

Short Communication

Increases in fruit intakes in older low consumers of fruit following two community-based repeated exposure interventions

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Abstract

The present study investigated the value of two repeated exposure interventions for increasing intakes of fruit in older people. A total of ninety-five participants (aged 65 years and over) were randomised to receive either one (E1), five (E5) or five plus (E5+) exposures to fruit over a 5-week period. Fruit exposures occurred in community-based church and social groups, through fruit-tasting sessions involving familiar fruits and novel fruit products and dishes (E1, E5, E5+), and through fruit provision (E5+). Daily intakes of fruit and vegetables were assessed before and after all interventions. Liking for all fruits was also measured during repeated exposure (E5, E5+). In low consumers of fruit (one portion/d or less), fruit intakes increased significantly in the repeated exposure groups (E5, E5+) ($t(30) = 5.79, P < 0.01$), but did not change in the E1 group ($t(16) = 0.29, P = 0.78$). No differences were found between E5 and E5+ groups ($F(3,87) = 1.22, P = 0.31$). Similar effects were also found in fruit and vegetable intakes. No effects were found in other participants. Also, no changes in liking were found. These findings suggest that compared to single exposure, repeated exposure to fruit via fruit-tasting sessions once per week for 5 weeks in a community setting significantly improved fruit intakes, and fruit and vegetable intakes in older low consumers of fruit, although no benefits of additional fruit provision were found. Repeated exposure was also easy to implement, of low cost and enjoyable.

Key words: Fruit: Exposure: Intervention: Intakes: Liking: Older people: Low consumers

Intakes of fruit and vegetables in the older population of the UK and elsewhere are currently below those recommended for health^(1–4). Strategies to increase intakes in adults typically focus on changing knowledge and/or attitudes in an attempt to change behaviours^(5–8). While some success has been achieved, however, many of these interventions are individual-based, highly intensive and costly to run.

Strategies to increase intakes in children and young people more often focus on changing liking and familiarity to result in changes in behaviour, and tend to be conducted using exposure, often in groups. These strategies have also achieved success. Deliberate repeated exposure to and tasting of fruit and vegetables have been found to successfully result in increases in liking and consumption^(9–14). Lakkakula *et al.*^(9,10) found the repeated presentation of fruits and vegetables to increase liking; Davis *et al.*⁽¹¹⁾ found increased intakes of fruit following repeated exposure to fruit; Siem Gribble *et al.*⁽¹²⁾ found increased intakes of fruit following

repeated exposure to fruit amongst other strategies; and Wardle *et al.*^(13,14) found the repeated presentation of vegetables to increase liking and intakes of vegetables.

Use of exposure for adults is uncommon. The present study hence aimed to investigate the impact of two repeated exposure interventions for older people on intakes of fruit. The interventions were designed to be enjoyable activities to be undertaken in community-based groups, which could be implemented by non-health professionals.

Methods

Design

The two interventions involved repeated fruit exposure over a 5-week period. Intakes of fruit and vegetables were assessed before and after repeated fruit exposure, and compared to those following a single exposure. Liking for all fruits was also assessed.

Abbreviations: E1, single exposure; E5, five exposure; E5+, five plus exposure.

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Participants

A total of ninety-five participants took part in the study. All participants were aged 65 years or over, were community dwelling and regularly attended a church or social group for older people. Participants were recruited via group announcements, and all participants who volunteered were included in the study, provided they were able to provide informed consent and complete all necessary measures. The study was conducted according to the guidelines laid down in the Declaration of Helsinki and all procedures were approved by the Research Ethics Committee of the School of Psychology, Queen's University, Belfast. Written informed consent was obtained from all participants.

Fruit exposure

For this study, two repeated fruit exposure interventions and one single exposure comparison were used:

- (1) Single exposure (E1): fruit sampling on one occasion only.
- (2) Repeated exposure (E5): fruit sampling on one occasion per week for 5 weeks.
- (3) Repeated exposure Plus (E5+): fruit sampling on one occasion per week for 5 weeks and fruit provision of one portion of fruit per d to be consumed at home for the entire period of 5 weeks.

Participants were randomised into fruit exposure groups on inclusion in the study, based on order of entry (E1 – thirty-nine participants; E5 – thirty-eight participants; E5+ – eighteen participants). Group E1 acted as a control group for repeated exposure, but sampled fruit on one occasion to allow comparisons with other groups in terms of group membership. The interventions lasted for 5 weeks based on suggestions from group leaders during pilot discussions. The primary intention of this study was to investigate effectiveness under realistic conditions.

Fruit sampling

On each fruit sampling occasion, participants were required to sample four familiar fruits – tinned pineapple, tinned peaches, raisins and dried apricots; and four novel fruit products or dishes – white grape juice, strawberry smoothie, stewed apple with cinnamon and stewed pear with ginger. Tinned pineapple, tinned peaches, raisins and dried apricots are regularly consumed by older people in the UK, while the novel fruit products and dishes are not⁽¹⁵⁾. Tinned, dried fruit, and fruit products and dishes were used in preference to fresh fruit to ease the practical aspects of running the interventions (preparation, cost, spoilage and waste), and so aid accessibility for community-based groups. On each occasion, participants were provided with an *ad libitum* supply of each fruit and were asked to sample as much as they wished in order to be able to make judgements on liking. Fruits were sampled in the same order on each occasion, to allow comparability

over time. Familiar fruits and novel fruit products and dishes were alternated in the order.

Fruit provision

Participants in the E5+ group were also provided with one portion of one of the fruits per d for consumption at home. This fruit was selected by the researcher and remained constant over the 5-week period.

Fruit intakes

Intakes of fruit were assessed every week using 24 h food recalls^(16–18). Participants completed each 24 h recall for the day previous to each weekly group meeting, by working through the day from before breakfast to after supper and recording all foods and quantities consumed. All foods were requested to aid completion, and to reduce the possibility of responses due to demand characteristics. Prompts from the researcher, e.g. 'Did you eat anything with your cup of tea?', were also used to ensure completion. Similar 24 h recalls have previously been suggested to provide accurate measures of intake, even in older groups, if prompts are used^(16–18). Participants were also allowed to make diary-type notes the previous day if they wished. Intakes were assessed by converting the amount of fruit consumed to portions/part portions⁽¹⁹⁾, and adding these. Fruit intakes were the primary outcome measure, but vegetable intakes were also measured (using the same method) and added to fruit intakes (portions of fruit and vegetables), to ensure that changes in fruit intakes were not counteracted by corresponding changes in vegetable intakes. Compensatory decreases in vegetable intakes may occur if fruit intakes increase and participants adhere to an idea that a specific number of portions of fruit and vegetables per d are adequate.

Fruit liking

Liking was assessed using 100 mm visual analogue scales of liking ('How much do you like this food item?', anchors: 'not at all', 'extremely') and pleasantness ('How pleasant is this food item?', anchors: 'not at all', 'extremely'), completed for each fruit item, by each individual on each sampling occasion. Individually completed visual analogue scales are commonly used measures of liking^(20,21).

Procedure

Participants undertook all fruit sampling and completed all measures during weekly regular meetings. During each meeting, diet recalls were completed first, followed by fruit sampling where appropriate, followed by fruit provision where appropriate. All activities were conducted as communal activities in groups of four to six individuals, with the help of the researcher, to increase participation, completion and enjoyment, but participants were encouraged to be accurate and truthful. Allocation to exposure group was randomised across all church/social groups.



Analyses

Likings and consumption in week 1 were initially compared across all three fruit exposure groups to ensure comparability. Consumption over the subsequent 4 weeks was then compared in repeated exposure *v.* single exposure groups, and then between the two repeated exposure groups (E5 *v.* E5+). Likings over the subsequent 4 weeks were also compared between the two repeated exposure groups. Comparisons at week 1 were investigated using one-way ANOVA. Comparisons over subsequent weeks were investigated using two-way ANOVA (group × time). Data from week 1 were not used in analyses investigating effects due to time, due to the potential unreliability in these data as the participants familiarised themselves with the measures, particularly the 24 h recall on their first occasion. Data were analysed using intention-to-treat analyses. All participants provided at least three data points, although not necessarily the first three (six participants provided only three data points (E1: three participants, E5: two participants, E5+ : one participant), eleven participants provided four data points (E1: four participants, E5: four participants, E5+ : three participants) and seventy-eight (82%) participants provided data for all five data points). Incomplete data sets were largely a result of other commitments, e.g. doctors appointments, or a lack of transport resulting in the missing of a regular meeting; thus incomplete data sets were completed with means of data points from other weeks. All analyses were conducted twice – once for all participants and once for all participants consuming one portion of fruit per d or less at week 1 – low consumers. One portion of fruit was used as the cut-off for low consumers as the median amount of fruit consumption in the whole sample. Ratings for liking and pleasantness were highly correlated (smallest *r* 0.786, *P*<0.01), and thus only ratings of liking are reported. Data were not analysed for differences between church and social groups, as all exposure groups were represented in each church or social group.

Results

All participants

Group demographics, mean liking for all fruit samples and mean intakes of fruit, and fruit and vegetables for all groups each week are shown in Table 1.

At week 1, no differences were found between groups in all measures (largest *F*(2,94) = 2.81, *P*=0.07), except in liking for familiar fruits (*F*(2,94) = 3.28, *P*=0.04), where familiar fruits were liked significantly more by E1 than by E5 (*t*(74) = 2.29, *P*=0.03), but no differences were found between E1 and E5+, or E5 and E5+ (largest *t*(54) = 1.69, *P*=0.10).

Intakes

Significant increases in fruit intakes were found over time (smallest *F*(3,279) = 4.96, *P*<0.01), but no differences were found between single and repeated exposure groups (group × time interaction: *F*(3,279) = 1.14, *P*=0.33) or between E5 and E5+ groups (group × time interaction:

Table 1. Characteristics, intakes and liking for all groups (Mean values and standard deviations)

Group	Male (%)	Age (years)		Week 1		Week 2		Week 3		Week 4		Week 5		
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
E1 (n 39)	28	76	7	Fruit intakes (portions/d)	1.6	1.3	1.6	0.9	1.8	1.0	1.8	1.2	1.7	1.1
				Fruit and vegetable intakes (portions/d)	2.7	1.6	3.0	1.4	3.3	1.5	3.0	1.8	3.0	1.3
				Liking (mm) – familiar fruits	80	15	80	15	80	15	80	15	80	15
E5 (n 38)	28	74	7	Liking (mm) – novel fruit products and dishes	63	18	63	18	63	18	63	18	63	18
				Fruit intakes (portions/d)	1.2	0.9	1.3	0.9	1.6	1.0	1.6	0.9	1.7	1.1
				Fruit and vegetable intakes (portions/d)	2.1	1.4	1.9	1.2	2.2	1.3	2.1	1.1	2.1	1.3
E5+ (n 18)	34	72	6	Liking (mm) – familiar fruits	72	18	71	16	69	18	70	17	72	18
				Liking (mm) – novel fruit products and dishes	58	21	59	20	58	23	56	22	58	23
				Fruit intakes (portions/d)	1.4	1.0	1.3	1.0	1.5	1.2	1.9	1.5	1.9	0.8
				Fruit and vegetable intakes (portions/d)	2.9	1.4	2.7	1.6	2.8	1.6	3.2	1.7	3.0	1.1
				Liking (mm) – familiar fruits	80	11	71	19	73	19	74	19	76	20
				Liking (mm) – novel fruit products and dishes	57	25	59	24	59	20	59	23	59	25

E1, single exposure; E5, five exposure; E5+, five plus exposure.



$F(3,162) = 0.69, P=0.56$). No differences were found in fruit and vegetable intakes over time (largest $F(3,162) = 2.05, P=0.11$), and no differences were found between single and repeated exposure groups (group \times time interaction: $F(3,279) = 1.05, P=0.37$) or between E5 and E5+ groups (group \times time interaction: $F(3,162) = 1.00, P=0.40$).

Liking

Familiar fruits were liked significantly more than novel fruit products and dishes ($F(1,54) = 31.15, P<0.01$), but no differences were found over time or between E5 and E5+ groups (largest $F(3,162) = 0.80, P=0.50$).

Low consumers

Group sample sizes, demographics, mean liking for all fruit samples and mean intake of fruit, and fruit and vegetables for all groups each week are shown in Table 2. Between groups of low consumers, significant differences were found at week 1, where low consumers in E1 consumed significantly fewer portions of fruit than low consumers in E5 and E5+ ($F(2,47) = 5.68, P<0.01$), and low consumers in E5+ consumed significantly more portions of fruit and vegetables than low consumers in E1 and E5 ($F(2,47) = 3.70, P=0.03$).

Intakes

Number of portions of fruit consumed per d differed significantly between single and repeated exposure groups over the four subsequent weeks (group \times time interaction: $F(3,138) = 3.36, P=0.02$), where consumption increased significantly in the repeated exposure groups ($t(30) = 5.79, P<0.01$), but did not change in the E1 group ($t(16) = 0.29, P=0.78$). Number of portions of fruit consumed per d, however, did not differ between E5 and E5+ groups (group \times time interaction: $F(3,87) = 1.22, P=0.31$). Similar results were also found in portions of fruit and vegetables consumed per d, where consumption increased significantly in the repeated exposure groups ($t(30) = 3.14, P=0.01$), but did not change in the E1 group ($t(16) = 0.04, P=0.97$). Number of portions of fruit and vegetables consumed per d did not differ between E5 and E5+ groups (group \times time interaction $F(3,87) = 0.95, P=0.42$).

Liking

Familiar fruits were liked significantly more than novel fruit products and dishes ($F(1,29) = 10.25, P<0.01$), but no differences were found over time or between E5 and E5+ groups (largest $F(3,87) = 0.64, P=0.59$).

Discussion

These findings suggest first that repeated exposure to fruit can result in increases in fruit intakes in older low consumers of fruit. This effect of repeated exposure has been demonstrated previously in children and young people⁽⁹⁻¹⁴⁾, but, as far as

Table 2. Characteristics, intakes and liking for low consumers (Mean values and standard deviations)

Group	Male (%)	Age (years)		Week 1			Week 2			Week 3			Week 4			Week 5				
		Mean	SD	Mean	SD	Outcome measure	Mean	SD	Outcome measure	Mean	SD	Outcome measure	Mean	SD	Outcome measure	Mean	SD	Outcome measure		
E1 (n 17)	24	77	9	0.3	0.4	Fruit intakes (portions/d)	1.1	0.9	1.2	0.9	1.0	0.8	1.0	0.8	1.0	0.9	0.9	0.9		
						Fruit and vegetable intakes (portions/d)	2.2	1.1	2.4	1.0	1.9	1.1	2.2	1.1	2.2	1.2	1.2	1.2		
						Liking (mm) – familiar fruits	78	18	–	–	–	–	–	–	–	–	–	–	–	–
E5 (n 21)	40	73	7	0.6	0.4	Liking (mm) – novel fruit products and dishes	0.7	0.4	1.2	1.0	1.2	0.8	1.4	0.8	1.4	0.8	1.4	0.8		
						Fruit intakes (portions/d)	1.6	1.6	1.9	1.3	1.8	1.1	1.8	1.1	1.8	1.1	1.8	1.1	1.8	1.2
						Fruit and vegetable intakes (portions/d)	69	18	68	19	70	18	72	18	72	18	72	18	72	18
E5+ (n 10)	44	71	5	0.8	0.2	Liking (mm) – novel fruit products and dishes	60	18	60	24	58	23	61	23	61	23	61	23		
						Fruit intakes (portions/d)	2.7	1.5	2.6	1.6	2.8	1.7	2.8	1.3	3.0	1.4	3.0	1.4	3.0	1.4
						Fruit and vegetable intakes (portions/d)	80	9	78	14	80	11	81	11	81	11	81	11	81	11
						Liking (mm) – familiar fruits	64	22	65	18	68	22	68	22	68	22	68	22		
						Liking (mm) – novel fruit products and dishes	–	–	–	–	–	–	–	–	–	–	–	–		

E1, single exposure; E5, five exposure; E5+, five plus exposure.

I am aware, has only once been demonstrated previously in older people. Essed *et al.*⁽²²⁾ reported increases in fruit drink intakes in older people following exposure to fruit drinks over 12 d. Greater effects in low consumers have also been reported previously^(9,10). Strategies that have an impact specifically on low consumers are of particular value. The magnitude of the effect is relatively small – approximately 3/4 portion; but in these consumers, this represents a meaningful increase. The results of this study are furthermore noteworthy for the limited number of exposures required for effects to be found, and the similar findings in intakes of fruit and intakes of fruit and vegetables. This similarity suggests that increases in fruit consumption are not counteracted by comparable decreases in vegetable consumption.

No differences were found, however, dependent on the amount/type of repeated exposure (no differences were found between those who sampled the fruits on five occasions and those who sampled the fruits on five occasions and were provided with a portion of fruit per d). These findings may first suggest that only a limited amount of exposure is required for effects to be achieved, and that additional exposure is unnecessary. Secondly, however, these findings may also suggest a particular role for the social and enjoyable aspects of the fruit-sampling sessions. The social aspect of the interventions here should not be underestimated. Both single and repeated exposure groups experienced some interaction as a result of group membership, but social interaction was higher in the two repeated exposure groups compared to the single consumption group due to the length of time required for the fruit sampling, and was roughly equal in these two groups as fruit provision was for consumption at home. Other work also demonstrates the benefits of social interaction for fruit and vegetable consumption for older people^(23,24).

The similar findings between the two repeated exposure groups, however, may also have resulted from poor compliance regarding consumption of the provided fruit in the E5+ group. Compliance was not assessed, but anecdotal comments from participants suggested lack of consumption in some cases or redistribution of the provided fruit among partners and friends. The poor consumption of provided fruit suggests that this added component to the fruit sampling intervention may be unnecessary, but other interventions using fruit provision have resulted in significant increases in intakes^(25,26). Compliance may have been increased if participants had selected the fruit with which they were provided, or had been provided with different fruits each week. Interventions that have also provided recipes, cooking classes, or suggested ways to include additional portions of fruit and vegetables in the diet have also reported good compliance^(5,25,27).

The E5+ group may also simply have been too small to detect effects, particularly when comparing groups of low consumers. A repetition or extension of the study with greater numbers would clearly be of value. Greater control in the form of a randomised, controlled trial may also increase the conclusions that can be drawn from the study, such as the number of exposures required for the effects to be achieved, or the likely impact of the social aspects.

The absence of effects on liking is surprising. Liking for fruit and vegetables has previously been associated with consumption^(4,25,28), and changes in liking following repeated exposure in children and young people are often found^(13,14). However, changes in liking in response to repeated exposure were also not found in older people in the study by Essed *et al.*⁽²²⁾. As suggested by Essed *et al.*⁽²²⁾, the lack of changes in liking may demonstrate a resistance to changes in liking in response to the repeated presentation of the same foods in older people. This lack of effect may be related to poorer perceptions of taste and smell, or poorer taste and smell discrimination in older people^(22,29,30). The older people in this study, however, were clearly able to distinguish between fruit items, by demonstrating higher liking for the familiar compared to the unfamiliar fruit items used. Higher liking for familiar foods items is well reported⁽³¹⁾, and does suggest the possibility that unfamiliar food items may become more liked as they become more familiar, but that five exposures were not sufficient for this effect to occur. Detection of the associated benefits of a food may also be necessary for liking to change^(32,33), and this again may not have been sufficient after only five tastings. The absence of effects in liking also suggests that increases in intake do not necessarily result from changes in liking, but may be mediated more by variables such as familiarity or experience^(13,14). These variables, however, were not measured here.

The interventions were also well tolerated by participants and easily implemented. Group leaders commented on the ease with which the interventions could be run, their low cost and their ability to provide enjoyable activities for group members. Participants also reported enjoying the tasting sessions, and the absence of decreases in liking due to monotony or boredom⁽²²⁾ suggests that the interventions were well tolerated, and may be tolerated for longer than 5 weeks. Studies often use more exposures than those used here^(9,14,22), and a longer exposure period may result in greater effects. The interventions could also potentially be improved by the use of different fruits or a choice of fruits. The interventions were conducted using the same eight fruit items each week, but similar interventions have encouraged participants to try as many fruits of a varying selection as they wished per exposure with success^(11,12). Other similar studies have also combined exposure with additional strategies such as rewards, self-monitoring and education^(12,14), again with success. The possibility of achieving greater effects than those achieved here would clearly be of value.

The results of the present study may be slightly compromised by the use of 24 h recall as a measure of intake, but prompts were used as much as possible and notes were allowed to maximise accuracy, and previous studies have reported validity^(17,18). The validity of the measure is also unlikely to systematically differ between exposure groups⁽¹⁶⁾, and reported intakes in all groups were similar to those previously reported in this population⁽¹⁾. Use of alternative measures, however, to provide measures of regular or habitual intakes, and to provide intakes that are unaffected by social desirability, e.g. biomarkers, would be of value. The results of this study may have been affected by social desirability,



but any effects again are unlikely to systematically differ between exposure groups or over time⁽³⁴⁾. The absence of liking measures for E1 at the end of the study also limits the conclusions that can be made about liking, but additional measurement would also have resulted in additional exposure. Measurements of liking may also have been affected by order and/or carry-over effects as the same order was utilised in all fruit sampling sessions⁽³⁵⁾, but systematic differences between groups and over time are again likely to be minimal. The groups of low consumers in this study were also small, and differ significantly at baseline in fruit intakes and fruit and vegetable intakes. The differences at baseline, however, due to their direction are unlikely to have resulted in the major findings.

In conclusion, these analyses demonstrate the potential value of repeated exposure to fruit for older low consumers of fruit. Exposure to fruit via fruit-tasting sessions once a week for 5 weeks was found to significantly improve fruit intakes compared to a single exposure, although additional benefits were not also achieved from fruit provision. The repeated exposure was also easy to implement, of low cost, enjoyable and has the potential to reach far into the community.

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