

Impact assessment of an intervention on the consumption of fruits and vegetables by students and teachers¹

Avaliação do impacto de uma intervenção no ambiente escolar sobre o consumo de frutas e hortaliças por alunos e professores

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ABSTRACT

Objective

To evaluate the impact of an intervention that promoted the consumption of fruits and vegetables on the intake of these products by students and teachers in *Rio de Janeiro* (RJ), Brazil.

Methods

This is a one-group pretest-posttest study of students and teachers from elementary public schools in *Rio de Janeiro*. The intervention included a training course for promoting healthy eating; distribution of educational materials; and holding of a one-day health fair. We assessed the activities that had been carried out, teachers' habitual fruits and vegetables intake, students' fruits and vegetables intake at school, and intervention-related issues.

Results

Before the intervention, 65.1% of the students consumed the school lunch and most ($\geq 79.4\%$) accepted and consumed the fruits and vegetables served. Most teachers ($>75.0\%$) consumed fruits and other vegetables regularly, but only 36.4% consumed leaf vegetables regularly. The intervention was implemented only moderately (52.7%) but was well accepted by the teachers. The students of schools that implemented the intervention more extensively showed better acceptance of vegetables ($p=0.009$). Teachers' fruits and vegetables intake did not change.

¹ Article based on the dissertation of SC FARIAS intitled "Avaliação de impacto de uma intervenção de promoção de frutas e hortaliças sobre o consumo desses alimentos por alunos e professores de escolas públicas". Universidade do Estado do Rio de Janeiro; 2011.

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Conclusion

Students' fruits and vegetables intake changed modestly. This study contributes to the design of intervention studies for Brazilian schools because it coordinated the National School Food Program with educational activities.

Indexing terms: Fruits. Intervention study. Promotion of Healthy Eating. Students. Vegetables.

RESUMO

Objetivo

Avaliar o impacto de uma intervenção dirigida à promoção de frutas e hortaliças sobre o consumo desses alimentos por alunos e professores no Rio de Janeiro (RJ).

Métodos

Trata-se de estudo de intervenção do tipo antes e depois, não randomizado, com alunos e professores do primeiro ciclo do ensino fundamental de escolas públicas do Rio de Janeiro. A intervenção abarcou um curso de formação sobre promoção da alimentação saudável, distribuição de materiais educativos e realização de feira de saúde na comunidade. Foram avaliadas as atividades de promoção da alimentação saudável desenvolvidas, o consumo usual de frutas e hortaliças pelos professores e o consumo pelos alunos das frutas e hortaliças oferecidas pelo Programa de Alimentação Escolar.

Resultados

Foi observada adesão à alimentação escolar de 65,1% e alta proporção ($\geq 79,4\%$) de alunos que aceitaram e que consumiram frutas e hortaliças na escola no momento pré-intervenção. Observaram-se baixa proporção de consumo regular de verduras (36,4%) e alta de frutas e legumes ($>75,0\%$) entre os professores. A intervenção atingiu nível intermediário de implementação (52,7%), tendo sido bem avaliada pelos professores. Foi observado aumento da aceitação de hortaliças entre alunos das escolas com melhor nível de implementação da intervenção ($p=0,009$). Não houve mudança no consumo de frutas e hortaliças entre professores.

Conclusão

Os resultados alcançados foram modestos em termos de variação do consumo de frutas e hortaliças entre os alunos. O presente estudo contribui para o desenho de estudos de intervenção no ambiente escolar no contexto brasileiro, uma vez que articulou o Programa Nacional de Alimentação Escolar com ações educativas.

Termos de indexação: Frutas. Estudo de intervenção. Promoção da Alimentação Saudável. Estudantes. Verduras.

INTRODUCTION

Inadequate Fruits and Vegetables (FV; here considered as non starchy vegetables) intake occurs in many countries and ranks among the ten risk factors that most contribute to mortality around the world¹. In Brazil FV participation in the number of calories available in households remained relatively stable at 3.0% to 4.0%, which is below the minimum World Health Organization's (WHO) recommendation of at least 6.0% to 7.0%. Moreover, inadequate FV participation was found throughout the country and all income strata, indicating that other factors, in addition to purchasing power, promoted their low consumption². For children, motivating factors such as preference, influence of parents and

friends, the home environment, and access are some determinants of FV intake³. Thus, promoting FV intake today is one of the great challenges and priorities of Brazilian and other countries' public policy agendas⁴.

Schools are one of the best places for promoting healthy food practices and FV intake because they reach a large part of the population. They are favorable environments both for providing a quantitatively and qualitatively balanced diet and for developing health education actions that favor healthy choices⁵, sensitize and train school food professionals, and incorporate the theme healthy diet in the curriculum⁶. Hence, educators are critical for ensuring the success of actions that promote a healthy diet in schools. Educators are

important opinion leaders with a crucial role in actions that promote healthy diets, arousing students' and the school community's interest and participation, and promoting the collective construction of knowledge. Therefore, designing healthy diet-promoting actions requires paying special attention to these professionals' education, and enabling and motivating them to include this theme in their daily activities in a cross-sectional and interdisciplinary manner⁷⁻⁹.

Intervention studies conducted globally assessing the impact of school interventions for promoting healthy diets have found that FV intake increased modestly in the study groups. Such studies have also shown that it is important for these interventions to consider the school's context, assessing the local geographic, economic, social, and environmental factors that impact food choices^{10,11}. In Brazil such interventions have improved schoolchildren's food habits¹²⁻¹⁴, and educator sensitizing and training⁷⁻⁹. Nevertheless, effective public policies require intervention studies to analyze schools subject to different Brazilian realities.

The present study assessed the impact of an intervention that promoted the consumption of FV on the intake of these products by public school students and teachers from a Brazilian city. Aiming to contribute to the advancement of the knowledge on this issue, the study intervention was designed to allow its reproduction in public elementary schools.

METHODS

The present study was part of a larger project called "Building a local intervention strategy for promoting FV intake", coordinated by *Empresa Brasileira de Pesquisa Agropecuária* (Embrapa, Brazilian Agricultural Research Corporation) and many other institutions. Its objective was to develop instruments and strategies to promote FV intake in daycare centers, schools, companies, FV retailers, and households

covered by the *Estratégia da Saúde da Família* (Family Health Strategy) and *Programas de Agentes Comunitários de Saúde* (Community Health Agent Program) located in the western region of the municipality of *Rio de Janeiro* (RJ) that could be used in other cities. This municipal region has a very low Human Development Index (HDI) and the lowest municipal per capita income¹⁵. Communities were selected among the 22 communities located in the catchment area of the larger project covered by the Family Health Strategy when the study activities began. The selection criteria were: presence of schools and FV retailers in the Family Health Strategy catchment area; presence of a well-established Family Health Strategy team with low personnel turnover; and willingness of the Family Health Strategy supervisor to implement the project. Three of the 22 communities had these characteristics, so the project was implemented in them.

This is a one-group pretest-posttest study (therefore, with no control group) conducted in all eight municipal elementary schools located in the three study communities. The study population were the first, second, and third graders, their teachers, and the school principals. These grades were chosen because each class had only one teacher. Hence, the teacher training activities composing the study intervention would be able to focus on a smaller number of teachers who are strong opinion leaders among their students. There were no student or teacher inclusion or exclusion criteria.

The pre-intervention diagnosis occurred in April 2008 to estimate the adherence of the students to the *Programa Nacional de Alimentação Escolar* (PNAE, National School Food Program), their acceptance and intake of the FV served in the school lunch, the habitual FV intake of the teachers, and the existing school activities for promoting healthy eating. The diagnosis included: (1) observing the proportion of students who had lunch on the study days; (2) observing acceptance (students taking the fruits or letting the cook place vegetable items on their plate)

and actual ingestion of the FV; (3) interviewing the teachers and principals or education coordinators; and (4) observing the school environment.

The standard menu of the municipal school network of the city of *Rio de Janeiro* consists of one grain, one legume, one source of animal protein, one vegetable, and one fruit. The vegetable is a side dish or mixed with the meat or grain, and the fruit is served as dessert¹⁶. The students were observed (have lunch and accept and ingest the FV) on three nonconsecutive days when different FV were served. Three days should be enough to observe the level of student acceptance of the FV. This number of days has been used by many studies on food intake, and even as a reference method in validation studies on food intake questionnaires and indicators¹⁷.

For each class, the following data were registered: number of students who had a fruit and a vegetable (registered separately) on their plate; and to what extent these food items were consumed (also registered separately): totally, partially, or not consumed. Data were collected by directly observing the group, not by student. Structured questionnaires were administered to the teachers to collect the following data: habitual FV intake (separate questions for fruits, leaf vegetables, and other non-starchy vegetables), activities performed during class, and interest in participating in discussions and/or activities about the promotion of healthy eating at school. Another questionnaire was administered to the principal or education coordinator to collect information about the development of activities directed to healthy eating promotion. This questionnaire also included a section for registering the existence of posters or other displays promoting healthy eating.

The post-intervention diagnosis performed during the months of October and November 2009 relied on the same pre-intervention data collection procedures. This time the second, third, and fourth graders were studied because they were the first, second, and third graders assessed

and exposed to the intervention in 2008, and they were still in touch with the teachers who participated in the intervention. The questionnaires for teachers and education coordinators also included questions to investigate their knowledge about and use of materials provided by the intervention, their assessment of the project, and how the project contributed to their personal and professional lives.

This phase lasted from July 2009 to July 2009 and included actions to promote healthy eating, emphasizing FV intake, as follows:

The educational activities included a basic training course and school sensitizing and mobilizing activities. The course was offered jointly to the teachers, cooks, and education coordinators of the three communities. Three seats were available per school to be filled preferably by the education coordinator, the reading teacher, and a cook. This course was developed and given by dietitians, home economists, food engineers, agricultural engineers, and educators, members of the larger project on which this study is based, and lasted 28 hours. The course modules included: healthy eating (cooking workshop); home gardening (fruits and vegetables); making full use of FV; education and health: communication tools; and assessment of the previous stages and planning of the school activities.

Professional attendance decreased with each passing module, so a sensitizing activity focused on FV promotion was performed in each school involved in the project as soon as the basic training course ended, on a teachers' meeting day with the school's professionals.

A one-day health fair was held in each community to encourage the community to interact with the schools, daycare centers, and Family Health Strategy units, creating a favorable environment for the development of new actions that promote health and FV intake.

The health fair included: FV-themed games, step-by-step demonstration of how to

wash FV consumed raw, anthropometric assessment, and vaccination, among others. They were performed by the project's researchers together with professionals from the local Family Health Strategy, daycare centers, schools, and local institutions.

At the end of the basic training course and according to participant demand, six educational materials were created to aid FV intake-promoting actions: a booklet with the preliminary results of the pre-intervention diagnosis; a booklet called "Promoting FV intake: Schools and Daycare Centers" containing information about suggested educational activities, including how to encourage students to eat the school food; a booklet called "Promoting FV intake: Food School Program" for the educators responsible for developing the PNAE; educational folder containing the twelve steps to healthy eating based on the "ten steps to a healthy diet", published by the Ministry of Health¹⁸; flyers containing a brief description and the characteristics of four fruits and eight non-starchy vegetables, the importance of consuming them, tips on how to buy and prepare them, and healthy recipes containing them; and a magnetic sheet with step-by-step instructions on how to wash fruits and vegetables. These materials were distributed during an activity to encourage their use directed at teachers, education coordinators, reading teachers, and principals.

Data analysis

The coverage and implementation level of each project action were analyzed and the following indicators were constructed:

- *Educational activities:*
 - School participation in the basic training modules in relation to the number of noted available;
 - Teacher participation in the meeting about promoting FV intake and in the training sessions about how to use the educational materials created by the project team.

- *Access to the educational material produced by the project team:*

- Acknowledgment, expressed in percentage, of each and all the materials produced by the project team;

- *Student activity performed by the interviewed teachers:*

- Students participation in the health fair held in their community;

- Inclusion of the theme food and nutrition in a class activity.

- *Intervention implementation level:*

- Complementarily, a summary indicator was created to express the intervention implementation level by taking the simple mean of the following percentages: (school participation in the training modules + teacher participation in the roundtable + teacher participation in the meeting that taught them how to use the educational materials + teacher's recollection of the booklet Schools and Daycare Centers + teacher's recollection of the magnetic sheet + teacher's recollection of the recipe flyers + teacher's recollection of the 12-steps folder + student participation in the healthy farmer's market + inclusion of the 'food and nutrition' theme as a classroom activity)/9. For example, a school with the following percentages for the items above would have an intervention implementation level of 79.8%: $(60+75+85+90+70+83+60+95+100)/9$. The objective of this indicator was to synthesize the intervention implementation level, allowing measuring how intervention implementation level in each school affected student acceptance and intake of FV, and teacher habitual FV intake.

The indicators intervention adherence; FV acceptance; and FV intake were given by calculating the mean proportions obtained at each school in each collection day. For example, adherence to school lunch was given by the following formula: (number of students (first, second, and third graders) who consumed the PNAE meal on the first day of school "Y"/number

of students at school on the first day of data collection "Y") + (number of students who consumed the PNAE meal on the second day of data collection "Y"/number of students at school on the second day of data collection) + (number of students who consumed the PNAE meal on the third day of data collection "Y"/number of students at school on the third day of data collection "Y")/3x100].

$$\text{Adherence to school lunch} = \frac{(C1/P1) + (C2/P2) + (C3/P3) \times 100}{3}$$

Where C_1 , C_2 , and C_3 are the number of students at first, second, and third graders who *consumed* the PNAE meal on the first, second, and third days of data collection, respectively; and P_1 , P_2 , and P_3 are the number of students at first, second, and third graders who were *present* in school on the first, second, and third days of data collection, respectively.

This indicator was included because student adherence to school meals affects their exposure to FV, which may increase their FV intake¹⁹.

The acceptances of fruits and vegetables in each school were calculated separately in a similar manner (mean number of students who consumed these food items on the respective data collection days divided by the mean number of students who consumed the PNAE meal on the respective data collection days).

The fruit and vegetable intakes were given by dividing the mean number of students who consumed those items (counted separately) divided by the mean number of students who had those items on their plates. Students who ate some or all of the fruits and/or vegetables on their plates were classified as fruit and/or vegetable consumers because (1) the rates of partial intakes (children who did not consume the entire fruit or vegetable serving) were very low, and (2) the analyses that treated them together or separately produced similar results. A second variable was created for fruits: whether the child took the fruit with himself/herself. As can be seen, the variables

that composed the outcome assessment indicators for the students are group-based (ecological), not individual.

The indicators of teachers' habitual FV intake were calculated based on the teachers' answers about their fruit and vegetable intakes (registered separately) in a regular week. These calculations included only the teachers who were interviewed twice, once before and once after the intervention.

These data generated the following pre-intervention and post-intervention indicators: proportion of teachers who consumed fruits, leaf vegetables, and other non-starchy vegetables (noted separately) at least five days a week; and mean number of days per week they consumed fruits and non-starchy vegetables (noted separately).

The answers given by the education coordinators/principals before and after the intervention were compared to identify whether: (1) the number of activities that directed to healthy eating promotion at school increased or decreased, and (2) the education strategy changed.

Finally, the teachers, education coordinators, principals, or principal assistants who participated in the intervention informed their opinion about the project by means of: indicating on a scale of one to five whether the intervention had been implemented at the school; informing how much the intervention contributed to their personal lives; and making comments and suggestions for promoting FV intake at school.

The schools reported that nearly all the students from 2008 returned in 2009. However, the schools could not inform precisely in which classes of each grade the students were placed. Hence, instead of analyzing the data by class, the data was analyzed by school.

First, indicators mentioned above were analyzed descriptively. Next, we calculated the pre- and post-intervention variation in the students' FV acceptance and intake indicators. The paired Student's *t* test was used for statistical analyses of these variations. All tests used a

significance level of 5% ($p < 0.05$). The same procedure was used for analyzing the pre- and post-intervention variation in the mean number of days teachers consumed FV. The McNemar's Chi-Square test assessed the pre- and post-intervention variation in the proportion of teachers who consumed FV on at least five days a week (dichotomous variable).

Finally, linear regression models (or logistic models in the case of teachers' FV intake on at least five days a week) assessed how school intervention implementation level influenced the results. The dependent variables were the variations in students' FV intake and acceptance, and teachers' FV intake. The independent variable was the intervention implementation level adjusted for the students' baseline acceptance and intake, or teachers' baseline intake values. One model was constructed for each dependent variable.

The database was built in the software Microsoft Office Excel 2007, and the data were analyzed by the statistical software Statistical Package for the Social Sciences (SPSS) 13.0.

The larger project of which this study is part was approved by the Research Ethics Committee of *Rio de Janeiro's* (RJ) Municipal Department of Health under Protocol number

120/07. The teachers, principals, and education coordinators who participated in the study signed an Informed Consent Form before entering the study.

The larger project of which this study is part was sponsored by Embrapa Food Technology (Process MP4 04.06.06.015.00) and *Fundação de Amparo à Pesquisa do Estado do Rio de Janeiro* (FAPERJ) (Process E-26 110.203/2007), and supported logistically by *Rio de Janeiro's* City Hall.

RESULTS

Before the intervention, the eight study schools had 70 classes and 2,032 first, second, and third graders. After the intervention, the schools had 67 classes and 1,946 second, third, and fourth graders. A total of 66 and 82 teachers were interviewed before and after the intervention, respectively, and, in each school, one principal or his/her representative before and after the intervention.

At baseline the mean student adherence to the school meal for all eight schools was 65.1%, and a high proportion of the students ($\geq 79.4\%$) accepted and consumed FV (Table 1). A higher proportion of teachers (more than

Table 1. Adherence to school food, and acceptance and intake of fruits and vegetables by students of the eight study schools before and after the intervention. Municipal schools included in the Project FLV-Embrapa. *Rio de Janeiro* (RJ), Brazil, 2008-2009.

| Indicators | Before (95%CI) | After (95%CI) | Δ | p^* |
|--------------------|----------------------|---------------------|----------|-------|
| ATSF | 65.1 (57.3-72.9) | 75.5 (62.7-88.3) | 10.4 | 0.05 |
| Took fruit | 79.4 (70.9-87.8) | 78.6 (69.4-88.0) | -0.8 | 0.78 |
| Ate fruit | 85.4 (79.1-91.8) | 86.8 (78.0-95.6) | 1.4 | 0.84 |
| Kept fruit | 12.1 (6.7-17.5) | 10.5 (1.4-19.6) | -1.6 | 0.79 |
| Accepted vegetable | 85.5 (65.5-105.3) | 90.0 (81.9-98.0) | 4.5 | 0.46 |
| Ate vegetable | 88.3 (81.7-94.8) | 86.5 (79.0-94.0) | -1.8 | 0.68 |

Note: *Paired Student's *t* test comparing the observed means of each school.

Embrapa: *Empresa Brasileira de Pesquisa Agropecuária* (Brazilian Agricultural Research Corporation); 95%CI: Confidence Interval of 95%; Δ : Delta; ATSF: Adherence to School Food.

75.0%) consumed fruits and non-leaf, non-starchy vegetables regularly than leaf vegetables (36.4) regularly. Similar results were found for the mean number of days these foods were consumed (Table 2).

The mean intervention implementation level was intermediate (52.7%), ranging from 38.2% to 65.1%. The scope of each intervention component also varied, from 28.1% to 88.0% (Table 3).

Table 2. Intake of fruits, leaf vegetables, and other vegetables by the interviewed teachers before and after the intervention. Municipal schools included in the Project FLV-Embrapa. Rio de Janeiro (RJ), Brazil, 2008-2009.

| Indicators | Before (95%CI) | After (95%CI) | Δ | p |
|--|---------------------|---------------------|-------|--------|
| <i>Regular intake ≥5 days per week (%)</i> | | | | |
| Fruits | 75.8 (59.0-91.0) | 78.8 (63.0-93.0) | 3.0 | 1.00* |
| Other vegetables | 81.3 (67.0-96.0) | 66.7 (48.0-83.0) | -14.6 | 0.23* |
| Leaf vegetables | 36.4 (20.0-55.0) | 39.4 (20.0-55.0) | 3.0 | 1.00* |
| <i>Mean number of intake days (days)</i> | | | | |
| Fruits | 5.6 (4.9- 6.4) | 5.9 (5.2- 6.5) | 0.3 | 0.44** |
| Other vegetables | 5.7 (5.0- 6.5) | 5.5 (4.7- 6.2) | -0.2 | 0.51** |
| Leaf vegetables | 3.9 (3.0- 4.8) | 4.2 (3.4- 5.0) | 0.3 | 0.31** |

Note: *McNemar's Chi-square test. **Paired Student's t test.

Embrapa: *Empresa Brasileira de Pesquisa Agropecuária* (Brazilian Agricultural Research Corporation); Δ: Delta; 95%CI: Confidence Interval of 95%.

Table 3. Intervention implementation indicators by school. Municipal schools included in the Project FLV-Embrapa. Rio de Janeiro (RJ), Brazil, 2009.

| Indicators | Intervention implementation indicators by school | | | | | | | | |
|--|--|------|------|-------|-------|-------|-------|------|-------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | Total |
| <i>Training activities</i> | | | | | | | | | |
| Basic training* | 93.3 | 13.3 | 13.3 | 26.7 | 53.3 | 13.3 | 6.7 | 26.7 | 30.8 |
| Meeting of FV intake promotion | 33.3 | 42.9 | 50.0 | 16.7 | 80.0 | 100.0 | 44.4 | 50.0 | 52.2 |
| Training for using the intervention material | 55.6 | 57.1 | 33.3 | 83.3 | 20.0 | 75.0 | 44.4 | 33.3 | 50.3 |
| <i>Access to the educational materials</i> | | | | | | | | | |
| School booklet | 42.9 | 33.3 | 50.0 | 42.9 | 75.0 | 37.5 | 0.0 | 25.0 | 38.3 |
| Magnetic sheet | 64.3 | 55.6 | 50.0 | 92.9 | 50.0 | 12.5 | 37.5 | 50.0 | 51.6 |
| Flyers | 92.9 | 55.6 | 50.0 | 100.0 | 62.5 | 25.0 | 75.0 | 50.0 | 63.9 |
| 12 Steps | 78.6 | 55.6 | 50.0 | 57.1 | 75.0 | 62.5 | 62.5 | 37.5 | 59.9 |
| Knew all materials | 11.1 | 33.3 | 66.7 | 41.7 | 60.0 | 0.0 | 0.0 | 16.7 | 28.1 |
| <i>Student activities</i> | | | | | | | | | |
| Take class to the health fair | 33.3 | 57.1 | 50.0 | 83.3 | 0.0 | 50.0 | 4.4 | 0.0 | 39.8 |
| Discuss the theme during class | 77.8 | 85.7 | 85.7 | 83.3 | 100.0 | 100.0 | 100.0 | 71.4 | 88.0 |
| <i>Synthesis indicator**</i> | 63.5 | 50.7 | 48.0 | 65.1 | 57.3 | 52.9 | 46.1 | 38.2 | 52.7 |

Note: *This indicator refers to the intervention coverage according to the number of seats available for each school. The other indicators shown in this table (except for the synthesis indicator) refers to the proportion of target teachers per school who were covered by each intervention component.

**Synthesis indicator= (Σ of the percentages of all indicators in the table (Except recollection of all materials))/9.

Embrapa: *Empresa Brasileira de Pesquisa Agropecuária* (Brazilian Agricultural Research Corporation).

Students' adherence to the school meal, FV acceptance, and FV intake before and after the intervention were similar. Analysis of FV acceptance and intake variations by intervention implementation level showed that only vegetable acceptance improved with higher intervention implementation level ($p=0.009$) (Table 1). The teachers' mean number of days of FV intake and the proportion of teachers who consumed FV regularly did not change (Table 2).

At baseline, seven of the eight study schools had already included diet-related activities in their curricula. Five schools already had food-related materials in display. The materials were displayed in the cafeterias of three schools, classrooms of two schools, or hall of one school.

After the intervention, the theme 'FV' was present in the curriculum of seven schools. The theme was in the curriculum of four schools before 2008, of five in 2008, and of seven in 2009, and three of the eight schools had the theme in the curriculum in all three periods. All schools reported having included the theme 'FV' in routine classroom activities. Some schools had food-related displays in the cafeteria (three schools) and/or classroom (one school).

Of the interviewed teachers and principals/coordinators, 47.1% considered that the intervention had been fully implemented (score of 5). The mean score was 4.2 of a maximum of 5 points. They believe this intervention supported their work of sensitizing students to the theme and encouraged students and teachers to consume FV and adopt healthy habits. Most education professionals expressed the importance of performing ludic activities regularly to promote FV intake at school.

DISCUSSION

The students' and teachers' FV intake in all study schools did not increase. However, students' acceptance of vegetables increased with intervention implementation level. In other words, children were more likely to let cooks put

vegetables on their plate as intervention implementation level increased, suggesting that higher implementation levels would yield better results.

The intervention was implemented in schools with an already high rate of FV acceptance and intake by students and teachers. The teachers had a higher baseline FV intake than the national average for adults^{20,21}. Although many of the student indicators could improve, the maximum possible variation was 20.0%. The Project ProChildren, for example, tried to increase FV intake indicators by 20.0% in an environment with a baseline intake of 17.6% of the 400g recommended per day²². Regardless of the indicators used by that project and the present study, the maximum possible variation depends directly on the baseline values.

The intervention implementation level, critical for its success, was influenced by the schools' curricular flexibility. The low attendance of school personnel in the training activities (30.8%) reflects the difficulties that educators have of leaving their routine activities. A similar difficulty was found in public schools of *São Paulo* (SP) and public and private schools of *Brasília* (DF)^{7,8}, showing the need of viable strategies for training these educators. It is also possible that despite the training, some teachers were not enough mobilized to include the theme in their educational routine.

The intervention was designed to focus on educational activities, that is, to focus on individuals, not on the environment, such as changing the menu or the place where the children ate their meals. The inclusion of cooks in the basic training course may have helped them to improve the school food, but this is not enough to characterize the intervention as having had an environmental component. Interventions that include individual and environmental actions^{5,23,24} by encouraging, supporting, and promoting healthy eating²⁵ achieve better results^{5,23,24}.

The students' post-intervention indicators of school FV intake were not able to detect other

behavioral changes, such as higher FV intake at home and/or changes in lunchbox content. However, the choice of these indicators is justified theoretically and operationally: theoretically because children spend a significant portion of the day at school and need to eat during this time; and because PNAE supplies free meals to all children attending public elementary schools; and operationally because of the difficulty of obtaining accurate information from young children about their food intake, whether at school or elsewhere.

CONCLUSION

Students' and teachers' FV intake did not increase. Despite the limitations, the present study contributes to the design of intervention studies in Brazilian schools by having made a joint assessment of PNAE (through the outcome indicators chosen for the students) and the study educational actions. The study also tried to innovate in the design of its exposure and outcome indicators.

CONTRIBUTORS

SC FARIAS helped to design the study, performed the field work, organized and analyzed the data, and wrote the manuscript. IRR CASTRO helped to design the study, supervised the field work, analyzed the data, and reviewed the manuscript. VM MATTA helped to design the study, analyzed the data, and reviewed the manuscript. LMC CASTRO helped to design the study, performed the field work, organized and reviewed the manuscript.

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