due to the different ethnic/racial make-up in each school, and because of a central limiting result can be assumed to be approximately normally distributed. Hence the power of our test can be calculated in terms of the effect size. The graph in Fig. 1 shows the power that can be achieved for a range of effect sizes.



24-Hour food recalls

Methods for the 24-hour food recall were the same in both the 1998 and 2000 data collections. The child was asked about what they ate over the last 24 hours. The interviews took place in the morning or afternoon during the school day, and the child was asked about the 24 hours prior to the time of the interview. Each student was interviewed face-to-face using food models as prompts. Interviews took place over a one-week period in each school during the same F&V growing season for both the baseline (1998) and the post-intervention (2000) data collection. In order to allow for the initial novelty of the salad bar to dissipate and for a 'steady-state' participation rate to set in, interviews to collect the post-intervention data were done 2 months or more after the introduction of the salad bar menu option. All fieldworkers underwent rigorous training to collect the data. To ensure quality control, and therefore reliability and validity, a protocol specifying exact record-keeping and interview techniques was developed for the fieldworkers. Standard food models and a product identification notebook were used to help quantify food and beverages. A sticker or a pencil was offered to the children who agreed to participate in the study.

The salad bar offered a variety of F&V allowing the child to make choices and go back for second helpings. There were at least four different choices of F&V on the salad bar each day. In addition, the salad bar also had food items that contained protein, dairy and grain. Children who chose the salad bar for lunch were required to have four different food groups on their trays in order for the food services to meet the USDA's *Lunch Guidelines for hot or salad bar lunches*²¹. This rule was enforced by food service staff who supervised the salad bars daily during the lunch period. The hot lunch was prepared off-site and children were given a standard pre-packaged food with at least four different food groups represented, but no choices. Children choosing the hot lunch could not go back for seconds, but children who chose the salad bar could. Children could choose the salad bar or the hot lunch menu at the time of lunch. The salad bar was generally near the window where the hot lunch was served by the cafeteria staff.

The child chose to be interviewed in the English or Spanish language. Data were collected by experienced bilingual staff. The field supervisor for data collection was the same for years 1998 and 2000. From our previous experience, children with Chinese-speaking parents can speak English well enough by the 2nd grade to be interviewed in English; therefore, it was not necessary to offer the children the option of interviews in Chinese. The food models used had a wide variety of ethnic foods which were readily recognised by the children.

Nutrient analysis

All data collected from the 24-hour food recall were entered into the Food Intake Analysis System (FIAS), version 3.98. Food intake was analysed using FIAS, which was developed by the Human Nutrition Research Center at the University of Texas School of Public Health and the USDA Human Nutrition Information Service. This software uses the USDA Nutrient Data Base for Individual Intake Surveys, version 4.0. FIAS contains information on 30 food components and has about 6000 foods, including ethnic, brand name and convenience foods. Foods were also entered according to their recipe, so that items are tailored to the specific preparations of the participant. FIAS analyses nutrient intake of each food, per day, per subject.

Food classification

Tomato-based products were included because of the carotenoid content. Ketchup was excluded in this study, despite its rich source of carotenoids, because the amounts in this sample were too small to be counted as a serving size. 100% F&V juices were also included, but not 10% juices. As in other F&V intake surveys, because French fried potatoes contain a high proportion of vegetable content, they were counted regardless of the fried preparation⁹. However, potato chips were not counted since they have a low nutrient content of minerals and vitamins. We included F&V salsa and picante sauce in order to increase cultural relevance to our study population and also because, in 1998, F&V salsas were included in the USDA school lunch programmes as qualifying as an F&V food group²². Frequency of consumption was defined as consuming F&V or a 100% F&V juice at any meal or snack.

Analysis of survey data

Survey data were analysed using tests for association (χ^2).

Results

- [TOP](#)
- [Design and methods](#)
- [Discussion](#)
- [Acknowledgements](#)
- [References](#)

Sample

A cross-sectional sample of 96 children was interviewed before introduction of the salad bar and 241 children were interviewed after the salad bar was introduced for 24-hour food intake in the years 1998 and 2000, respectively. We only included children in the analysis who were interviewed on a day that included a school lunch (i.e. not on a Monday or a day after a holiday); therefore, we ended up with fewer children in the analysis for the 1998 data because the original survey in 1998 included children interviewed on all days of the week.

There were almost equal percentages of boys and girls interviewed in both the years of 1998 and 2000 (males: 43% in 1998, 44% in 2000; females: 57% in 1998, 56% in 2000). In 1998, fewer 10–11-year-olds (5th graders) and more 9–10-year-olds (4th graders) were interviewed compared with the year 2000 (Table 1). The majority of children attending the schools were Hispanic, African American or Asian, and there was no reported change in ethnic breakdown in each school between 1998 and 2000. All children in the three schools were eligible to participate in the free or reduced-price lunch programme, and all of the children interviewed in the study had participated in the lunch programme the day before the interview. Interview time ranged from 20 to 60 min, with an average of 45 min.

Table 1

Demographics of the cross-sectional samples in the years 1998 and 2000

	1998	2000
Total (n)	96	241
Males (%)	43	44
Females (%)	57	56
Grade (%)		
2	24.0	29.5
3	21.9	19.5
4	44.8	29.5
5	9.4	21.6
Hispanic (%)	25.0	18.7
African American (%)	34.4	31.1
Asian (%)	37.5	30.7
Other (%)	1.0	8.3
Unknown (%)	2.1	11.2

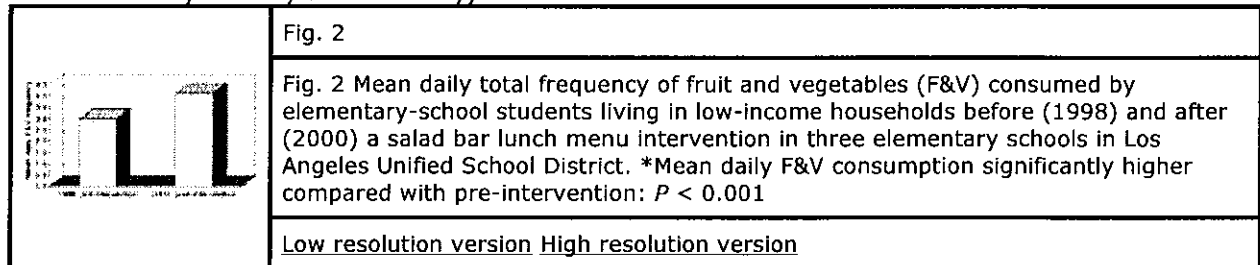
Participation in the salad bar

In 1998, there was no salad bar lunch menu option, so 100% of the children interviewed had eaten the

school's USDA reimbursable hot lunch programme. In 2000, an almost equal number of children interviewed ate from the salad bar the day before compared with those children who ate the hot lunch. The children who had eaten from the salad bar the day before the interview were much more likely to eat from the salad bar every day or most days (three or four) compared with the children interviewed who did not eat from the salad bar. Some 31.6% of the children reported eating every day from the salad bar, while 43.7% reported eating 3–4 days/week, 19.7% 1–2 days/week and 5.0% not often or never. Of note was that 28% of the children who chose to eat from the salad bar did so because of concern about weight loss. A higher percentage of boys than girls said they ate from the salad bar not very often or never (30.3% of boys vs. 19.4% of girls).

F&V consumption

The frequency of F&V consumption increased significantly, from a mean (standard deviation) of 2.97 (2.0) to 4.09 (2.7) ($P < 0.001$) between the years 1998 and 2000 (Fig. 2). The frequency of F&V consumption also increased significantly in 2000, compared with 1998, when age and gender were analysed separately ($P < 0.01$ and $P < 0.0001$, respectively). The increase in frequency of F&V consumed was almost all due (84%) to an increase during lunch. This was determined by analysing the 24-hour food intake results according to meal and including in the analysis only those children who were interviewed on a day that included a school lunch (i.e. not on a Monday or a day after a holiday).



Individual nutrients

Mean daily intakes of energy ($P = 0.03$), cholesterol ($P = 0.02$), saturated fat ($P < 0.0001$) and mean percentage energy from fat intake ($P = 0.03$) were significantly lower in the children in the year 2000 sample compared with children in the year 1998 sample (Table 2).

Table 2

Mean (standard deviation) daily consumption of energy, cholesterol and saturated fat, and percentage of energy from fat, in elementary-school students living in low-income households before (1998) and after (2000) a salad bar lunch menu option was introduced in the federal school lunch programme

	Year 2000	Year 1998	P-value
Energy (kcal)	1607 (611)	1803 (851)	0.03
Cholesterol (mg)	202 (173)	251 (199)	<0.02
Saturated fat (g)	19 (10)	26 (19)	<0.0001
% energy from fat	31 (8)	33 (9)	0.03

Discussion

- [TOP](#)
- [Design and methods](#)
- [Results](#)
- [Acknowledgements](#)
- [References](#)

Offering a salad bar as a lunch menu option in the USDA reimbursable lunch programme significantly increased the frequency of F&V consumed by children in 2nd–5th grades (7–11-year-olds) who live in low-income households. The increase in frequency of F&V consumed was almost all due to an increase during lunch (84%). A higher percentage of girls than boys said they ate from the salad bar very often; however, both boys and girls increased the frequency of F&V consumed in 2000 compared with 1998 before the salad bar was in place. To date, few studies reported in the literature have involved an evaluation of a school-based environmental intervention in the cafeteria to increase availability and accessibility of F&V for children living in low-income households^{11,23}. Perry *et al.*¹⁸ introduced a cafeteria-based intervention that included increased opportunities to eat a variety of F&V during school lunch, provided new healthful role models and instituted social support for

children to eat F&V at lunch. The cafeteria intervention significantly increased fruit consumption from 0.14 to 0.17 servings during lunch, which the investigators suggested could have public health significance when introduced to a large school population; however, 90% of the children attending the 26 elementary schools in the study were white and only 21% of the children participated in the free or reduced-price school meal. The findings therefore cannot necessarily be applied to other ethnic or racial groups. More recently, Adams *et al.*²⁴ reported on an observational study with a more diverse student population (non-white population ranging from 45 to 67%, and 52–59% participation in free or reduced-price lunch). This study found no differences in 1st–5th graders' F&V consumption among children who attended schools with self-service salad bars compared with those children who attended schools with pre-portioned F&V servings. They did find a positive relationship between F&V consumption and number of F&V items offered on the salad bars. However, the study did not control for student ethnicity or participation in the USDA reimbursable lunch programme. In the study reported here, all of the children participated in the USDA reimbursable lunch programme and they were of African American, Latino or Asian descent.

The increase in the frequency of F&V consumed in this study in turn resulted in a reduction in the mean daily intake of energy, cholesterol and saturated fat, and in the mean percentage energy from fat intake, in the diet of the children. These findings are consistent with other previous reports in the literature^{4,5,25}. Indeed consuming more than five F&V servings per day has been identified as one strategy for reaching optimal health^{1,2}. In addition, the nutritional adequacy of young children has been found not to be compromised by consuming lower-fat foods²⁶.

Study constraints

The salad bar intervention was limited in strategies to increase F&V consumption; i.e. it only increased access and availability to F&V during school lunch and provided modest strategies to promote the salad bar programme through one all-school assembly, visits to a local farm and student artwork. There was no comprehensive nutrition education effort directed towards the children or their parents. The children may have improved their F&V intake more if they or their parents had received a nutrition education intervention. Many studies have shown changes in dietary patterns in school-aged children through nutrition education and multi-component interventions¹¹. Although the cultural preferences of the children were taken into account when purchasing the F&V for the schools, there was no formal review of opinions among the children regarding the F&V offered.

Other limitations to this study include the 2-year gap between the pre- and post-intervention data collection. According to the school principals, there were no significant changes in the school curriculum nor any campaigns related to nutrition at the three pilot schools during this 2-year period other than the salad bar intervention. There was a state-wide, California Children's 5 a Day – Power Play! Campaign, however, that targeted 9–11-year-olds during this 2-year period in four major regions of California including Los Angeles. This campaign promoted eating five or more F&V and physical activity of 60 min every day. But evaluation of the campaign found no significant differences in average F&V consumption when comparing children who were aware (mean 3.4) and not aware (mean 3.2) of the campaign's television spots⁹.

The cross-sectional design of the study is also a constraint. We did not follow the children prospectively because it was not practical due to the annual transience rate of 30% among children in Los Angeles and the funding constraints. Some researchers identify limitations of the 24-hour food recall as a dietary assessment tool; however, in the hands of experienced interviewers, it is considered the 'gold standard' for collecting data on F&V intake^{27–29}. Stang and Story³⁰ have summarised the strengths and limitations of various dietary assessment methods used in clinical settings, including 24-hour recall, food frequency, food record and diet history methods. The strengths of the 24-hour recall identified included not requiring literacy, relatively low respondent burden, data may be directly entered in a dietary analysis program, and may be conducted in-person and over the telephone. We addressed the limitations of the 24-hour food recall by providing training and retraining of the interviewers by a nutritionist. Other studies, for example, use the method of plate waste or lunch observation as a measurement of F&V consumption^{18,24}. The advantage of the 24-hour recall over plate waste or lunch observation is that our study was able to assess school meals vs. out-of-school meals.

Applications

This study demonstrates that the frequency of F&V consumed by elementary-school children living in low-income families can be significantly increased by offering a salad bar as a lunch menu option in conjunction with a modest child nutrition educational component. Increasing the dietary intake of F&V among children is a major public health objective and is part of the US *Healthy People 2010* objectives for overweight and nutritional health³¹.

The salad bar intervention was chosen rather than modifying the hot lunch programme because the LAUSD Food Service has a central kitchen that provides most of the hot lunches for the schools in the district. The salad bar was a pilot programme to see if children will actually eat the F&V if offered to them in an appetising and accessible manner. The study demonstrated that children will do this. Since this study, the LAUSD school board voted positively on an Obesity Prevention Motion in 2003 that includes recommending F&V bars as a modification of the hot lunch programme.

Further studies are needed that are designed to follow children prospectively. In addition, more work is needed to evaluate an intervention that combines parent education with school lunch menu changes. Finally, further research should be conducted to investigate the reasons why boys are less likely to eat from the salad bar at lunch and on ways to increase their participation rates in the salad bar lunch menu option.

Acknowledgements

- [TOP](#)
- [Design and methods](#)
- [Results](#)
- [Discussion](#)
- [References](#)

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References

- [TOP](#)
- [Design and methods](#)
- [Results](#)
- [Discussion](#)
- [Acknowledgements](#)

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