

# Dietary improvement in people with schizophrenia

## Randomised controlled trial

ROBIN G. McCREADIE, CIARA KELLY, MOIRA CONNOLLY, SUE WILLIAMS, GWEN BAXTER, MICHAEL LEAN and JOHN R. PATERSON

**Background** People with schizophrenia make poor dietary choices.

**Aims** To measure the impact of giving free fruit and vegetables for 6 months on eating habits in schizophrenia.

**Method** We randomly allocated 102 people with schizophrenia in two areas of Scotland to receive free fruit and vegetables for 6 months, supported by instruction in meal planning and food preparation; free fruit and vegetables alone; or to continue as before. Diet was assessed using the Scottish Health Survey questionnaire. Blood samples to measure micronutrients were taken and mental state, body mass index, level of physical activity and future risk of coronary heart disease (CHD) were assessed.

**Results** After the intervention, those who received free fruit and vegetables, or free fruit and vegetables and associated instruction, were consuming significantly more fruit and vegetables than those in the treatment as usual group. Consumption fell to pre-intervention levels 12 months after the intervention stopped. There was no between-group difference at any time in blood micronutrients, body mass index, physical activity or risk of CHD.

**Conclusions** The diet of people with schizophrenia improved when they were given free fruit and vegetables but this was not sustained after withdrawal of the intervention. A support programme added no benefit.

**Declaration of interest** None. Funding detailed in Acknowledgements.

People with schizophrenia die early, especially from cardiovascular disease (Mortensen & Juel, 1993), which is associated with a low intake of fruit and vegetables (Gillman, 1996). We have previously shown that people with schizophrenia make poor dietary choices (McCreadie *et al*, 1998), and we concluded that assertive programmes to improve their eating habits were necessary. Advice to the general population to improve fruit and vegetable intake has been shown to be successful, at least in the short term (Zino *et al*, 1997). However, we believe that improvements in patients' eating habits might be achieved if the intervention focused on the environment, rather than relying on the patient to make changes. We therefore decided that the principal intervention in our randomised controlled trial would be the provision of free fruit and vegetables. Provision of free food can influence the diet of the general population (Pietinen *et al*, 1984), and also that of people who are homeless (Gelberg *et al*, 1995) or obese (Wing *et al*, 1996). Associated instruction in the preparation of food may be necessary, and we incorporated this in one arm of our intervention programme.

## METHOD

### Participants

Patients with a DSM-IV diagnosis of schizophrenia (American Psychiatric Association, 1994) were recruited from those living in the community in two areas of Scotland: Nithsdale, in Dumfries and Galloway ( $n=55$ ), and Partick, in west Glasgow ( $n=47$ ). Patients lived on their own or in supported accommodation, 2-11 to a house. Patients were encouraged to be responsible for their own domestic chores, including shopping and cooking. Support was provided by regular input from care workers. The patients in supported accommodation were no longer

living with their families for various reasons but their position in the community had been assessed by social services as sufficiently precarious for them to need additional support. A generation ago it is likely these patients would have been in long-stay psychiatric wards.

All patients gave written, informed consent and the project was approved by the relevant local research ethics committees.

### Randomisation

Randomisation of patients was clearly impractical where there was more than one resident in a house. Therefore houses, not patients, were randomly allocated to receive free fruit and vegetables for a period of 6 months, and associated instruction; free fruit and vegetables alone; or to continue as before. Randomisation was stratified by urban (Partick) and rural (Nithsdale) areas.

Where a house was allocated free fruit and vegetables, care workers responsible for that house ensured that each week sufficient fruit and vegetables were purchased to provide at least five portions per resident per day. The residents were encouraged to take part in the shopping expeditions and make appropriate purchases. Care workers kept the till receipts from supermarkets and shops as a record of what was purchased. Those who received free fruit and vegetables and associated instruction received in addition to the free food basic instruction in food preparation from an occupational therapist or senior care worker. Such instruction included meal planning and the purchase, storage and preparation of food, with particular reference to fruit and vegetables. The occupational therapist worked with the patient during the first month and gave additional help in the third and sixth months.

### Assessment

Patients' diets were assessed in three ways. First, a nurse, masked as to whether the patient received free food, assessed the usual eating habits of the patient by means of the eating habits section of the Scottish Health Survey Questionnaire (Scottish Executive Health Department, 1998), which assesses food intake retrospectively. Second, within this questionnaire there is a specific assessment of fruit and vegetable intake. Third, a blood sample was taken to measure plasma folate, glucose, vitamins

C and E and carotenoids, and serum total cholesterol and high-density lipoprotein (HDL) cholesterol (see below). Plasma and serum were stored at  $-70^{\circ}\text{C}$ . Measurements were made masked to intervention status.

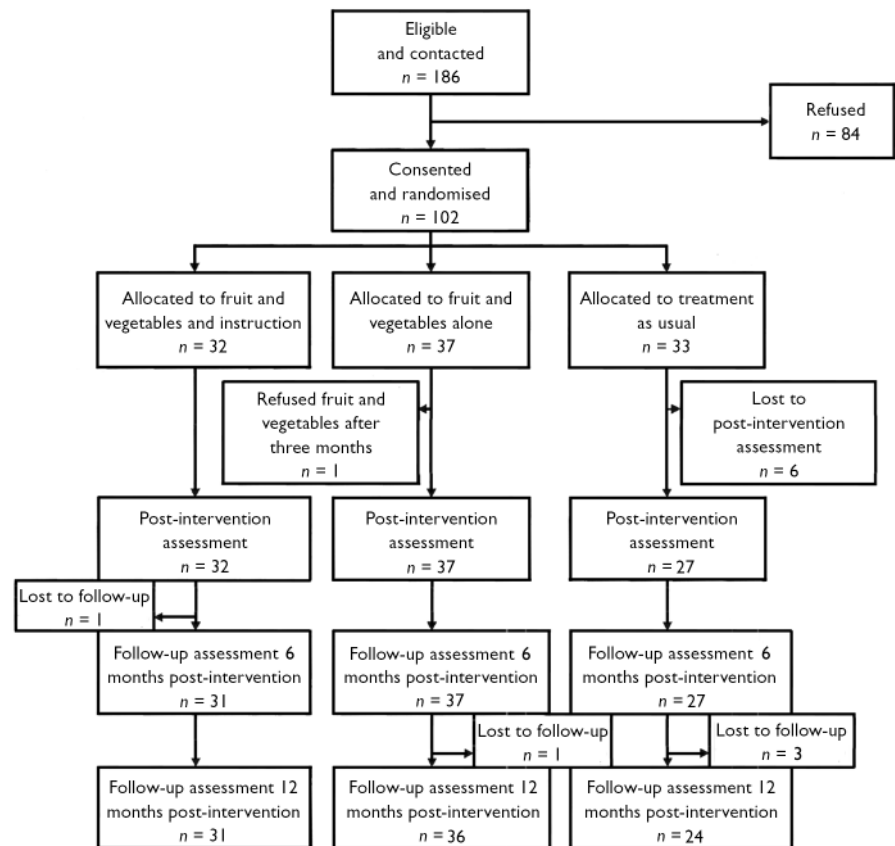
Dietary assessments were made, and blood samples taken as close as possible to the dietary assessment, at baseline (before randomisation), at the end of the intervention (6 months) and at 6 months and 12 months after the intervention. At the same time intervals, each patient's mental state was assessed by a psychiatrist masked to intervention status, using the Positive and Negative Syndrome Scale (PANSS) for schizophrenia (Kay *et al*, 1987); also recorded were body mass index and level of physical activity (Lowther & Mutrie, 1996). At baseline and 18 months later, cardiovascular risk factors (age, gender, smoking status, blood pressure, left ventricular hypertrophy, plasma glucose concentration and serum total cholesterol and HDL cholesterol levels) were measured by the Framingham assessment and associated computer program (Hingorami & Vallance, 1999).

### Outcome measures

The primary outcome measure was the number of portions of fruit and vegetables eaten per week, with a comparison of change from baseline to 12 months after the provision of free fruit and vegetables was withdrawn. This was measured by the fruit and vegetables section of the Scottish Health Survey questionnaire (Lean *et al*, 2003). Secondary measures included global

**Table 1** Socio-demographic data

Gender, <i>n</i> (%)	
Male	72 (71)
Female	30 (29)
Age, years: mean (s.d.)	45 (13)
Length of illness, years: mean (s.d.)	21 (13)
Marital status, <i>n</i> (%)	
Single	82 (80)
Married	3 (3)
Divorced/separated	14 (14)
Widowed	3 (3)
Domiciliary status, <i>n</i> (%)	
Lives alone	56 (55)
Lives with other patients	41 (40)
Other	5 (5)



**Fig. 1** Progress of participants through the trial.

assessment of diet; plasma folate, vitamins C and E and carotenoids; cardiovascular risk factors and body mass index.

### Analysis

Analyses were done on an intent-to-treat basis. All patients with baseline data and at least one post-baseline measurement were included in the analyses. The differences among the three groups in the primary outcome measure (the number of portions of fruit and vegetables consumed per week) were measured by analysis of variance, including baseline intake as a covariate in the model. Clusters (the houses) were the unit rather than individual patients (Kerry & Bland, 1998). Two-tailed tests were used.

### Power calculation

Based on the assumption of 90 houses, 1 with seven patients, 1 with six, 5 with three, 13 with two and 70 with one patient, there would therefore be 90 clusters with an average of 1.4 patients per cluster. If we assume the mean intake of fruit and vegetables in the intervention group (free fruit and vegetables plus instruction) rises

from 16 to 23 portions per week (an increase of one portion per day), and there is no change in the two other groups, then these are adequate numbers to detect a significant among-group difference, with 90% power and 5% significance level.

### RESULTS

We approached 186 patients with an invitation to participate in the study; 102 patients (55%) living in 85 houses consented. Those who consented did not differ from those who refused in gender distribution or age. The progress of participants through the trial is shown in Fig. 1.

### Baseline findings

Baseline findings have been reported elsewhere (McCreadie, 2003); they are summarised in Table 1 (socio-demographic data) and Table 2, a comparison of our patients' dietary choices with the Scottish Health Survey data (Scottish Executive Health Department, 1998) which most closely reflect the aspirational targets of the Diet Action Plan for Scotland (Scottish Office Department of Health, 1996,

**Table 2** Baseline findings: dietary choices of patients and of the general population of Scotland

Dietary choice <sup>1</sup>	Men			Women		
	Patients	General population <sup>2</sup>	P <sup>3</sup>	Patients	General population <sup>2</sup>	P <sup>3</sup>
	(n=72) %	(n=3941) %		(n=30) %	(n=5106) %	
Fresh fruit once a day or more	33	46	0.04	43	59	0.12
Fruit juice once a day or more	17	26	0.09	20	32	0.23
Cooked green vegetables five times a week or more	10	39	<0.0001	27	44	0.08
Cooked root vegetables five times a week or more	1	22	<0.001	10	27	0.06
Raw vegetables or salad twice a week or more	25	45	0.001	40	59	0.05
Use skimmed or semi-skimmed milk	50	63	0.03	50	69	0.04
Oil-rich fish less than once a month	43	33	0.09	27	33	0.59
Potatoes, pasta or rice five or more times a week	25	64	<0.0001	30	69	<0.0001
Pulses two or more times a week	32	67	<0.0001	30	58	0.004
Breakfast cereal once a day or more	58	38	0.0007	50	38	0.25
Usually eat wholemeal bread	6	10	0.29	20	16	0.73

1. Scottish targets (Scottish Office Department of Health, 1996) are average intake of fruit and vegetables to double; average intake of fat (especially saturated) to reduce; oil-rich fish consumption to double; complex carbohydrate consumption to increase by 25%; bread intake, mainly wholemeal, to increase by 45%.  
 2. General population respondents interviewed in the Scottish Health Survey (Scottish Executive Health Department, 1998).

**Table 3** Participants' consumption of fruit, vegetables and fruit juice

	Portions per week, n: mean (s.d.)											
	Free fruit and vegetables with instruction group				Free fruit and vegetables group				Treatment as usual group			
	Baseline (n=32)	6 months (n=32)	12 months (n=31)	18 months (n=31)	Baseline (n=37)	6 months (n=37)	12 months (n=37)	18 months (n=36)	Baseline (n=33)	6 months (n=27)	12 months (n=27)	18 months (n=24)
All fruit and vegetables	16 (14)	30 (19)	23 (21)	21 (19)	14 (12)	31 (24)	16 (11)	20 (19)	19 (17)	18 (15)	20 (25)	19 (14)
Fruit (excluding fruit juice)	7 (6)	12 (11)	9 (11)	10 (11)	5 (7)	13 (12)	8 (8)	9 (10)	9 (15)	9 (10)	7 (12)	10 (16)
Vegetables	6 (4)	7 (5)	8 (7)	6 (5)	5 (6)	8 (6)	5 (4)	6 (4)	8 (6)	5 (5)	6 (7)	6 (5)
Fruit juice	4 (8)	10 (10)	7 (8)	5 (8)	3 (5)	10 (14)	3 (4)	5 (8)	2 (6)	4 (7)	7 (6)	4 (7)

1999). Fewer men with schizophrenia than men in the general population reached target levels of consumption of fresh fruit and vegetables, skimmed or semi-skimmed milk, potatoes, pasta or rice and pulses. More men with schizophrenia than men in the general population frequently consumed breakfast cereal. Fewer women with schizophrenia than women in the general population reached acceptable levels of consumption of skimmed or semi-skimmed milk and potatoes, pasta or rice.

The mean number of fruit and vegetable portions consumed each week was 16 (s.d.=14). This was made up of fruit (excluding fruit juice): mean number of portions 7 (s.d.=10); vegetables: mean 6 (s.d.=6); and fruit juice: mean 3 (s.d.=7).

**Intervention**

Thirty-two patients received free fruit and vegetables plus instruction, 37 received free fruit and vegetables alone and 33 received treatment as usual (Table 3). One patient in the free fruit and vegetable group refused further free food at 3 months. All patients in the first two groups were reassessed at the end of the intervention and 27 of 33 in the treatment as usual group.

Figure 2 shows in the three groups the mean weekly total number of fruit and vegetable portions at different stages in the study. Using the last observation carried forward method, there was no significant between-group difference in the primary outcome measure, namely change from baseline to 12 months after the intervention finished in the number of portions of fruit

and vegetables consumed. Further analysis of the different periods showed that, when change from baseline to the end of the intervention was examined, there was a significant between-group difference; fruit and vegetable intake increased in both the free fruit and vegetables alone and the free fruit and vegetables plus instruction groups, but not in the treatment as usual group. Figure 2 suggests that the fall in consumption after the intervention stopped was more gradual in the fruit and vegetable plus intervention group, but the difference between the groups 6 months after the intervention stopped was not statistically significant. Table 4 shows the results separately for fruit (excluding fruit juice), vegetables and fruit juice. Inspection of the data suggests that at the end of the intervention, in the two free fruit and vegetables groups it was

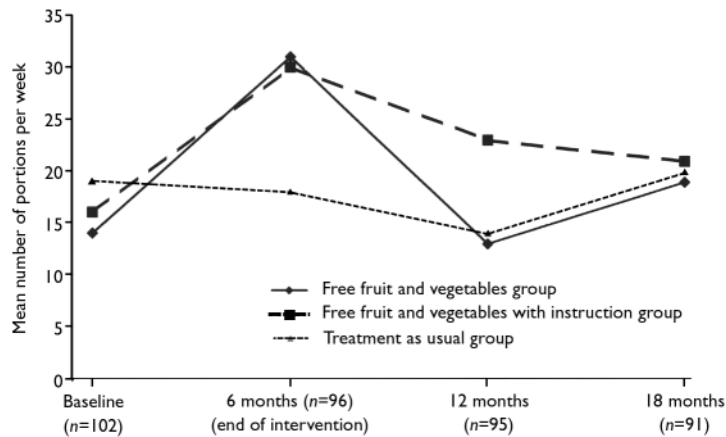


Fig. 2 Total fruit and vegetable intake in the three study groups.

Table 4 Analysis of variance

	All fruit and vegetables		Fruit (excluding fruit juice)		Vegetables		Fruit juice	
	F	P	F	P	F	P	F	P
0–6 months	8.82	0.003	2.85	0.06	8.32	0.0005	4.01	0.02
0–12 months	0.27	0.76	0.68	0.50	4.16	0.02	0.79	0.46
0–18 months	0.46	0.63	0.03	0.97	3.82	0.03	0.30	0.74

the consumption of fruit and fruit juice that rose most. However, the most significant result, statistically speaking, was in the consumption of vegetables; this was because consumption fell in the treatment as usual group.

There was no significant between-group difference at any time point in measures of change from baseline in blood indices of nutrition, mental state as measured by the PANSS, body mass index, level of physical activity and risk of coronary heart disease, as measured by the Framingham assessment (further details available from the author upon request). Also, there was no significant change from baseline at any time point in other aspects of the patients' diet, such as consumption of skimmed or semi-skimmed milk, oil-rich fish, potatoes, pasta or rice, pulses, breakfast cereal or wholemeal bread.

## DISCUSSION

### Methodological issues

We have discussed some of the methodological issues in a previous paper (McCreadie, 2003). First, although almost half the patients we approached refused to

participate in the study, those who refused did not differ from those who did participate in gender distribution, age or living arrangements. Second, the dietary questionnaire that we used assesses food intake retrospectively, with the possibility of recall errors. However, it is by no means certain that a prospective weighed intake of food would have provided a more accurate assessment. Third, there was no independent way to confirm that the free fruit and vegetables provided were actually eaten.

The power calculation suggested that about 120 patients should enter the study. Only 102 did so. However, the calculation was based on an increase in consumption of only one portion of fruit and vegetables per day. The actual increase achieved by the end of the intervention was substantially greater than this.

### Consumption of fruit and vegetables

We found that people with schizophrenia who habitually eat little fruit or vegetables are able and willing to consume more if the food is provided free of charge. Only

one patient withdrew from the free fruit and vegetable groups before the intervention stopped. The mean consumption of fruit and vegetables doubled in those who were given either free fruit and vegetables or free fruit and vegetables and associated instruction. Inspection of the data suggested it was easier to increase the intake of fruit and fruit juice than that of vegetables. Fruit and fruit juice can be readily consumed, whereas most vegetables need preparation.

The change in consumption of fruit and vegetables by the end of the intervention was not accompanied by changes in any of the other dietary targets identified in the Scottish Health Survey (Scottish Office Department of Health, 1996), such as an increase in the consumption of oil-rich fish, potatoes, pasta or rice, or wholemeal bread. Thus fruit and vegetables were simply 'added on' to their existing diet. The change in fruit and vegetable consumption was also not accompanied by any change in mental state, as assessed by PANSS total and sub-scale scores. This longitudinal finding complements that in the cross-sectional survey (McCreadie, 2003), which identified no difference in PANSS scores between those taking the most and the fewest portions of fruit and vegetables per week.

### Persistence of improvement

With regard to the primary outcome measure – that is, the difference in consumption of fruit and vegetables between baseline and 12 months after the intervention stopped – there was no difference between the three groups. In this sense the intervention was unsuccessful.

In three of the studies quoted in the opening paragraph there was either no follow-up or only a very brief one (8 weeks) (Pietinen *et al*, 1984; Gelberg *et al*, 1995; Zino *et al*, 1997). In the fourth (Wing *et al*, 1996), improvement in the intervention groups was sustained 1 year later.

There are no doubt a number of reasons why change did not persist. First, perhaps the intervention did not last long enough. Second, after the intervention stopped, patients had to buy their own food; fruit and vegetables are not cheap and are not always easily available. Almost all our patients were unemployed and lived on state benefits. Two-thirds of our patients smoke; approximately a third of their benefits is spent on tobacco (McCreadie & Kelly, 2000). Third, we found that fruit

and vegetable consumption increased among both those who received free fruit and vegetables alone and those who received free fruit and vegetables together with associated instruction. Our hypothesis was that not only was the provision of free fruit and vegetables necessary to improve patients' diet but also that dietary education and help with food purchase and preparation would be essential. However, the results show little value from the additional support, so although the lessons were 'taught' they were not 'learned'. Perhaps the occupational therapists' help was not sufficient or aspects of the patients' illness contributed to an unwillingness or inability to change. It may also be that, although patients consented to enter the study, they lacked the will to change. Perhaps a form of motivational interviewing might have been more effective.

The positive results at 6 months raise the possibility that if patients had continued to receive free fruit and vegetables weekly, their consumption might have remained at a higher level. Continuing long-term provision of free food has been advocated for the homeless (Gelberg *et al*, 1995) and now, under the National School Fruit and Vegetable Scheme (Department of Health, 2005), all children aged 4–6 years in state schools in England are entitled to a free piece of fruit or vegetable each school day. For population subgroups who are not fully able to make wise, informed choices about dietary health, a case can be made for providing foods that will fulfil dietary targets for health. Many patients with schizophrenia come into this category.

### The wider context of treatment

The failure of an intervention to produce a sustained change in people with schizophrenia must be placed in the wider context of their treatment. Other interventions in people with schizophrenia, unless sustained, do not produce lasting benefits. For example, it has long been known that withdrawal of antipsychotic medication can cause relapse (Leff & Wing, 1971). Medication is provided free to most people with schizophrenia.

Although there was an increase in fruit and vegetable consumption by the end of 6 months, this was not accompanied by changes in plasma micronutrients, which at baseline were at abnormal levels in substantial numbers of patients: for example, 42% had low  $\beta$ -carotene levels, 49% had

### CLINICAL IMPLICATIONS

- People with schizophrenia who habitually eat little fruit or vegetables are able to consume more if the food is provided free of charge.
- After withdrawal of free fruit and vegetables the improvement in diet did not persist. Perhaps the intervention should have continued longer.
- Both primary and secondary care should probably be involved in the management of the physical health of people with schizophrenia.

### LIMITATIONS

- Almost half of the patients approached refused to participate in the study.
- The dietary questionnaire assessed food intake retrospectively.
- There was no independent way to confirm that the free fruit and vegetables were actually eaten.

ROBIN G. McCREADIE, DSc, Department of Clinical Research, Crichton Royal Hospital, Dumfries; CIARA KELLY, MRCPsych, Leverdale Hospital, Glasgow; MOIRA CONNOLLY, MRCPsych, Gartnavel Royal Hospital, Glasgow; SUE WILLIAMS, BA, Department of Clinical Research, Crichton Royal Hospital, Dumfries; GWEN BAXTER, BSc, Dumfries & Galloway Royal Infirmary, Dumfries; MICHAEL LEAN, MD, Department of Human Nutrition, Glasgow Royal Infirmary, Glasgow; JOHN R. PATERSON, PhD, Dumfries & Galloway Royal Infirmary, Dumfries, UK (died November 2004)

Correspondence: Professor R. G. McCreadie, Director of Clinical Research, Crichton Royal Hospital, Dumfries DG1 4TG, UK. Tel: +44 (0)1387 244 000; fax: +44 (0)1387 257 735; e-mail: robin.mccreadie@nhs.net

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low vitamin C levels and 53% had a high cholesterol:HDL ratio (McCreadie, 2003). There are at least three possible reasons for this. First, the plasma half-life of some water-soluble micronutrients is short; if blood samples were taken even a few days after fruit and vegetable consumption fell, plasma micronutrient levels might also have fallen. Second, within the groups there was a great variability in plasma levels; differences between groups would therefore be harder to detect. Third, as stated before, there was no independent way to confirm that the fruit and vegetables had actually been eaten.

There was no change in body mass index or risk of coronary heart disease. This reinforces the view that the consumption of free fruit and vegetables was an 'add-on' and the extra consumption was not enough to displace other foods.

We have found that the lifestyle of people with schizophrenia as measured by diet, weight and exercise must give cause

for concern, especially in relation to coronary heart disease (McCreadie, 2003). Our intervention did not prove successful in the longer term and therefore other ways must be found to address these issues. Primary care services should be encouraged to be more involved. In addition, outreach from secondary services to such patients in the community (a vulnerable section of the population) should be concerned not only with mental but also with physical health, otherwise the risk of cardiovascular and other diseases will remain high and patients will die prematurely.

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