

This is an Open Access document downloaded from ORCA, Cardiff University's institutional repository: <https://orca.cardiff.ac.uk/id/eprint/122952/>

This is the author's version of a work that was submitted to / accepted for publication.

Citation for final published version:

Bharucha, Zareen Pervez, Weinstein, Netta , Watson, Dave and Boehm, Steffen 2020. Participation in local food projects is associated with better psychological well-being: Evidence from the East of England. *Journal of Public Health* 42 (2) , e187-e197. 10.1093/pubmed/fdz057

Publishers page: <https://doi.org/10.1093/pubmed/fdz057>

Please note:

Changes made as a result of publishing processes such as copy-editing, formatting and page numbers may not be reflected in this version. For the definitive version of this publication, please refer to the published source. You are advised to consult the publisher's version if you wish to cite this paper.

This version is being made available in accordance with publisher policies. See <http://orca.cf.ac.uk/policies.html> for usage policies. Copyright and moral rights for publications made available in ORCA are retained by the copyright holders.



1 **Participation in local food projects is associated with better psychological**  
2 **well-being: Evidence from the East of England.**

3  
4 Zareen Pervez Bharucha<sup>1\*</sup>, Netta Weinstein<sup>2</sup>, Dave Watson<sup>3</sup>, Steffen Boehm<sup>4</sup>

5  
6 <sup>1</sup>Global Sustainability Institute, Anglia Ruskin University, 183 East Road, Cambridge CB11PT, UK.

7 Corresponding author. E: [zareen.bharucha@anglia.ac.uk](mailto:zareen.bharucha@anglia.ac.uk)

8 <sup>2</sup>School of Psychology, Cardiff University, Tower Building, 70 Park Place, Cardiff CF10 3AT, UK

9 <sup>3</sup>Norwich Business School, University of East Anglia, Earlham Road, Norwich NR4 7TJ, UK

10 <sup>4</sup>University of Exeter Business School, Penryn Campus, Penryn, Cornwall, TR10 9FE, UK

11  
12

13 **ABSTRACT**

14 **Background:** Studies suggest that local food may contribute to well-being, but do not  
15 use standardised measures, or control groups.

16 **Methods:** An online survey compared participants of local food initiatives (n=302) with  
17 members of the general population (n=157) in terms of scores on standardised measures  
18 of well-being and distress. Using hierarchical ordinary least squares regression models,  
19 we explored the relationship between participation and well-being via four mediators –  
20 nature connectedness, psychological need satisfaction, diet and physical activity.

21 **Results:** Participants scored higher than non-participants on life satisfaction ( $t(346) =$   
22  $2.30, p = .02, \rho r = .12$ ) and the WEMWBS scale ( $t(335) = 2.12, p = .04, \rho r = .10$ ), but  
23 differences in psychological distress were insignificant. More actively engaged  
24 participants scored higher on positive well-being and longer duration participation was  
25 associated with higher life satisfaction and less psychological distress. Finally, we found  
26 that participation contributes to psychological need satisfaction, better diet and  
27 connection to nature, three known drivers of well-being.

28 **Conclusions:** Well-being may be a co-benefit of local food initiatives beyond the  
29 physical and psychological benefits of growing food. Further research is needed to  
30 explore the mediators driving these effects, quantify benefits, and track impacts over  
31 time and across different social groups.

32 **KEYWORDS**

33 Communities, Food and nutrition, Mental health

34  
35  
36  
37  
38

39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60  
61  
62  
63  
64  
65

## INTRODUCTION

The contribution of alternative modes of food production, provisioning and consumption to physical health<sup>1, 2, 3, 4</sup> diets<sup>5, 6</sup> and social goods<sup>7, 8</sup> has been highlighted, but in the sphere of potential contributions to mental health, there is a lack of generalisable evidence<sup>9</sup>.

This gap is worth addressing, because psychological well-being generates benefits for individuals and societies, including good health, longevity, improved relationships, better productivity and civic citizenship<sup>10, 11</sup>. Additionally, mental illness presents a growing global public health crisis<sup>12</sup>, with an estimated burden of 32.4% of years lived with disability and 13% of disability-adjusted life-years<sup>13</sup>. In the UK, mental ill-health contributes to 28% of the total disease burden<sup>14</sup>. Fostering well-being may confer a protective effect against the later onset of ill-health<sup>15</sup>. Relevant drivers include diet<sup>16, 17, 18, 19</sup>, physical activity<sup>20, 21</sup>, connection to nature<sup>22</sup>, social connection<sup>23</sup> and the opportunity to fulfil basic psychological needs for autonomy, competence and relatedness<sup>24</sup>. Several of these drivers are potentially manifest in local food initiatives, as we outline subsequently.

Definitions of 'local' food vary<sup>25</sup> from 30 miles<sup>26</sup>, to 400 miles<sup>27</sup> between farm and fork. Our paper focuses on seven different types of local food initiative (Table 1), reflecting the diversity of the movement.

66 **Table 1: A brief outline of seven different types of local food initiative in the UK and their scale**  
 67 **in terms of number of initiative or number of consumers involved.**

68  
 69  
 70

INITIATIVE	DESCRIPTION	SCALE
<b>Supermarket ranges of specialist 'local' food</b>	Consumers purchase locally-sourced food in a conventional retail environment. Consumer participation is limited to selecting items chosen by suppliers who curate ranges, manage stocks and set prices.	Local and regional food represents ≈6% of food and drink sales (Defra 2003). Between 2010 and 2011, local ranges in one supermarket chain alone increased by £130 million (Rohwedder 2011).
<b>Community shops</b>	Community-run retail outlets selling locally-sourced produce, with community members and business-owners typically interacting more frequently than is the norm in mainstream retail environments.	~337 community shops (Plunkett Foundation 2016).
<b>Box schemes</b>	Consumers are sent locally-produced food, usually weekly. Participants may exercise limited choice over the content of their boxes. Scheme sizes vary greatly, from 50,000+ customers to schemes with a few dozen participants.	Over 500 schemes (ethicalconsumer.org 2016).
<b>Farmers' markets</b>	Farmers sell locally-grown produce within farmers' markets.	~ 500 markets; 250 are FARMA-certified, guaranteeing the provision of ethically- or locally-produced food (DEFRA 2013)
<b>Buying cooperatives</b>	Groups self-organise to bulk-buy produce, choosing what to purchase, where to source goods and enjoying lower prices due to bulk purchases.	There are 6,796 cooperative businesses in the UK, owned by around 15 million people. 416 are retail cooperatives, and 621 are agricultural (Cooperatives UK)
<b>Allotments</b>	Individuals cultivate food on allotment plots, exercising sole discretion over their choices in line with allotment regulations, and are solely responsible for food production.	~330,000 plots; 90,000 more are needed to meet demand (National Allotment Society, 2016)
<b>Community food growing</b>	Collectively-run production in community-managed gardens. Small groups participate in joint decisions about what to grow, and collaborate to grow and distribute food.	~1000 community gardens (Federation of City Farms & Community Gardens, 2016).

71  
72  
73  
74  
75 Consumer interest in local food is growing. Two-thirds of consumers in the US and 80% in the UK  
76 express an interest in buying local produce<sup>28, 29</sup>. Over half of US consumers seek information on  
77 the provenance of their food<sup>30</sup> and retail sales for local ranges have grown by 13% annually since  
78 2008<sup>31</sup>. In the UK, some 6 million are interested in having an allotment<sup>32</sup>. The number of  
79 farmers' markets has grown over 20-fold, from 340 in 1970 to 8,000 in 2012<sup>33</sup> and in the US, the  
80 number of community-supported agriculture schemes has grown from 2 projects in the 1980s to  
81 over 3,500 in 2009<sup>34</sup>.

82  
83 Growing food offers an opportunity for green exercise, which enhances both physical and  
84 mental well-being<sup>35</sup>. Allotment gardeners report higher levels of physical activity, scoring better  
85 than non-gardeners on all measures of health and well-being<sup>36</sup>, including better mood, self-  
86 esteem, general health and vigour, and less mood disturbance, depression and fatigue<sup>37</sup>.

87  
88 All forms of local food initiatives engage people with the physical context of food growing either  
89 directly or indirectly through a discourse of more sustainable production and a re-connection to  
90 the natural elements of its production<sup>38</sup>. Nature connectedness is positively associated with  
91 vitality, subjective well-being and happiness<sup>22, 39; 40; 41; 42; 43; 44; 45</sup>, reduced physiological markers of  
92 stress<sup>46</sup> and lower mental distress<sup>47</sup>. Diet – and particularly the consumption of fresh fruit and  
93 vegetables – is important for mental well-being<sup>19; 48</sup> and engagement with food initiatives has  
94 also been shown to improve diets<sup>6; 49</sup>.

95

96 Finally, well-being is associated with the satisfaction of three basic psychological needs – for  
97 *autonomy*, or an experience of choice and volition in one’s actions; *competence*, or the feeling  
98 one is efficacious and can achieve desired outcomes in the world, and *relatedness*, or the  
99 experience of closeness and connected with others<sup>24, 50</sup>. Need satisfaction is associated with  
100 greater happiness and life satisfaction and lower symptoms of depression and anxiety<sup>51, 52, 53, 54</sup>.  
101 Local food projects may offer opportunities to satisfy all three needs, by increasing ecological  
102 literacy and improving food preparation skills (autonomy and competence), providing a sense of  
103 belonging and shared goals (relatedness) and giving people the ability to participate directly in a  
104 social enterprise (competence and relatedness).

105

106 These benefits are implicitly recognised by practitioners<sup>55</sup> but there is as yet no generalisable  
107 evidence on the links between participation in local food initiatives and mental health, with the  
108 exception of studies on food-growing that focus primarily on its contribution to green exercise<sup>4</sup>.  
109 Existing studies have not used standardised measures of psychological well-being or distress,  
110 nor focused on the general (rather than the therapeutic) population<sup>56</sup>. Initiatives that do not  
111 involve a food-growing component are largely unexamined.

112

113 To fill these gaps, we explored whether participation in a range of local food projects would be  
114 associated with higher well-being relative to a control group of non-participants, among a  
115 sample from the general population, and we examine, for the first time, the mechanisms that  
116 may underlie any association.

117 We hypothesise:

118 (1) Participants in local food projects would score *higher* on well-being and *lower* on  
119 measures of psychological distress than non-participants;

120 (2) Increased participation would be associated with increased well-being and lower levels  
121 of distress.

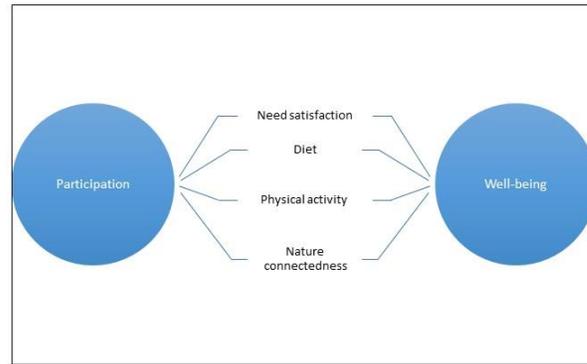
122 (3) Four mediators would indirectly influence the association between food project  
123 engagement and well-being – connection to nature, the satisfaction of basic  
124 psychological needs, diet and outdoor physical activity (Figure 1).

125

126

127

128 **Figure 1: Model showing hypothesised links between participation in local food projects and**  
129 **well-being mediators of psychological need satisfaction, nature connectedness and outdoor**  
130 **physical activity.**  
131



132  
133  
134  
135

## 136 **METHODS**

137

138 A questionnaire was deployed using Qualtrics (qualtrics.com), an online tool for collecting,  
139 storing and analysing survey data. Online surveying was used in order to generate a large  
140 sample across three English counties – Essex, Norfolk and Suffolk – within the context of a time-  
141 bound research project.

142

### 143 *Participants*

144 Survey respondents were recruited via a mix of snowballing from known contacts and  
145 convenience sampling, using the following methods:

146 (1) We targeted local food participants by emailing the survey link to gatekeepers in local  
147 food projects. Recipients were asked to send the survey link to participants in their  
148 initiatives, onward through their wider networks, as well as to contacts who could give  
149 their views as non-participants. In cases where emails were unanswered and a contact  
150 number was available, we followed up with a phone call.

151 (2) We wrote a short post about the research on our project website, with a link to the  
152 survey, and advertised this using the project Facebook page and Twitter account, as well  
153 as the personal social media accounts of the researchers involved. These posts (website  
154 and social media) asked for people to share the link to the survey and highlighted that  
155 we were searching for both participants in local food projects as well as non-participants  
156 drawn from the general public.

157 (3) Finally, we wrote a short press release summarising the project and calling for survey  
158 respondents. This was picked up by the online edition of a local newspaper, which  
159 helped to spread word within the study area.

160 The survey was not password-protected, allowing respondents to share it onward as widely  
161 as possible. No incentives were offered to participants for completing the survey.

162

163

#### 164 *Variables*

165 The same survey instrument was used for both participants and non-participants, with some  
166 questions in common and others pertaining to the details of participation (these were restricted  
167 to respondents who had self-identified as such). Questions were put to all respondents in the  
168 same order, and are summarised in Table 2.

169

170  
171  
172  
173

**Table 2: Variables included in a survey comparing well-being scores of participants and non-participants in local food projects in the East of England and testing for potential mediators of any differences found.**

Variable	Survey component	Reason for inclusion
Demographics (All respondents)	<ul style="list-style-type: none"> <li>Location (County and name of town/city/village)</li> <li>Date of birth</li> <li>Gender</li> <li>Employment status (as a nominal variable, including the following options: Full-time work, part-time work, student, house-person, retired, other)</li> <li>Yearly earnings (as a categorical variable, with the categories: &lt;£10,000, £10-20,000, £20-30,000, £30-40,000, £40-50,000 and &gt;£50,000)</li> </ul>	<p>Location data was collected in order to clarify, in further analyses, the influence of residence in different sized towns and compare across our 3 case counties.</p> <p>Age (collected as date of birth), gender and income (collected as yearly earnings) are important mediators of well-being, to control for in our analysis.</p> <p>Employment status was collected in order to clarify, in later analyses, the influence of time-availability on participation in different types of food projects.</p>
Well-being measures (All respondents)	<ul style="list-style-type: none"> <li><i>The Warwick-Edinburgh Mental Well-being Scale*</i> (WEMWBS)</li> <li><i>Life Satisfaction</i> (standardised 11-point single measure)</li> <li><i>The Duke Anxiety-Depression Scale</i> ('DUKE-AD')</li> </ul>	<p>WEMWBS includes hedonic elements (capturing positive affect) and eudaimonic elements (a sense of purpose). It has been validated for use in the UK among adults aged 16 and over,<sup>57</sup> with a provisional mean score in validation studies of 50.7.</p> <p>A single-point measure of life satisfaction was used for economy of survey length. Such measures are reliable<sup>58</sup> and valid<sup>59</sup>, even when compared with multiple-item measures<sup>60</sup>.</p>

\* The Warwick-Edinburgh Mental Well-being Scale was funded by the Scottish Executive National Programme for improving mental health and well-being, commissioned by NHS Health Scotland, developed by the University of Warwick and the University of Edinburgh, and is jointly owned by NHS Health Scotland, the University of Warwick and the University of Edinburgh.

		The Duke-AD scale measures mental distress. Individuals attaining a raw score of 5 or more (of a possible 14) are at a high risk of clinically significant anxiety or depression.
<b>Mediators of well-being</b>  <b>(All respondents)</b>	<ul style="list-style-type: none"> <li>• Diet: number of days per week respondents consumed 5 or more portions of fruit and vegetables</li> <li>• Levels of physical activity, indoors or outdoors (number of minutes per week)</li> <li>• Connection to nature (measured by the 'Inclusion of Nature in Self Scale'<sup>61</sup>) and</li> <li>• The satisfaction of basic psychological needs when procuring and preparing food.</li> </ul>	Good diet, physical activity, connection to nature and the satisfaction of basic psychological needs are known to be drivers of good mental health and multidimensional well-being. Existing studies and anecdotal evidence highlight a possible contribution to well-being via these mediators.
<b>Type of participation in local food projects</b>  <b>(If applicable to the respondent)</b>	<ul style="list-style-type: none"> <li>• Duration of engagement with local food initiative, in years</li> <li>• Type of participation (organisational or administrative capacity or consumers)</li> </ul>	<p>We hypothesised that participants engaged for longer would score higher on positive well-being measures.</p> <p>We additionally sought to explore whether different types of engagement were associated with different well-being scores within the sample.</p>

174

175

176 Prior to data collection, ethical approval was sought via the Departmental Director of Research

177 at Essex Business School. The questionnaire was piloted offline with ten respondents before

178 deployment in order to test for clarity of the questions, time taken to answer them and to solicit

179 general feedback. In its final version, the survey was prefaced by an overview of the study, and

180 assurance to participants of confidentiality and anonymity. Respondents were briefed on our

181 plans for storage of data, and assured that only the study team would have access to it. Finally,

182 all respondents were given the researchers' contact details and invited to express any concerns

183 <sup>62; 63</sup>. The survey ran for a 3-month period and had a high completion rate (ratio of users who

184 finished the survey)<sup>63</sup> with only 19 respondents proceeding beyond the initial consent form and  
185 then omitting to answer any questions.

186

### 187 *Statistical analysis*

188 The aim of analysis was to identify significant differences between participants and non-  
189 participants in terms of well-being scores, and, to test for associations between types of  
190 participation and well-being outcomes. Qualtrics data was downloaded as an Excel file after the  
191 survey was closed, and then transferred to the software package IBM SPSS Statistics.

192 Hierarchical ordinary least squares regression models were used to explore associations  
193 between participation and well-being scores. In a first step, we co-varied out three potentially  
194 relevant demographic variables: gender, age, and income (Tables 3 and 4). In a second step,  
195 participation was included as a predictor (in different models, because these predictors were  
196 highly collinear)<sup>64</sup>. Scores on the three well-being scales were then each regressed on to  
197 predictors.

## 198 **RESULTS**

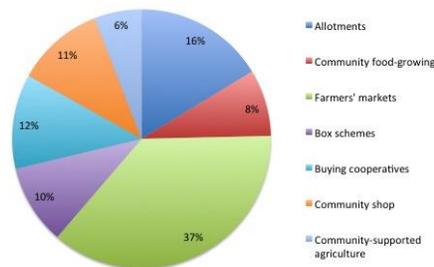
199

200 459 sets of responses were retained for analysis after removing 93 sets of responses where  
201 participants had omitted to answer a majority of the questions. Response-sets containing  
202 sporadic unanswered questions were retained. 302 of these self-identified as 'participants' in  
203 some form of initiative (Figure 2).

204

205 **Figure 2: Percentage of 491 respondents in seven different types of local food project:**  
206 **allotments, community food-growing, farmers' markets, box schemes, buying cooperatives,**  
207 **community shops and community-supported agriculture.**

208



209  
210

211 **Table 3: Respondents' characteristics across the sample, presenting demographic background**  
212 **of the sample as a whole and comparing participants in local food projects with a control**  
213 **group of non-participants.**

214  
215

Variable	Non-participants	Participants	Total sample	Statistically significant difference?
<b>Age (mean years)</b>	43.81 (n = 144, SD = 15.2)	47.63 (n = 280, SD = 13.9)	46.33 (n = 424, SD = 14.4)	No significant difference
<b>Gender (n)</b>				
Male	58	96	154	No significant difference
Female	97	201	298	
<b>Income (n)</b>				
Below £10,000	37	78	115	No significant difference
£10-20,000	40	69	109	
£20-30,000	31	58	89	
£30-40,000	20	43	63	
£40-50,000	12	20	32	
Above £50,000	10	23	33	
<b>Diet (7-point scale)</b>	3.86 days/week	5.12 days/week	4.75 days/week	Participants score higher: t = -5.558, p <0.0005
<b>Nature connectedness (8-point scale)</b>	3.73	4.50	4.28	Participants score higher: t = -4.706, p <0.0005
<b>Basic Need Satisfaction (7-point scale)</b>				
Autonomy	3.06	3.53	4.39 (n = 369, SD = 1.51)	Participants score higher: t = -2.736,

				p = 0.007
Competence	2.84	3.58	4.36 (n = 368, SD = 1.45)	Participants score higher: t = -2.736, p = 0.007
Relatedness	2.05	3	3.73 (n = 368, SD = 1.59)	Participants score higher: t = -5.414, p < 0.0005
<b>Physical Activity (days/week)</b>				
Indoors	1.90 days/week	1.91 days/week	1.90 (n = 357, SD = 1.83)	No significant difference
Outdoors	2.75 days/week	3.10 days/week	2.99 (n = 382, SD = 2.17)	No significant difference

216  
217

218  
219  
220  
221  
222

*H1: Participation in local food and scores on standardised well-being scales:*

223 Participants scored higher on measures of positive well-being – i.e. on life satisfaction,  $t(346) =$   
 224 2.30,  $p = .02$ ,  $pr = .12$  and on the WEMWBS scale,  $t(335) = 2.11$ ,  $p = .03$ ,  $pr = .12$ . than non-  
 225 participants. There was no statistically significant difference in Duke-AD scores between  
 226 participants and the control group,  $t(344) = -0.22$ ,  $p = .82$ ,  $pr = .01$ .

227

228 *H2: Influence of intensity of participation on well-being scores:*

229

230 **Table 4: Summary of three covariates included in all models and their association with scores**  
 231 **for Life Satisfaction, WEMWBS, Duke-AD, Nature Connectedness, Need Satisfaction and**  
 232 **Outdoor Physical Activity and diet.**

233

	Age		Gender		Income	
	<i>t, p</i>	<i>ρr</i>	<i>t, p</i>	<i>ρr</i>	<i>t, p</i>	<i>ρr</i>
Life satisfaction	2.52, .01	.13	-0.32, .75	-.17	-0.29, .77	-.02
WEMWBS	0.29, .78	.06	0.73, .47	.06	1.15, .25	.10
Duke-AD	-3.56, .001	-.19	0.38, .70	-.02	-2.86, .004	-.15
Nature Connectedness	3.36, .001	-.18	-0.50, .62	-.02	-3.78, .001	-.20
Need Satisfaction	2.01, .04	.11	0.02, .98	.00	0.05, .36,	-.05
Outdoor physical activity	0.87, .39	.07	-1.01, .32	-.08	-0.34, .73	-.03
Diet	4.89, .001	.26	2.84, .005	.15	0.68, .50	.04

234

235 Controlling for demographics (Table 4), we found that participants who played an active role  
 236 reported higher life satisfaction,  $t(346) = 2.55, p = .01, \rho r = .14$ , and WEMWBS scores,  $t(335) =$   
 237  $2.12, p = .04, \rho r = .10$ , than those who engaged solely as consumers. There was no link between  
 238 participants' roles and their Duke-AD scores,  $t(344) = -0.70, p = .49, \rho r = -.04$ . Those participating  
 239 for longer scored higher on life satisfaction,  $t(148) = 2.02, p = .04, \rho r = .16$  and lower Duke-AD  
 240 scores,  $t(147) = -2.67, p = .008, \rho r = -.22$ . Duration of participation did not influence scores on  
 241 the WEMWBS scale,  $t(142) = 1.86, p = .07, \rho r = .15$ . While it could be argued that participants  
 242 exposed to managerial tasks (e.g. accounting or sales) may have less direct exposure to nature  
 243 than growers, it is also possible that such tasks provide opportunities for the satisfaction of basic

244 needs as well as increased social interaction and thus facilitate well-being through these  
245 pathways.

246

247 *H3: Mediators*

248 Participants felt more connectedness to nature than the control group ( $t(339) = 4.90, p < .001,$   
249  $\rho r = .26$ ) and also experienced greater need satisfaction around food ( $t(339) = 5.18, p < .001, \rho r$   
250  $= .27$ ). There were no significant differences between levels of physical outdoor activity between  
251 participants and non-participants ( $t(340) = 1.27, p = .21, \rho r = .07$ ), possibly because our sample  
252 included participants from a wide range of local food initiatives, not all of which include a food-  
253 growing component (across our sample, discounting overlaps, just under 25% of participants  
254 were engaged in initiatives with a food-growing component, namely allotments and community  
255 food-growing). Participants also consumed more fruits and vegetables than non-participants  
256 ( $t(348) = 5.36, p = .001, \rho r = .28$ ).

257

258 Finally, we tested for associations between levels of participation (intensity and duration) and  
259 these four mediators of well-being. Those who played a more engaged role in projects  
260 experienced greater connectedness to nature:  $t(339) = 3.11, p = .002, \rho r = .17$ , as well as greater  
261 need satisfaction,  $t(339) = 3.79, p < .001, \rho r = .20$ . There was no link between the duration of  
262 participation and psychological need satisfaction,  $t(145) = 0.48, p = .63, \rho r = .04$ , suggesting that  
263 even short-duration engagement with local food projects provided opportunities for autonomy,  
264 competence and relatedness, and associated well-being benefits. Finally, there was no link  
265 between outdoor physical activity and either the intensity of participation,  $t(340) = 1.30, p = .20,$   
266  $\rho r = .07$ , or the length of time participants engaged in local food projects,  $t(145) = 1.02, p = .31,$   
267  $\rho r = .08$ . Greater intensity of participation (i.e. taking part as an organiser) was associated with

268 higher fruit and vegetable intake, ( $t(348) = 2.86, p < .001, \rho r = .20$ ), probably as a result of higher  
269 food and nutritional literacy and skilling, though the length of participation did not affect diet,  
270  $t(149) = -0.36, p = .72, \rho r = .03$ .

271

272 Because there were no statistically significant links between participation and outdoor physical  
273 activity, further analysis focused only on links between diet, need satisfaction, connectedness  
274 with nature and participation. Indirect effects analysis tested for a significant indirect effect  
275 linking local food projects with well-being through these three proposed mechanisms  
276 *concurrently*. Further, because both the act of participation and its intensity were linked to life  
277 satisfaction and mental wellness (and these two indicators were themselves strongly correlated,  
278  $\rho r = .68$ ), the two indicators of mental well-being were standardised and combined into a single  
279 indicator of positive well-being.

280

281 We found that connection to nature,  $t(326) = 3.92, p < .001, \rho r = .21$ , psychological need  
282 satisfaction,  $t(326) = 5.57, p < .001, \rho r = .30$ , and diet,  $t(326) = 3.03, p = .003, \rho r = .17$  were  
283 positively associated with well-being. Controlling for these mediators resulted in the effect of  
284 local food on well-being, which we reported above, becoming non-significant,  $t(324) = 0.76, p <$   
285  $.45, \rho r = .04$ , suggesting that it was through their impact on need satisfaction and nature  
286 connection that local food initiatives influenced participants' psychological well-being.

287 Bootstrapping analysis<sup>65, 66</sup> indicated indirect effects were present between participation and  
288 well-being through both mediators; the estimate of the indirect effect for nature connection  
289 was .097 with a 95% bootstrap confidence interval of .036 to .181, for need satisfaction was  
290 .156 with a 95% confidence interval of .081 to .254, and for diet, .080 with a 95% confidence  
291 interval of .025 to .158. These indirect effects support our hypothesis that involvement in local

292 food fostered a sense of well-being by encouraging people to feel a sense of connection with  
293 nature, improved diets and provided psychological need satisfaction.

294

295 **DISCUSSION**  
296

297 ***Main findings of this study***

298 Our three key findings are, first, that participation in local food projects is associated with higher  
299 levels of positive well-being relative to a control group of non-participants. Within our sample,  
300 there were no significant differences between participants' and non-participants' levels of  
301 psychological distress – a finding we discuss at greater length below. Second, we find that  
302 increased intensity of participation – proxied by duration and role – is associated with higher  
303 well-being scores and lower levels of distress. Finally, our results suggest that these associations  
304 derive from the satisfaction of basic psychological needs, better diet and increased connection  
305 to nature.

306

307 The lack of significant differences in anxiety and depression scores between participants and the  
308 control group possibly stems from the fact that the sample was drawn from the general (rather  
309 than therapeutic) population. The absence of an effect does not however preclude the  
310 relevance of local food initiatives within discussions of anxiety and depression amongst the  
311 general public. First, in assisting positive well-being, local food initiatives may help to generate a  
312 protective effect, as levels of life satisfaction and positive well-being predict the later onset of  
313 depressive symptoms<sup>67</sup>. Food-based interventions – primarily food-growing and horticulture –  
314 are already well-represented in the menu of nature-based activities partaken of by the general  
315 population, and provide an important means by which nature may be incorporated into *daily life*

316 and harnessed as a means of health promotion<sup>68</sup>. Our findings support the extension of these  
317 food-growing and food-related projects as a public health measure aimed at the general  
318 population.

319

320 Second, the presence of symptoms of psychological distress does not preclude the enjoyment or  
321 development of positive aspects such as positive affect or life satisfaction<sup>15</sup>. In other words, it is  
322 possible for people experiencing mental ill-health to *also* enjoy positive mood, healthy self-  
323 esteem and meaningful and enjoyable activities. For those within our sample who experience  
324 intermittent or sub-clinical levels of anxiety or depression, the opportunity to participate in local  
325 food projects may still enhance well-being even if levels of distress are not directly affected.

326 Finally, our results suggest that current and on-going participation increases perceptions of  
327 happiness, but that for the more serious symptoms of depression and anxiety, it is important for  
328 people to engage in the long term.

329

330 These findings resonate with recent evidence showing that engaging in pro-social behaviour  
331 enhances well-being, likely through the mediating effects of autonomy and competence need  
332 satisfaction<sup>69</sup>. The implication for practitioners is that giving people the opportunity to  
333 participate more actively, such as by rotating organisational and leadership roles, may  
334 contribute to greater well-being benefits.

335

### 336 ***What is already known about this topic***

337 The influence of environmental ‘harms’ to public mental health have been well-studied (e.g. for  
338 air quality<sup>70</sup>; the effect of climate change on health<sup>71, 72</sup>; food-borne toxins and poor diets<sup>18, 73,</sup>  
339 <sup>74</sup>), there is now a growing recognition of the potential co-benefits of sustainability for *positive*

340 *well-being*, with scholars going ‘beyond toxicity’<sup>75</sup>, to assess the benefits of engaging with the  
341 natural environment and in initiatives that seek to ‘re-green’ the human environment<sup>76, 77, 78</sup>.  
342 Local food initiatives are exemplars of such initiatives. Accordingly, previous studies have found  
343 that direct involvement in food growing in particular has clear relevance for well-being<sup>4, 36, 37</sup>,  
344 particularly as a result of green exercise and connection to nature.

345

346 ***What this study adds***

347 Our results extend the existing literature on the impacts of food-growing, focusing attention on  
348 the impacts of a broader array of local food initiatives, including those that do not involve a  
349 food-growing component. Across our sample, we find statistically significant differences in life  
350 satisfaction and WEMWBS scores between participants and non-participants across a range of  
351 different types of local food project, with participants scoring higher than non-participants. We  
352 have also found that longer duration participation is associated with higher life satisfaction and  
353 lower levels of distress, while higher intensity participation is associated with relatively higher  
354 levels of positive well-being.

355

356 The lack of an association between participation and outdoor physical activity is an important  
357 point of divergence between existing studies on food-growing and well-being. Our cohort of  
358 participants, engaging in community shops, community-supported agriculture and farmers’  
359 markets in addition to allotments and community gardens, may not have had the opportunity to  
360 engage directly in the physical activity of growing food, but as a group still have better well-  
361 being scores than non-participants. This is particularly relevant in urban areas, where planners  
362 may be hard-pressed to allocate land to new food-growing activities, or where practitioners may  
363 come up against difficult zoning or planning regulations while at the same time, the potential of

364 local food initiatives is increasingly investigated as a means of improving food self-sufficiency  
365 and delivering social and environmental goals<sup>79</sup>.

366

367 ***Limitations of this study***

368 Local food initiatives are complex interventions<sup>80</sup>, consisting of multiple, interacting  
369 components, where outcomes are sensitive to the local context and with complex causal chains  
370 linking interventions with outcomes. We have made a start towards understanding the influence  
371 of mediators within our sample, but do not claim to have determined the extent of reverse  
372 causality – i.e. the extent to which connection to nature and high levels of well-being may be  
373 predisposing engagement in initiatives such as local food projects, and what, if any measures  
374 can be taken to increase participation. Instead, we have been able to present correlational  
375 evidence linking the broad spectrum of local food initiatives to well-being scores on  
376 standardised instruments, and highlighted the statistically significant role of three mediators in  
377 driving this association within our sample. A second limitation is that given the relatively low  
378 (albeit growing) numbers of participants in local food projects, our sampling approach relied in  
379 part on the use of known contacts, snowballing and convenience sampling to recruit  
380 respondents. Convenience sampling entails the risk of selecting a biased or unrepresentative  
381 sample. We were mindful of this during our communication with gatekeepers and contacts,  
382 limiting our recruitment efforts to publicising the survey and instructing email recipients to  
383 spread the survey link as broadly as possible amongst their networks of participants and non-  
384 participants. Combined with the use of print and social media to spread word of the survey, we  
385 thus received a wide range of responses from beyond our own networks.

386

387 Further research would need to include in-person surveys with a larger and more gender-  
388 balanced sample, exploration of differences between types of initiative, as well as international  
389 comparisons in comparable contexts. These comparisons would need to be structured to  
390 account for differences in key demographic characteristics, particularly socioeconomic status,  
391 which might play a significant role in enabling or constraining access to local food projects, or  
392 shape the role that participants are able to play. Differences between participants might be  
393 further explored by collecting data on location linked to, for example, the Index of Multiple  
394 Deprivation, as well as exploring differences in type of employment (affecting time availability  
395 and social capital). Finally, we suggest that longitudinal and multi-cohort studies are needed to  
396 explore mechanisms behind the impacts we have found within the sample, and testing the  
397 influence of additional mediators of well-being such as improved diet and social contact – both  
398 important determinants of well-being.

399

#### 400 **FUNDING**

401 This work was supported by grants from the East of England Cooperative Society and the British  
402 Academy/Leverhulme Trust Small Research Grants Scheme [SG120771]. The East of England  
403 Cooperative Society funded salary costs for the lead author as a Research Officer on the project,  
404 and the British Academy funded research costs associated with the project. Neither funder  
405 influenced the design, execution or reporting of the study.

#### 406 **ACKNOWLEDGEMENTS**

407 The authors extend sincere thanks to three anonymous referees for comprehensive reviews that  
408 have greatly strengthened the paper. We thank the journal editor and editorial assistant for  
409 their support during the submission and review process, the two funding bodies for generous  
410 support and our research participants for taking the time to engage with the study. We also  
411 thank Jules Pretty and colleagues at the University of Essex for collegial engagement with our  
412 ideas, and Mark Cruickshank for thorough proofreading of the final version of the manuscript.

413

414 **REFERENCES**

- 415 1. Brown KH and Jameton AJ. 2012. Public Health Implications of Urban Agriculture.  
416 *Journal of Public Health Policy* 21(1): 20–39.
- 417 2. Kingsley JY, Townsend, M, and Henderson-Wilson, C. (2009). Cultivating health and  
418 wellbeing: members’ perceptions of the health benefits of a Port Melbourne community  
419 garden. *Leisure Studies*, 28(2), 207–219. doi:10.1080/02614360902769894
- 420 3. Rundle A, Neckerman KM, Freeman L, Lovasi GS, Purciel M, Quinn J, Richards C, Sircar N  
421 and Weiss C. 2009. Neighbourhood food environment and walkability predict obesity in  
422 New York City. *Environmental Health Perspectives* doi: 10.1289/ehp.11590
- 423 4. van den Berg AE, van Winsum-Westra A, de Vries S, van Dillen SM. 2010. Allotment  
424 gardening and health: a comparative survey among allotment gardeners and their  
425 neighbors without an allotment. *Environmental Health*. 23(9): 74.
- 426 5. Alaimo K, Packnett E, Miles RA, Kruger DJ. 2008. Fruit and vegetable intake among urban  
427 community gardeners. *J. Nutr. Educ. Behav.* 40 (2): 94-101.
- 428 6. Bimbo F, Bonanno A, Nardone G, Viscecchia R. The hidden benefits of short food supply  
429 chains: farmers’ markets density and body mass index in Italy. *International Food and*  
430 *Agribusiness Management Review*. **2015**, 18(1), 1.
- 431 7. Firth C, Maye D, Pearson D. 2011. Developing “community” in community gardens. *Local*  
432 *Environment: The International Journal of Justice and Sustainability*. 16 (6): 555-568.
- 433 8. Glover TD. 2004. Social Capital in the Lived Experiences of Community Gardeners.  
434 *Leisure Sciences*, 26(2): 143–162.
- 435 9. Ohly H, Gentry S, Wigglesworth R, Bethel A, Lovell R, Garside R. 2016. A systematic  
436 review of the health and well-being impacts of school gardening: synthesis of  
437 quantitative and qualitative evidence. *BMC Public Health* 25(16): 16:286.
- 438 10. Lyubomirsky S, King L and Diner E. 2005. The benefits of frequent positive affect: Does  
439 happiness lead to success? *Psychological Bulletin* 131(6): 803-855.
- 440 11. Diener E, Heintzelman S, Kushlev K, Louis T, Derrick W, Lutes LD., Shigehiro O. 2016.  
441 Findings all Psychologists should know from the new science on subjective well-being.  
442 *Canadian Psychology* <http://dx.doi.org/10.1037/cap0000063>
- 443 12. Vos T et al. 2013. Global, regional, and national incidence, prevalence, and years lived  
444 with disability for 301 acute and chronic diseases and injuries in 188 countries, 1990–

- 445           2013: a systematic analysis for the Global Burden of Disease Study. *The Lancet*. 386  
446           (9995). pp. 743-800.
- 447           13. Vigo D, Thornicroft G, Atun R. 2016. Estimating the true global burden of mental illness.  
448           *The Lancet* 3(2): 171-178.
- 449           14. Davies SC. 2013. Chief Medical Officer's summary. In: N. Metha, ed., *Annual Report of*  
450           *the Chief Medical Officer 2013, Public Mental Health Priorities: Investing in the Evidence*  
451           [online]. London: Department of Health, pp.11-19. Available at:  
452           [https://www.gov.uk/government/publications/chiefmedical-officer-cmo-annual-report-](https://www.gov.uk/government/publications/chiefmedical-officer-cmo-annual-report-public-mental-health)  
453           *public-mental-health* [Accessed 25 Aug. 2015].
- 454           15. Seligman, MEP. 2008. Postive health. *Applied Psychology*. Doi: 10.1111/j.1464-  
455           0597.2008.00351.x
- 456           16. Mujuc R and Oswald AJ. 2016. Evolution of Well-being and Happiness After Increases in  
457           Consumption of Fruit and Vegetables. *American Journal of Public Health* 106(8): 1504-  
458           1510.
- 459           17. Conner TS, Brookie KL, Richardson AC and Polak MA. 2015. On carrots and curiosity:  
460           eating fruit and vegetables is associated with greater flourishing in daily life. *British*  
461           *Journal of Health Psychology* 20(2): 413-427.
- 462           18. Sustain. 2005. *Changing Diets, Changing Minds: how food affects mental well being and*  
463           *behaviour*. Sustain. The alliance for better food and farming: London, U.K. URL:  
464           [https://www.mentalhealth.org.uk/sites/default/files/changing\\_diets.pdf](https://www.mentalhealth.org.uk/sites/default/files/changing_diets.pdf)
- 465           19. Cornah D, no date. *Feeding Minds: The impact of food on mental health*. Mental Health  
466           Foundation: London, U.K.
- 467           20. WHO 2002. *The World Health Report 2002 – Reducing Risks, Promoting Healthy Life*.  
468           WHO: Geneva, Switzerland.
- 469           21. Public Health England 2013. *Health Impact of Physical Activity*. URL:  
470           <http://www.apho.org.uk/resource/view.aspx?RID=123459>
- 471           22. Howell AJ, Dopko RL, Passmore HA, Buro K. 2011. Nature connectedness: Associations  
472           with well-being and mindfulness. *Personality and Individual Differences*. 51(2): 166-171.
- 473           23. Helliwell JF and Putnam RD. 2004. The social context of well-being. *Phil Trans Roy Soc*  
474           *London (B)* 1435-1446.
- 475           24. Ryan RM, Deci EL. 2000. Self-determination theory and the facilitation of intrinsic  
476           motivation, social development, and well-being. *American Psychologist*. 55(1): 68-78.

- 477 25. Blake M, Mellor J, and Crane L. 2010. Buying local food: shopping practices, place, and  
478 consumption networks in defining food as “local.” *Annals of the Association of American*  
479 *Geographers*, 100(2), 409–426. Retrieved from  
480 <http://www.tandfonline.com/doi/abs/10.1080/00045601003595545>  
481 26. CPRE 2016. Local food. URL: [http://www.cpre.org.uk/what-we-do/farming-and-](http://www.cpre.org.uk/what-we-do/farming-and-food/local-foods)  
482 [food/local-foods](http://www.cpre.org.uk/what-we-do/farming-and-food/local-foods)  
483 27. United States Congress 2008. Food, Conservation and Energy Act of 2008. URL:  
484 <https://www.congress.gov/bill/110th-congress/house-bill/2419/text>  
485 28. Defra 2013. Farm shops and farmers’ markets. URL:  
486 <https://www.gov.uk/guidance/farm-shops-and-farmers-markets>  
487 29. A.T.Kearney, Inc. 2013. *Buying into the Local Food Movement*. New York, USA.  
488 30. Packaged Facts 2015. *Shopping for Local Foods in the US*. URL:  
489 <https://www.packagedfacts.com/Shopping-Local-Foods-8684801/>  
490 31. A.T. Kearney, Inc. 2014. *Ripe for Grocers: The Local Food Movement*. New York, USA.  
491 32. New Economics Foundation 2012. *The Real Meaning of Allotments*. New Economics  
492 Foundation. London, UK.  
493 33. Union of Concerned Scientists. 2013. *The \$11 trillion reward: How simple dietary*  
494 *changes can save lives and money, and how we can get there*. Cambridge, MA, USA,  
495 2013.  
496 34. Galt R, Beckett J, Hiner C, O’Sullivan L. 2011. *Community Supported Agriculture (CSA) in*  
497 *and around California’s Central Valley: Farm and farmer characteristics, farm-member*  
498 *relationships, economic viability, information sources, and emerging issues*. University  
499 of California, Davis: Davis, CA, USA.  
500 35. Pretty J, Peacock J, Sellens M, Griffin M. 2005. The mental and physical health outcomes  
501 of green exercise. *International Journal of Environmental Health Research* 15(5): 319-  
502 337.  
503 36. van den Berg AE, Custers MH. 2011. Gardening promotes neuroendocrine and affective  
504 restoration from stress. *Journal of Health Psychology*. 16(1): 3-11.  
505 37. Wood C, Pretty J, Griffin MA. 2015. case-control study of the health and well-being  
506 benefits of allotment gardening. *Journal of Public Health*. doi. 10.1093/pubmed/fdv146  
507 38. Kneafsey M., Holloway, L., Venn, L., Dowler, E., Cox, R., & Tuomainen, H. (2008).  
508 *Reconnecting Consumers, Producers and Food: Exploring “Alternatives”* Berg.

- 509 39. Capaldi CA, Dopko RL, Zelenski JM. 2014. The relationship between nature  
510 connectedness and happiness: A meta-analysis. *Frontiers in Psychology*. 5: 76.
- 511 40. Cervinka R, Röderer K, Hefler E. 2012. Are nature lovers happy? On various indicators of  
512 well-being and connectedness with nature. *Journal of Health Psychology*. 17(3): 379-  
513 388.
- 514 41. Mayer FS, Frantz CM, Bruehlman-Senecal E, Dolliver K. 2009. Why is nature beneficial?  
515 The role of connectedness to nature. *Environment and Behavior*, 41:
- 516 42. Mayer FS, Frantz CM. 2004. The Connectedness to Nature Scale: A measure of  
517 individuals' feeling in community with nature. *Journal of Environmental Psychology*. 24:  
518 503-515.
- 519 43. Nisbet EK, Zelenski JM, Murphy S. 2009. Happiness is in our Nature: Exploring Nature  
520 Relatedness as a Contributor to Subjective Well-Being. *Journal of Happiness Studies*. 12  
521 (2): 303-322.
- 522 44. Ryan RM, Weinstein N, Bernstein J, Brown KW, Mistretta L, Gagne M. 2010. Vitalizing  
523 effects of being outdoors and in nature. *Journal of Environmental Psychology*. 30(2):  
524 159-168.
- 525 45. Tam KP. 2013. Concepts and measures related to connection to nature: Similarities and  
526 differences. *Journal of Environmental Psychology*. 34 (June): 64-78.
- 527 46. Ulrich RS, Simons RF, Losito BD, Fiorito E, Miles MA, Zelson M. 1991. Stress recovery  
528 during exposure to natural and urban environments. *J. Environ. Psych*. 11(3): 201-230.
- 529 47. White MP, Alcock I, Wheeler BW, Depledge MH. 2013. Would You Be Happier Living in a  
530 Greener Urban Area? A Fixed-Effects Analysis of Panel Data. *Psychological Science*.  
531 24(6): 920-928.
- 532 48. Sustain. 2005. *Changing Diets, Changing Minds: how food affects mental well being and*  
533 *behaviour*. Sustain. The alliance for better food and farming: London, U.K. URL:  
534 [https://www.mentalhealth.org.uk/sites/default/files/changing\\_diets.pdf](https://www.mentalhealth.org.uk/sites/default/files/changing_diets.pdf)
- 535 49. Alaimo K, Packnett E, Miles RA, Kruger DJ. 2008. Fruit and vegetable intake among urban  
536 community gardeners. *J. Nutr. Educ. Behav*. 40 (2): 94-101.
- 537 50. Deci EL, Ryan RM. 1985. *Intrinsic motivation and self-determination in human behavior*.  
538 Plenum: New York, USA.
- 539 51. Deci EL, Ryan RM. 2000. The " what" and " why" of goal pursuits: Human needs and the  
540 self-determination of behavior. *Psychological Inquiry*. 11(4): 227-268.

- 541 52. Gagne M. 2003. Autonomy support and need satisfaction in the motivation and well-  
542 being of gymnasts. *Journal of Applied Sport Psychology*. 15 (4): 372-390.
- 543 53. Kasser VG, Ryan RM. 1999. The relation of psychological needs for autonomy and  
544 relatedness to vitality, well-being, and mortality in a nursing home. *Journal of Applied*  
545 *Social Psychology*. 29(5): 935-954.
- 546 54. Sheldon KM, Ryan RM, Reis HT. 1996. What makes for a good day? Competence and  
547 autonomy in the day and in the person. *Personality and Social Psychology Bulletin*.  
548 22(12): 1270-1279.
- 549 55. Big Lottery Fund, n.d. More than just the veg. Growing community capacity through  
550 Local Food projects. Local Food, Big Lottery Fund, U.K. URL:  
551 <http://www.joycarey.co.uk/wp-content/uploads/2016/01/Summary-report.pdf>  
552 607-643.
- 553 56. Thorsen Gonzalez M, Hartig T, Patil GG, Martinsen EW, Kirkevold M. 2010. Therapeutic  
554 horticulture in clinical depression: A prospective study of active components. *Journal of*  
555 *Advanced Nursing* 66 (9): 2002-2013.
- 556 57. Tennant R, Hiller L, Fishwick R, Platt S, Joseph S, Weich S, Parkinson J, Secker J, Stewart-  
557 Brown S. 2007. The Warwick-Edinburgh Mental Well-being Scale (WEMWBS):  
558 development and UK validation. *Health and Quality of Life Outcomes*. 5: 63.
- 559 58. Lucas RE, Donnellan MB. 2012. Estimating the Reliability of Single-Item Life Satisfaction  
560 Measures: Results from Four National Panel Studies. *Social Indicators Research* 105(3):  
561 323.
- 562 59. Kobau R, Sniezek J, Zack MM, Lucas, RE, Burns, A. 2010. Well-being assessment: an  
563 evaluation of well-being scales for public health and population estimates of well-being  
564 among US adults. *Applied Psychology: Health and Well-Being*. 2(3): 272–297.
- 565 60. Cheung F, Lucas RE. 2014. Assessing the validity of single-item satisfaction measures:  
566 results from three large samples. *Quality of Life Research*. 23(10): 2809–2818.
- 567 61. Schultz PW. 2002. Inclusion with Nature: The Psychology of Human-Nature Relations.  
568 (pp. 61-78) In Schmuck P, Schultz WP (eds) *Psychology of sustainable development*  
569 Kluwer Academic Publishers: Dordrecht, Netherlands.
- 570 62. Kelley K, Clark B, Brown V, Sitzia J. 2003. Good practice in the conduct and reporting of  
571 survey research. *Int J Qual Health Care*. 2003;15(3):261-266.

- 572 63. Eysenbach G. 2004. Improving the Quality of Web Surveys: The Checklist for Reporting  
573 Results of Internet E-Surveys (CHERRIES). *Journal of Medical Internet Research*. 6(3):  
574 e34.
- 575 64. Farrar DE, Glauber RR. 1967. Multicollinearity in Regression Analysis: The Problem  
576 Revisited. *The Review of Economics and Statistics*. 49(1): 92-107.
- 577 65. Hayes AF. 2009. Beyond Baron and Kenny: Statistical mediation analysis in the new  
578 millennium. *Communication monographs* 76(4): 408-420.
- 579 66. Preacher KJ, Hayes AF. 2008. Asymptotic and resampling strategies for assessing and  
580 comparing indirect effects in multiple mediator models. *Behavior Research Methods*.  
581 40(3): 879-911.
- 582 67. Koivumaa-Honkanen H, Kaprio J, Honkanen R, Viinamäki H, Koskenvuo M. 2004. Life  
583 satisfaction and depression in a 15-year follow-up of healthy adults. *Social Psychiatry*  
584 *and Psychiatric Epidemiology* 39(12): 994-999.
- 585 68. Natural England 2016. A review of nature-based interventions for mental health care.  
586 Natural England Commissioned Reports, Number 204. Natural England, London, U.K.
- 587 69. Martela F. and Ryan RM. 2016. Prosocial behavior increases well-being and vitality even  
588 without contact with the beneficiary: Causal and behavioral evidence. *Motivation and*  
589 *Emotion* 40(3): 351-357.
- 590 70. Allen JG, MacNaughton P., Satish U., Santanam S., Vallarino J. and Spengler JD. 2016.  
591 Associations of cognitive function scores with carbon dioxide, ventilation and volatile  
592 organic compound exposures in office workers: A controlled exposure study of green  
593 and conventional office environments. *Environmental Health Perspectives* doi:  
594 10.1289/ehp.1510037
- 595 71. Nurse J., Basher D., Bone A. and Bird W. 2010. An ecological approach to promoting  
596 population mental health and well-being – a response to the challenge of climate  
597 change. *Perspect Public Health* 130(1): 27-33.
- 598 72. Lake IR, Hooper L., Abdelhamid A., Bentham G., Boxall ABA, Draper A., Fairweather-Tait  
599 S., Hulme M., Hunter PR, Nichols G. and Waldron KW. 2012. Climate change and food  
600 security: Health impacts in developed countries. *Environmental Health Perspectives* doi:  
601 10.1289/ehp.1104424
- 602 73. Claudio L. 2012. Our food: Packaging and public health. *Environmental Health*  
603 *Perspectives* 120:a232-a237 (2012). doi: <http://dx.doi.org/10.1289/ehp.120-a232>

- 604 74. Nicole W. 2013. Secret ingredients: Who knows what's in your food? Environmental  
605 Health Perspectives 121:A126-A133.
- 606 75. Frumkin 2001. Beyond toxicity. Human health and the natural environment. American  
607 journal of preventive medicine. 20(3): 234-240.
- 608 76. Molsher R. and Townsend M. 2016. Improving wellbeing and environmental  
609 stewardship through volunteering in nature. EcoHealth 13:151.
- 610 77. Wolf, KL, & Robbins, AST (2015). Metro nature, environmental health, and economic  
611 value. Environmental Health Perspectives, 123(5), 390–8. doi:10.1289/ehp.1408216
- 612 78. Jenkinson CE, Dickens AP, Jones K, Thompson-Coon J, Taylor RS, Rogers M et al 2013. Is  
613 volunteering a public health intervention? A systematic review and meta-analysis of the  
614 health and survival of volunteering. BMC Public Health13:773 doi: 10.1186/1471-2458-  
615 13-773.
- 616 79. Nicholson CF, He X, Gómez MI, Gao HO, Hill E. 2015. Environmental and Economic  
617 Impacts of Localizaing Food Systems: The Case of Dairy Supply Chains in the  
618 Northeastern United States. Environmental Science and Technology, 49(20): 12005-  
619 12014.
- 620 80. Craig P, Dieppe P, Macintyre S, Michie S, Nazareth I, Petticrew M. 2006. Developing and  
621 evaluating complex interventions: new guidance. URL:  
622 <https://www.mrc.ac.uk/documents/pdf/complex-interventions-guidance/>