



The Impact of Gardening Experiences on Children's Intake of Vegetables

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ABSTRACT

Fruit and vegetable consumption plays an important role in a healthy diet to prevent nutritional diseases. Nutritionists therefore recommend the intake of five portions of mixed fruit and vegetables a day, excluding potatoes and including only one portion of fruit juice. Research suggests that children's daily intake of vegetables is lower than recommended, and that garden-based nutrition programmes can foster children's vegetable consumption and nutrition behaviour. In Germany, however, little is known about primary-school children's knowledge and intake of vegetables. The current study aimed to investigate children's knowledge of common vegetables (identification test), their preferences for vegetables, and whether knowledge and preferences were associated with gardening experiences. We presented different vegetables to children (n = 119, mean age = 8.4 years) and asked them about their knowledge, their eating habits and experiences in growing vegetables. The results showed that almost a third of the children correctly identified more than a half of the vegetables presented and also liked to eat them. About 44% of the children enjoyed eating vegetables in general, an answer given nearly twice as often by girls than boys. Experiences in growing vegetables had a positive effect on the intake of vegetables. Although further research is needed, our findings suggest that gardening experiences can foster knowledge and consumption of vegetables, and thus contribute to healthy nutrition behaviour.

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Introduction

Fruit and vegetable consumption plays an important role in a healthy diet. They contain essential vitamins, minerals and dietary fibre to prevent diabetes, cancer or cardiovascular diseases. Eating fruit and vegetables in childhood is a predictor of higher vegetable consumption later in life [1]. For an adult, a minimum of 400 g of mixed fruit and vegetables should be eaten every day, or five portions of 80 g [2]. In this recommendation potatoes are excluded and only one portion of fruit juice is advised. The amount varies for children, based on their activity levels and age, but a rough guide is that children should eat a minimum of 200 g of vegetables a day [3]. However, studies suggest that children's daily intake of vegetables is lower than this recommendation [4,5].

Experiences in school gardening can foster vegetable consumption [6-10]. Participants of garden-based nutrition programmes increased their daily vegetable servings [11,12]. Moreover, children with garden-based experiences knew more about nutrition [12-15] and could also identify more vegetables by name than children without these experiences [16]. Growing vegetables can foster children's willingness to taste unknown and unusual looking vegetables [17,18]. It

can also foster positive attitudes towards vegetables [ibid.] and lifelong healthy eating habits [11,12,19].

However, little is known about primary-school children's knowledge and intake of vegetables in Germany. The aim of this study was to investigate children's knowledge of vegetables, their eating habits and the impact of gardening experience on children's vegetable intake. We focused on the following questions: Which vegetables can children identify? Do they like to eat vegetables and how often are they eating them? Is the intake of vegetables related to experiences in growing them and attitudes towards vegetables? Do children know that vegetables are important for a healthy diet? Are there differences in their answers based on sex or age?

Methods

The present sample included 119 children (55% girls). The children were between six and twelve years old (M = 8.4 years). Data were gathered in two ways: firstly, children from six different classes and different schools visiting the open day of our university garden could voluntarily take part in the study (56 participants). Secondly, three teachers of one

primary school in the city of Karlsruhe, Germany volunteered to take part with their pupils (60 participants). The design was the same in both places: after presenting a selection of vegetables to a small group of children they were asked to fill in a questionnaire. If necessary, the researchers helped the younger children to read the questions. Data collection was strictly anonymous and participants were assigned numbers.

The children were asked about their age and sex and whether they had experiences in growing vegetables. Subsequently they had to indicate how much they liked eating vegetables in general (5-step scale ranging from 1: dislike it very much to 5: like it very much) and on how many days a week they eat vegetables.

All children were shown the same eight vegetables for identification (Fig.1). The selection considered raw and cooked eaten vegetables as well as commonly known and unknown types. Selected vegetables were spinach (could be mistaken for salad), kohlrabi (usually eaten cooked in small pieces or raw), celery and beetroot (not commonly known), broccoli (usually eaten in small pieces), carrot (commonly known, eaten raw and cooked), peas (could be mistaken for beans, could be eaten raw but often cooked) and zucchini (could be mistaken for cucumbers). In the subsequent questionnaire, the children were asked to write down the names of the vegetables presented and to indicate whether they had already eaten it (0: no, 1: yes) and liked it or not (0: no, 1: yes). Moreover, the participants were asked to name as many vegetables as they know (in addition to the ones already offered).



Figure 1. Presentation of eight selected vegetables for the children to identify

We also presented seven carrots in different stages of development, shape and size (from ugly to attractive). The carrots were either thin or normal looking, crooked, black from age, muddy, with roots or with green leaves. Children had to indicate for each of the carrots presented whether they would like to eat it and to provide a reason for their decision. Finally, they were asked whether they think that eating vegetables is healthy and why.

Data were analysed with the help of chi-square tests and multiple linear regression analyses (backward

elimination of non-significant factors or variables; $P > 0.05$). To investigate whether students' knowledge of vegetables (number of correctly identified plants) and their weekly intake of vegetables were associated with preferences, experiences, age, and sex, the following variables and factors were initially included in the models: general preference for vegetables (scores of 1-5), weekly intake of vegetable (number of days), age, gardening experiences (0: no, 1: yes), and sex (0: boy, 1: girl). All analyses were carried out with IBM SPSS Statistics 24 for Windows.

Results

About 78% of the children had experiences in cultivating vegetables (mainly tomatoes, carrots and cucumbers) and about 60% had done it at home together with their parents either in a garden or on the balcony (Fig. 2). Children who had experiences in growing certain vegetables found them tastier than children who had not. This relationship was found for broccoli (Chi-square value = 4.49, $P = 0.034$), kohlrabi (Chi-square value = 4.09, $P = 0.043$) and peas (Chi-square value = 4.08, $P = 0.043$).

About 44% of the children enjoyed eating vegetables. However, girls and boys differed in their preferences for vegetables (mean scores of 4.3 ± 0.13 and 3.7 ± 0.14 , respectively; $F_{1,117} = 7.32$, $P = 0.008$). While almost 60% of girls answered that they liked eating vegetables very much, only about 30% of boys felt that way (Fig. 3).

About 20% of the children could not remember their consumption of vegetables during the last week. On average, children consumed vegetables on 3.1 ± 0.24 days per week (Fig. 4). In a multiple linear regression (backward elimination) the weekly intake of vegetables was positively associated with children's age ($b = 0.39$, $P = 0.022$) and their preferences for vegetables ($b = 0.67$, $P = 0.003$).

All children were able to correctly identify carrots, and more than 50% were able to identify broccoli, zucchini and kohlrabi (Fig. 5). Nearly 50% of the children took the peas for a bean, about 30% the spinach for salad and 20% the zucchini for a cucumber. In a multiple linear regression (backward elimination), the number of correctly identified vegetables was positively associated with children's preferences for vegetables ($b = 0.29$, $P = 0.021$) and experiences in cultivating them ($b = 0.80$, $P = 0.011$).

Asked for their favourite vegetables 35% of the children named carrots and 21% cucumbers (Fig. 6). However, almost 20% of children stated that they do not have a favourite.

Nearly all of the children refused to eat the black carrot (Fig. 7). The normal looking and the one with leaves were regarded as tasty by more than 80% of the children. Children with gardening experiences, more often than those without, answered that they would eat the carrot with roots (Chi-square value =

7.49, $P = 0.006$) and the thin carrot (Chi-square value = 3.80, $P = 0.051$).

About 80% of the children considered vegetables an important component of a healthy diet. Most often, they reasoned that vegetables contain vitamins and no sugar (Fig. 8).

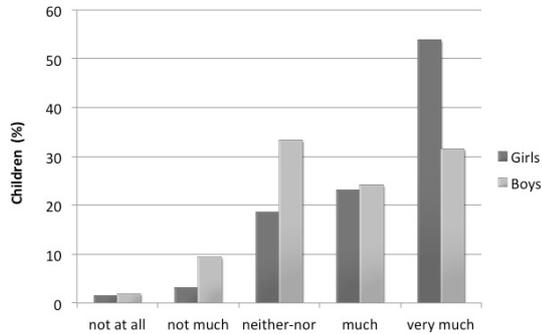


Figure 3. Preferences for vegetables of girls ($n = 65$) and boys ($n = 54$) who ticked one of five answer options on the 5-step rating scale.

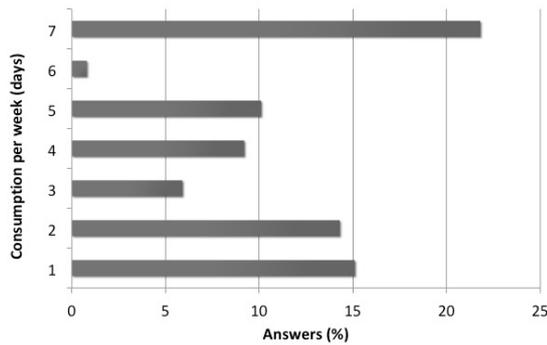


Figure 4. Weekly consumption of vegetables by primary-school children ($n = 95$)

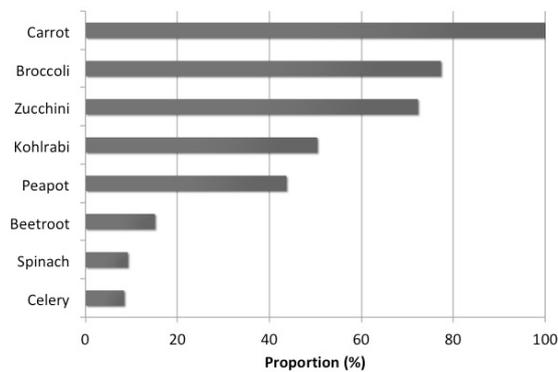


Figure 5. Correctly identified vegetables by primary-school children ($n = 119$)

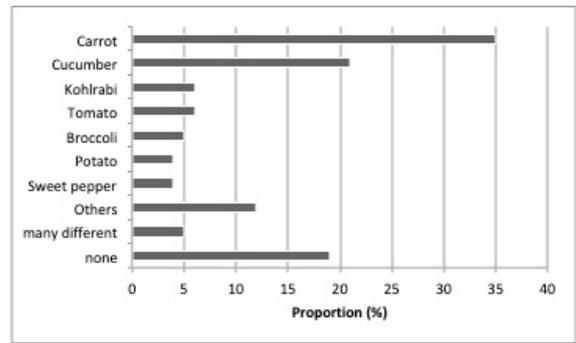


Figure 6. Favourite vegetables (named more than three times) in view of primary-school children ($n = 119$). The category “others” included responses such as cauliflower, peas or salad, multiple answers were allowed.

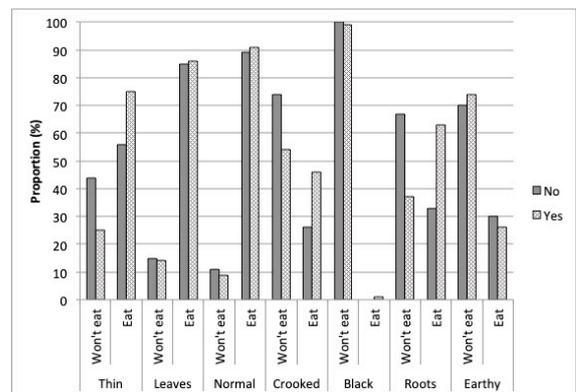


Figure 7. Eating behaviour. Proportion of primary-school children with gardening experiences (yes, $n = 92$) and without (no, $n = 27$) who would eat carrots of different appearance.

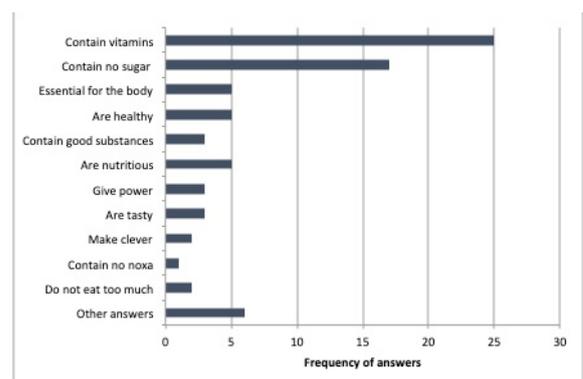


Figure 8. Importance of vegetables in view of primary-school children ($n = 98$). Answers to the open question were sorted into broad categories. The category “other answers” includes responses such as “it tastes disgusting” or “because it is a vegetable”. Multiple answers were allowed.

Discussion and conclusions

In the present study, many children had already experiences with growing vegetables. These experiences were positively associated with a willingness to eat them as already shown in different studies [6,9,11]. More girls than boys preferred eating vegetables, which is in line with the results of a representative study from Germany where girls more often ate vegetables especially raw ones [5]. Another representative pointed out that the intake of vegetables is generally low but the intake of girls is closer to the recommended portion than the intake of boys [4]. The strong association between previous gardening experiences and children's knowledge of and preferences for vegetables indicates a positive effect of school-based gardening approaches. Maybe gardening can compensate the differences.

On average the children consumed vegetables at least three times a week. There was no further specification whether children eat raw, freshly or deep-frozen cooked vegetables. This could be interesting for further studies. The data on the weekly consumption should be interpreted with caution as it was not easy for the younger children to remember if they had eaten vegetables two or three days ago. This might explain the positive association with age. Mensink et al. [6] found that the intake of vegetables decreases with increasing age. However, their participants were up to 17 years old while in our study the older ones were only twelve.

Only a third of the children were able to correctly identify more than half of the vegetables presented. Most often, carrots were correctly named. However, children with previous experiences in growing vegetables performed better in the identification task than those without such experiences. This finding is in line with previous research, which found that school gardening could foster knowledge about vegetables [12-16]. Children prefer eating raw vegetables like carrots or cucumbers [4,5]. The mistake such as taking a pea for a bean or spinach for salad suggests a lack of experiences with the plants. Children know peas without the pod as green little balls, so it is not surprising that they take the peapod for a green bean. Salad leaves are commonly known whereas spinach is generally bought in deep-frozen pieces not in leaves and is just a green puree after cooking. At school, children should be given the opportunity to grow their own vegetables, either in a school garden area or in suitable containers. The cultivation and preparation of these vegetables could help children better understand of the origin of their food [16]. This may increase both knowledge and intake of vegetables, and can therefore contribute to the development of healthy nutrition habits [8,12,13].

Gardening experiences led to a liking of certain vegetables and an acceptance of unusual looking ones [17,18]. With regard to sustainable consump-

tion patterns, this finding is promising. Much food is thrown away because it does not look perfect, although it might be perfect for consumption. Having grown food before seems to influence the acceptance of non-conformal food and could therefore reduce this waste. Growing food in a garden can therefore contribute to education for sustainable development.

Most children considered vegetables as an important component of a healthy diet because they contain vitamins and no sugar. This is an encouraging result as vegetable intake during childhood can lead to a healthy diet in adulthood [1,6,11]. However, it should be noted that the present study was only carried out with overall 119 children from one city in Germany. No teachers or parents were asked to validate the answers of the children. Therefore the results just follow the self-reported consumption behaviour of the children. Despite this limitation, our non-representative results allow some interesting conclusions.

Further research could investigate whether children prefer eating raw vegetables or cooked ones. The effects of colour or sweetness of vegetables on children's preference could give a hint how to increase the intake of vegetables. It would be interesting to ask the participants whether they are vegetarians as an increasing number of adults are. Teachers and parents could be asked about the nutrition behaviour of the children to validate the children's answers.

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