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The impact of a school-based gardening intervention on intentions and behaviour related to fruit and vegetable consumption in children

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Abstract

Seventy-seven children (34 boys, 43 girls, Mean age \pm SD = 9 \pm 1 years) participated in this study. Forty-six children (intervention) undertook a 12 week school gardening programme and 31 children acted as controls. Measures of the Theory of Planned Behaviour (TPB) and fruit and vegetable consumption were taken pre and post intervention. Repeated measures analysis of variance and hierarchical regression analysis indicated that the intervention group increased daily consumption of fruit and vegetables and increased intentions, attitudes, norms, PBC related to fruit and vegetable consumption. Attitudes, norms and PBC significantly predicted changes in fruit and vegetable consumption.

Key words: Theory of Planned Behaviour; Intervention; Diet; Gardening; Primary Schools

Introduction

Evidence for the health benefits of a diet rich in fruit and vegetables is substantial (He et al., 2007). Despite this, large proportions of children and adolescents do not meet recommended guidelines for fruit and vegetable consumption (Kothe, Mullan, and Butow, 2012; Yngve et al., 2005). Moreover, longitudinal data suggests that eating behaviours adopted in childhood track into adulthood (TeVelde, Twisk, and Brug, 2007). Review data has suggested that preference and availability are the most important predictors of fruit and vegetable consumption in children aged 6-12 years (Blanchette and Brug, 2005). It has also been suggested that five to ten exposures of new foods are often required to increase acceptance and intake of them in children (Thompson et al., 2007; Resnicow, et al., 1997). Increasing knowledge regarding the links between consumption of fruit and vegetables and health outcomes, providing instructions relating to eating behaviour, and allowing opportunity for social comparisons have also been identified as key in enhancing fruit and vegetable consumption (Kothe et al., 2012) whereas food preparation skills may be a barrier to fruit and vegetable consumption (Knai, et al., 2006). Therefore, a major challenge is the development and implementation of interventions that facilitate children's fruit and vegetable consumption (Heim, Stang, and Ireland, 2009), and to help establish healthy eating behaviour in order to ensure children's current and future health.

One context that has been suggested as efficacious for delivering such interventions has been the use of school gardening projects (Heim, Stang, and Ireland, 2009; Jaenke, et al., 2012; Christian, et al., 2012) The premise of a school gardening intervention is that the process of growing food and tending to it in the school setting may provide benefits to eating behaviour through increases in knowledge and understanding about healthy eating as well as providing children with the basic tools to grow their own produce in future. Increases in fruit and vegetable intake and associated factors such as preferences for, and home asking for fruit and

vegetables have been reported as a consequence of such interventions (Heim, Stang, and Ireland, 2009; Robinson-O'Brien, and Heim, 2009; Parmer, et al., 2009). Recent work by Gibbs et al. (2014) has also reported that a two year school gardening and cooking programme increased children's willingness to try new foods, their ability to describe foods and their healthy eating behaviour. Other studies have reported no changes in fruit and vegetable intake as a result of a school gardening programme (Jaenke et al., 2012).

Much of the research to date has been atheoretical and has not attempted to identify the key constructs underpinning behaviour that are required to support habitual fruit and vegetable intake in children (Brug, Oenema, and Ferreira, 2005). The Theory of Planned Behaviour (TPB, Ajzen 1991) is the most strongly supported theoretical model of intention and behaviour related to fruit and vegetable consumption in adults (Guillaumie, Godin, and Vezina-Im, 2010) and has been shown to predict dietary intake prospectively (McEachan, et al., 2011) in adults and to have application in predicting children's eating behaviour (Fila and Smith, 2006; Lautenschlager and Smith, 2007). The TPB is an expectancy-value model in which attitude, subjective norms, and perceived behavioral control (PBC) are proposed to predict behavioural intention which in turn is the best direct predictor of behaviour. Attitude is defined as a positive or negative evaluation of performing a behavior of interest based on expected outcomes. Subjective norm is defined as the social pressure implied by important referent individuals' or groups' approval or disapproval of engaging in a given behavior. Perceived behavioral control is defined as perceived ease or difficulty of performing a behavior. Lautenschlager and Smith (2007) reported that attitude was the best predictor of intention pre and post a community based gardening programme with 8-15 year olds and that perceived behavioural control was predictive of fruit and vegetable eating behaviour for girls but not boys. However, although promising they noted that the lack of a control group and the inclusion of

youth from particular ethnic groups where gardening behaviour was a cultural focus, may have biased their data. Fila and Smith (2006) however, reported no significant association between intention and healthy eating behaviour in a sample of Native American children and adolescents. Furthermore, they reported that subjective norm was the strongest predictor of healthy eating behaviour in boys, with no association being present in girls. It is also important to note that in more recent work by Kothe et al (2012), examining the efficacy of a TPB based intervention on fruit and vegetable consumption that the TPB did not successfully predict behaviour change related to fruit and vegetable consumption.

The available data relating to the efficacy of school gardening is also limited due to the failure of previous studies to include a control group (e.g., Heim, Stang, and Ireland, 2009). The aims of the current study were: a) to examine the impact of a 12-week, theory based school gardening intervention on intention and behaviour related to children's fruit and vegetable consumption, and: b) to examine predictions of intentions and behaviour related to fruit and vegetable consumption.

Methods

Participants

Following ethics approval, parental and child consent, 77 children (34 boys, 43 girls, Mean age \pm SD = 9.0 \pm 0.6 years) from two schools in Coventry volunteered to participate. The research was approved by the Institutional Review Board of Coventry University. Neither school involved had previously engaged in any school gardening activities, both were in the mid-range of socio-economic status as assessed by the index of multiple deprivation (placing both schools in the region 50-59.9% for deprivation nationally as compared across Lower Layer Super Output Area data), and had comparable school environments in relation to green space, outdoor areas and prior and current experience with school gardening. Children from one school (n

= 46, 27 girls, 19 boys) undertook a 12-week theory-based intervention involving creation of a school garden with associated curriculum time devoted to cooking and exploring plants and growth in science and literacy. Children from the second school acted as a control group (n = 31, 17 girls, 14 boys) and continued their standard school curriculum activity. Seventy-two children completed the follow-up questionnaires including 46 children in the intervention group and 26 children in the control group.

Procedures

All children completed validated measures of the constructs of the Theory of Planned Behaviour (TPB) related to fruit and vegetable consumption (Kothe, Mullan and Butow, 2012) and a measure of fruit and vegetable eating behaviour (DILQ, Edmunds and Ziebland, 2002) pre- and post-intervention. Height and body mass (to the nearest mm and 0.1kg respectively) were also recorded barefoot using a stadiometer and weighing scales (Seca Instruments, Hamburg, Germany). Body mass index (BMI, kg/m²) was calculated and weight status classified according to IOTF criteria (Cole et al., 2000). Thirty-three percent (n=24) of the sample were found to be overweight/obese.

The TPB questionnaire was designed using guidelines for TPB questionnaire construction (Francis et al., 2004) and acceptable internal reliability was evidenced via Cronbach's α scores ranging from .81-.92 by Kothe et al. (2012). Attitude was assessed using the stem item 'for me eating five portions of fruit or vegetables each day over the next week would be'. Five bipolar adjective scales were scored on a 7-point Likert scale using terms such as bad/good and difficult/easy. Overall attitude was determined from the summed responses. Subjective Norm was assessed using three questions rated on a 7-point Likert scale. The items assessed injunctive and descriptive norms, e.g., "Most people who are important to me want me to eat 5

portions of fruit and vegetables each day". Perceived Behavioural Control (PBC) was assessed using 3 items scored on a 7 point Likert scale using descriptors that captured both internal and external control (Ajzen, 1991), e.g., 'It is mostly up to me whether or not I eat 5 servings of fruit and vegetables each day'. Intention to consume fruit and vegetables was assessed using two questions (one for fruit, one for vegetables), on a 10 cm visual analogue scale. In each case this asked 'I plan to eat 5 servings of each day from now on'.

The Day in the Life Questionnaire (DILQ, Edmunds and Ziebland, 2002) was employed to assess fruit and vegetable consumption behaviour. This is a child specific and validated measure of fruit and vegetable consumption and was completed one week following completion of TPB measures. The DILQ measures food and beverage consumption at home, in transit to and from school, and at school and is interviewer administered. It allows the child to use word and pictures to recall their food intake from the previous day with every fruit and vegetable recalled scoring one point/portion; these were summed to create a DILQ score. Standardised instruction for administration and completion of the DILQ were followed throughout. It has previously been shown to be a valid, reliable and sensitive measure of children's fruit and vegetable intake (Edmunds and Ziebland).

School Gardening Intervention

The intervention group participated in a 12 week school gardening intervention with supporting curricula activities. The content of the intervention was designed using the taxonomy of behaviour change (Abraham and Michie, 2008) specifically drawing on techniques previously identified as being linked to the TPB (Abraham, Kok, Schlaama and Luszczynska, 2010; Kothe et al., 2012). For example, providing knowledge and information relating to the relationship between fruit and vegetable consumption and health is suggested to be relevant to attitude formation through the development of outcome expectancies. Activities which provide

information regarding what others eat and providing opportunity for social comparison is suggested to relate to subjective norm. Provision of instruction, educating children on how to perform a behaviour (e.g., how to grow fruit and vegetables) and demonstrating to the children that they can successfully perform the behaviour (e.g., growing fruit and vegetables) relates to PBC.

Gardening Activities: During week one the children were involved in constructing six raised beds resulting in a plot approximately 20m X 30m. Children then undertook twice weekly gardening sessions lasting approximately 30 minutes per session for the remaining 11 weeks of the intervention. Beans, courgettes, radishes, cucumbers, lettuce, rocket, carrots, sweetcorn, baby pumpkins and sweet peas were planted in the second week of the intervention. The children then tended to their garden in the remaining sessions. In these sessions children learned about planting, weeding, tending to and harvesting the foods they had grown. Children were also encouraged to touch, smell and feel the fruit and vegetables when they were tending to them (Kjelgren and Buhrkall, 2010).

Curricula Activities: The gardening activities were accompanied with curricula activities relating to growth and development in school science, learning about food, plant parts, nutrient needs and environmental issues related to food growth during four lessons delivered during weeks 2-5. From the 6th week onwards children tasted various fruit and vegetables (including some of the same types they were growing) and were encouraged to pick and eat some of the produce that was growing whilst they were tending to the garden. Throughout the period the origin of fruit and vegetables was discussed as were the nutritional benefits and potential ways to eat the fruit and vegetables. In the final two weeks children were asked to design their own healthy meals, discuss the composition of their creations and compare across the various meals created and then create/cook these in the final week using the fruit

and vegetables they had grown. The children were also encouraged to act as agents of change by sharing their experiences with family members at home and to ask for the fruits and vegetables they grew in the school garden at home. In this way the school garden project was also guided by social cognitive theory (Bandura, 1995) and experiential learning principles which have previously been effective in similar projects (Heim, Stang and Ireland, 2009).

Statistical Analysis

Any changes in the constructs of the TPB related to fruit and vegetable intention and behaviour, self-reported fruit and vegetable consumption via the DILQ and BMI were analysed using a series of 2 (intervention vs. control) X 2 (pre vs post) repeated measures analysis of variance. Where significant differences were found, Bonferroni post-hoc pairwise comparisons were used to determine where the differences lay. Hierarchical linear regression was also used to predict changes in fruit and vegetable eating behaviour from constructs of the TPB in the intervention and control groups, where changes are observed. Partial eta squared ($P\eta^2$) was used as a measure of effect size. The Statistical Package for Social Sciences (SPSS, Version 19, Chicago, IL, USA) was used for all analysis.

Results

At baseline there were no differences in age, gender or BMI between groups. In addition, there were no differences in baseline self-reported fruit and vegetable consumption, intentions, attitudes, norms and PBC ($P > .1$).

Changes in constructs of the TPB and fruit and vegetable consumption

Results from repeated measures ANOVA revealed a significant time x group interaction for self-reported fruit and vegetable consumption ($F(1, 70) = 24.22, P < .001, P\eta^2 = .26$, See Figure 1). Children in the intervention group increased fruit and

vegetable consumption (mean \pm SD = +1.4 \pm 1.5 portions/day, $p < .01$), whereas those in the control group did not (mean \pm SD = +0.2 \pm 1.2 portions/day, $p > .1$). In regard to the constructs of the TPB, repeated measures ANOVA indicated significant time \times group interactions for intention ($F(1, 70) = 9.79$, $P < .001$, $P\eta^2 = .123$), attitude ($F(1, 70) = 42.98$, $P < .001$, $P\eta^2 = .38$), norms ($F(1, 70) = 19.36$, $P < .001$, $P\eta^2 = .22$) and PBC ($F(1, 70) = 72.69$, $P < .001$, $P\eta^2 = .51$). In all cases, the constructs of the TPB increased pre to post for the intervention group (all $P < .01$), but did not significantly increase pre to post intervention for the control group (all $P > .1$). Mean \pm SE of constructs of the TPB for intervention and control groups pre to post the intervention are presented in Table 1. BMI decreased over time ($F(1,70)=6.13$, $P = .02$, $P\eta^2 = .08$) but these changes did not differ by group, i.e., the time \times group interaction was not significant ($F(1,70)=1.78$, $P = .19$, $P\eta^2 = .03$).

INSERT FIGURE1 HERE

INSERT TABLE1 HERE

Utility of the TPB in predicting intention and behaviour relating to fruit and vegetable consumption

In the first instance, bivariate correlations were used to examine relationships between variables in the intervention group. attitudes at baseline was inversely related to changes in self-reported fruit and vegetable consumption at the $P = .1$ level ($r = -.26$, $P = .07$); none of the TPB variables were related to changes in intention.

Hierarchical linear regression revealed that changes in intention were not predicted by TPB variables ($R^2 = .08$, $P > .1$). However, TPB variables (PBC, attitudes and norms) predicted changes in self-reported fruit and vegetable consumption,

accounting for 17% of the variance ($P < .05$); norms were the only significant predictor ($B = .47$, $SE = .21$, $\beta = .37$, $P = .03$) although attitudes were a predictor at $P = .1$ level ($\beta = .50$, $SE = .27$, $\beta = -.37$, $P = .08$).

Discussion

The results of this study support prior work which has shown school gardening interventions to have a positive impact on children's fruit and vegetable consumption (Heim, Stang and Ireland, 2009; Robinson-O'Brien, Story and Heim, 2009; Parmer et al., 2009). The current study extends prior work in this area in two ways. Prior research examining the efficacy of school garden interventions has not tended to employ a control group with which to compare findings in the intervention group and prior studies have lacked a clear theoretical basis against which the interventions is designed limiting their capacity to identify the key mechanisms and constructs underpinning behaviour.

In comparison to the control group, all TPB variables increased significantly pre to post intervention in the school gardening group suggesting the adoption of a theory-based intervention (Michie, 2004) in which the mechanisms underpinning the intervention are mapped to a specific model is an appropriate approach to test the efficacy of such models .

The results of the current study suggest that TPB is useful in explaining the proportion of variance in intention and behaviour for fruit and vegetable consumption in primary school children. These findings are in line with prior work by Lautenschlager and Smith (2007) and Backman, et al. (2002) which also supported the utility of the TPB in explaining healthy eating behaviour in children and adolescents. Furthermore, in line with Lautenschlager and Smith (2007) we found that attitudes were the strongest predictor of changes in behaviour in bivariate analysis. However, the results of the present study in are somewhat different to those

reported previously in respect of gender differences (e.g., Lautenschlager and Smith, 2007) as fruit and vegetable consumption increased post intervention for both boys and girls. Moreover, in the present study the only TPB variable to predict behaviour change was subjective norm. This is in contrast to the conclusions made by Kothe et al (2012), that the TPB was not effective in predicting behaviour change related to fruit and vegetable consumption. This discrepancy may be due to the younger age of participants investigated in the present study and that of Kothe et al (2012) but might also be due to differences in the interventions employed. In the current study, emphasis was placed on working collectively and collaboratively in both gardening and curricula activities whereas this was not the case in the intervention employed by Kothe et al (2012). This difference may then explain the discrepancy between the two studies and why subjective norm was a stronger predictor of behaviour change in the current study than in prior research.

This study is not without its limitations. The schools involved in the study were both in the mid-range of socio-economic status for schools in the city of Coventry. Whether such findings would transfer to more deprived and low socio-economic status or more affluent participants is unknown. There was also no randomisation of groups in the present study having adopted a school-level matched controlled design. There are other confounding variables that may also have impacted on the running of the current intervention such as the actions of the class teachers and parental involvement at home. Such interactions with the children are difficult to account for or control. In the present study, the class teachers were however asked to restrict their input relating to fruit/vegetable consumption to sessions relating to school gardening and curriculum alone in an attempt to minimise any additional exposure to messages related to eating fruit or vegetables outside of the intervention itself. However, the results of the current study suggest more than a whole portion increase in fruit and vegetable consumption. Increases in this behaviour may be

more impressive where baseline fruit and vegetable consumption is well below desired levels as the findings suggest that increases in consumption were most marked in those who had the least positive attitudes to fruit and vegetable consumption at baseline. The present study also focused solely on fruit and vegetable consumption. This was because in the process of school gardening, we assumed an explicit link between the produce grown (e.g. fruit and vegetables) and intention and behaviour relating to fruit and vegetable consumption. However it is possible that the intervention could have influenced intention and behaviour relating to other dietary behaviours (e.g. reducing fat, sugar, salt consumption). Future research examining the effect of school-based gardening or other diet-related interventions on dietary behaviours not examined here would be useful in understanding the breadth of impact that such interventions may have on children's dietary habits.

Although the present study did use a control group, the results represent responses to a school gardening intervention in one school only and trialling this form of intervention in a larger cross-city multi-site sample including suburban and rural settings would be desirable to fully determine the impact of structured school gardening programmes on children's healthy eating behaviour. We also accept the use of a self-report the measure of fruit and vegetable consumption may not be able to fully quantify the exact volume of fruit and vegetables consumed by participants. Using more labour-intensive methods of diet capture may be useful in future studies, although these should be considered alongside the higher participant burden and error that accompanies such methods when used in paediatric samples (Margarey et al., 2011). However, the measure employed in this study is child-specific and has shown good validity for this purpose (Edmunds and Ziebland, 2002). Finally, consideration of the resources required to deliver school based interventions cannot be ignored. Knowledge and skills to support fruit and vegetable production is

essential to the success of such interventions alongside suitable space in the school setting and curriculum to support the multimodal nature of these interventions. Therefore suitable human and environmental resource is required to make such interventions successful.

Conclusions

The results of the present study suggest that a school gardening intervention is effective in increasing daily fruit and vegetable consumption in British primary school children. However, in the context of behaviour change, the results of this study do not wholly support the TPB model. Only one theoretical construct from the TPB, subjective norm, predicted changes in fruit and vegetable consumption. Taken alongside other research using this model, it appears the TPB may be limited in its ability to explain behaviour change related to children's fruit and vegetable consumption.

Conflict of Interests: None

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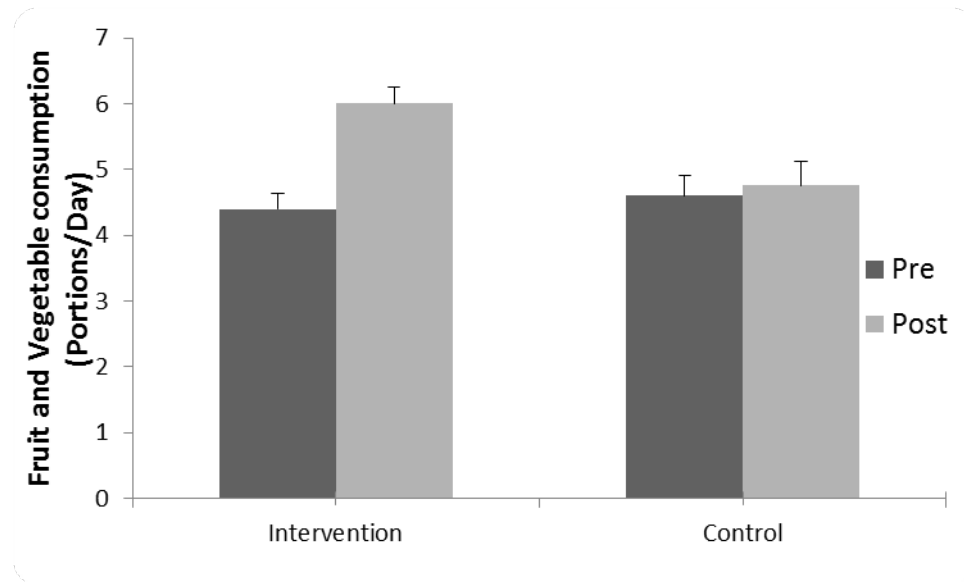


Figure 1. Mean \pm SE of fruit and vegetable consumption (portions/day) in intervention and control groups pre and post the intervention period.

Table 1. Mean \pm SE of constructs of BMI and TPB variables in intervention and control groups pre and post the intervention period.

	Intervention				Control			
	Pre		Post		Pre		Post	
	M	SE	M	SE	M	SE	M	SE
Intention	63.1	2.4	70.3	2.1	59.7	3.2	59.7	2.7
Attitude	4.6	.16	5.4	.12	4.3	.22	4.1	.16
Norms	4.6	.17	5.1	.14	4.7	.22	4.6	.18
PBC	3.8	.18	5.5	.12	3.4	.25	3.3	.17
BMI	18.1	.4	17.7	.4	18.4	.5	18.3	.6

