Drugs and Alcohol Today

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Suzanne Sayuri Ii Lisa Ryan Joanne Neale

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Suzanne Sayuri Ii, Lisa Ryan and Joanne Neale

Suzanne Sayuri Ii is based at National Addiction Centre, King's College London, London, UK.
Lisa Ryan is based at the Department of Natural Sciences, Galway-Mayo Institute of Technology, Galway, Ireland.
Joanne Neale is based at National Addiction Centre, King's College London, London, UK.

Abstract

Purpose – *The purpose of this paper is to provide new insights into the diet and nutrient intake of people receiving opioid agonist treatment (OAT) in the UK, offering implications for recovery-oriented treatment and care.*

Design/methodology/approach – *Diet and nutrient intake were assessed using quantitative methods. The research tools used were: a socio-demographic and drug use questionnaire, 24-hour dietary recall interview and anthropometry measures. A four-month follow-up was conducted using the same methods.*

Findings – *Mean (SD) body mass index for males (n = 15) and females (n = 10) exceeded the normal range (25.2 (5.9) kg/m^2 and 33.3 (8.6) kg/m^2, respectively) at baseline. Males decreased to the normal range at follow-up (mean (SD) = 24.1 (±6.2) kg/m^2]. Females increased to obesity Class II at follow-up (mean (SD) = 35.1 (±8.0) kg/m^2). Non-starch polysaccharide intakes were significantly lower than the reference nutrient intake (RNI). Iron intakes for females were significantly below the RNI. Saturated fat intake and sodium intake exceeded the RNI. In total, 11 (44 per cent) participants had multiple health conditions. Participants regularly consumed meals and reported frequent snacking events.*

Research limitations/implications – *There is a need for better understanding of nutrition-related issues and dietary deficiencies amongst people receiving OAT, including larger studies that explore differences between males and females, other sub-groups and changes over time.*

Practical implications – *Nutritional recommendations or guidelines and increased attention to nutrition and diet within treatment programmes are needed to help people receiving OAT.*

Originality/value – *This paper demonstrates how diet and nutrient intake are essential to recovery processes and outcomes.*

Keywords *Nutrient intake, Drug policy, Dietary behaviours, Non-communicable diseases, Opioid agonist treatment, Recovery-oriented treatment*

Paper type *Research paper*

Received 12 August 2015
Revised 30 October 2015
Accepted 30 October 2015

The authors wish to thank Oxford Brookes University for funding the first two years of the study. Thank you to Dr Jan Davison-Fischer, Dr Caral Brown and Dr Carly Wheeler for their discussions and advice about recruitment and research methods. Thank you to Dr Sarah Hiller and Dr Peter Wootton-Beard for their dietary methods training and advice. The authors would also like to thank the pharmacists who assisted the authors with recruitment. In particular, the authors would like to give their appreciation to the participants for their time in the study.

Introduction

The concept of recovery is embedded within international drug and alcohol policy and has been central to national drug strategies in the UK for several years (HM Government, 2010). Increasingly, recovery is understood as a concept that means more than simply not using drugs. Rather, it involves individuals achieving benefits in many life areas, such as their housing, health, employment, relationships, self-care and general well-being (Scottish Government, 2008; HM Government, 2010; ACMD, 2013). In addition, it is widely accepted that recovery can be supported by appropriately prescribed medications (Recovery Orientated Drug Treatment Expert Group, 2012). Health and well-being are important aspects of recovery, and a balanced diet is necessary for the maintenance of health and well-being. Dietary behaviours and nutrient intake have, however, been largely absent from the recovery literature.

Poor diet, in conjunction with other lifestyle behaviours, contributes to a wide range of chronic health conditions also known as non-communicable diseases (NCDs). These include cardiovascular diseases, diabetes, chronic respiratory disease and certain cancers. These conditions are prevalent in both low and high-income countries and within populations at global, national and local levels (Beaglehole and Yach, 2003; Daar *et al.*, 2007). In one UK general population study by Murray *et al.* (2013), nine of the 20 most important factors adding to the burden of disease for both sexes directly related to dietary intake. These factors included low intakes of fruit, nuts/seeds, vegetables, omega-3, fibre, whole grains and polyunsaturated fatty acids (SAT), plus high intakes of sodium and processed meat. High blood pressure and high cholesterol were also diet-related conditions that contributed to disease at a population level. Additionally, low physical activity or physical inactivity increased the risk of metabolic and physiological disease conditions associated with being overweight/ obese (Murray *et al.*, 2013).

People receiving opioid agonist treatment (OAT) are at increased risk of NCDs because of high rates of tobacco use (Tacke *et al.*, 2001; Nahvi *et al.*, 2006; Richter and Arnsten, 2006; Pajusco *et al.*, 2012) and alcohol consumption (Best *et al.*, 1998; Hillebrand *et al.*, 2001; Senbanjo *et al.*, 2007; Rengade *et al.*, 2009). Findings from international research exploring the dietary behaviours of people receiving OAT suggest that this risk is likely to be compounded by insufficient dietary and nutrient intake, high intakes of refined carbohydrates and sweet foods, and low intakes of fruit, vegetables, meat, whole grains and enriched cereals (Kolarzyk *et al.*, 2004a, b, 2010; Zador *et al.*, 1996; Gambera and Clarke, 1976; Alves *et al.*, 2011; Nolan and Scagnelli, 2007). Some studies have found that individuals receiving OAT ate fewer than three meals per day, skipped breakfast or viewed food as a low priority (Best *et al.*, 1998; Neale *et al.*, 2012; Zador *et al.*, 1996). Other studies of this population have reported evidence of significant weight gain and associated chronic illnesses (Rajs *et al.*, 2004; Cullen *et al.*, 2009; O'Toole *et al.*, 2014; Arnold-Reed *et al.*, 2014).

The aim of this paper is to explore the dietary behaviours and nutrient intake of people receiving OAT in the UK and to consider the implications for recovery-oriented systems of treatment and care. The data presented are part of a larger longitudinal convergent parallel mixed methods study employing both quantitative and qualitative research concurrently (Creswell, 2013). Only the quantitative findings are reported here.

Methods

Ethical approval for the study was granted by the National Research Ethics Service (NRES) Committee (NRES: 11/SC/0546). Data collection began in February 2012 and was completed by May 2013. Quantitative measurement tools were used to collect baseline socio-demographic information and data on prescription and illicit drug use, body composition, and dietary and nutrient intake. Data collection for each participant occurred over a five-day period and participants were followed-up at four months when the same quantitative tools were re-administered (over a second five-day period). Since previous research has found notable changes in opiate users' eating patterns, diet and weight over very short time frames (Neale *et al.*, 2012), we chose a four-month follow-up period. We believed this to be the optimal time frame – given the available study resources – for capturing any changes in eating behaviours whilst minimizing the likelihood of participant attrition from the research.

Recruitment took place in pharmacies in Oxfordshire, England. Although Oxfordshire has a resilient economy and overall compares favourably with other counties in the UK in terms of basic socio-economic indicators, it also has neighbourhoods that experience low skills and low incomes. Pharmacies located in areas of the county with higher levels of multiple deprivation were selected to participate in the research since they had higher numbers of OAT clients (Open Data Communities, 2015). Pharmacists identified potential participants (people receiving OAT) and made first contact with information about the study. Interested individuals were then directed to the study researcher (SSI), who provided more detail on what participation would involve. SSI took informed consent from each participant prior to any data collection. At baseline, 33 participants were recruited but 8 dropped out after the second or third day of data collection, so full data were only collected from 25 participants. Of these 25 participants, 20 were successfully followed-up at four months. Non-sensitive data were collected in a range of settings but sensitive data and body composition data were only collected in a private area of the pharmacy or in a room at the researchers' university.

Measures

Each participant completed a socio-demographic and drug use questionnaire that also included a modified section of the Maudsley Addiction Profile (MAP) (Marsden *et al.*, 1998). The socio-demographic questionnaire asked about age, ethnicity, employment, accommodation, partner/children and prescribed medications. The MAP section of the questionnaire incorporated the frequency, quantity and route of administration of non-prescribed, legal and illicit drugs during the three days and 30 days prior to data collection.

In all, 24 hour dietary recall interviews (24 HR) were also conducted with each participant using the triple pass method, a standard procedure for recording food consumption (Nelson *et al.*, 2007). SSI recorded each interview using pen and paper on a food consumption sheet. The first pass involved compiling a quick list of foods eaten. The second pass involved collecting more detailed information on the weight and amount of foods eaten, the time foods were eaten, any combinations of foods eaten together, any recipes used and any leftovers. In the third pass, SSI reviewed the food list with the participant and probed for any forgotten foods. Five 24 HRs were collected over consecutive days, including one weekend day, for each participant at each stage of the study (total = 10 × 24 HRs per participant).

To assess body composition, SSI additionally collected the following anthropometric measurement data from each participant: body mass, height, waist and hip circumferences and skinfold thickness. Body mass (kg) and height (cm) were used to calculate body mass index (BMI) in kg/m^2 and were measured using a digital electronic personal scale (Seca 813) (Seca GmbH, Hamburg, Germany) and a stadiometer (Seca 213) (Seca GmbH, Hamburg, Germany). Waist circumference and hip circumference (cm) were measured using a measuring tape for medical professionals (Seca 201) (Seca GmbH, Hamburg, Germany). Skinfold thickness measurements (mm) were taken from four body sites: biceps, triceps, the scapular (subscapular) and above the iliac crest (suprailiac) using a Harpenden skinfold calliper (Baty International, West Sussex, UK). The International Society for the Advancement of Kinanthropometry protocol was used for the skinfold measurements (Stewart *et al.*, 2011).

Analysis

24 HR data were entered into, and analysed in, the dietary software package Dietplan6 for Windows (Forestfield Software Ltd, version 6.70, West Sussex, UK). Month of birth, year of birth, body mass and height were entered for the profile information. Each food item was located in the food database in Dietplan6 and coded by its type and processing method. The photographic food atlas of portion sizes provided weight estimates for a majority of the food items (Nelson *et al.*, 1997). Packaged food weights were calculated from portion sizes provided by the Food Standards Agency (1988). Food items such as ready meals and takeaways were compared with the nutritional content of a similar item in the food database. Nutrient intake data for each participant were then compared to the reference nutrient intake (RNI) for the UK.

Body composition data were entered into a Microsoft Excel spreadsheet that included each participant's reference number, age, sex, height, body mass and body composition measures. Body density, body fat percentage, lean body mass and fat mass were next calculated in the spreadsheets.

Data from the socio-demographic questionnaire were then combined with the nutrient intake and body composition measures and entered into the statistical software programme International Business Machines Statistical Package for Social Sciences for Windows (version 21.0, Chicago, IL, USA). Standard statistical methods, suitable for small sample sizes, were employed to further analyse the data (de Winter, 2013; VanVoorhis and Morgan, 2007; Umali *et al.*, 2006). Descriptive statistics were used to determine the demographic characteristics of the sample and independent samples *t*-test were performed to compare nutrient intakes for gender and age groups against the RNI. Differences between sub-groups of the participants, as well as between baseline and follow-up data, were calculated.

Results

Demographic characteristics

At baseline, participants included 15 (60 per cent) males and 10 (40 per cent) females. Their mean age (SD) was 38.2 (8.8) years (Table I). The largest age group was 40-49 year olds. The mean age (SD) for males was 41.5 (7.2) years, while the mean age (SD) for females was 33.4 (9.1) years. Over half of the females in the study were under the age of 30 years. In total, 20 participants (80 per cent) identified themselves as white British or white Irish, and five participants (20 per cent) as mixed or other background. The group's ethnic background broadly reflected that of people in contact with drug treatment or general practitioners in England (Public Health England, 2013).

In total, 22 participants (88 per cent) had left school by age 16 years and ten (40 per cent) had no formal qualifications (Table II). Only one individual owned their own home; most lived in social housing (16 (64 per cent) at baseline and 13 (65 per cent) at follow-up). A significant minority had unstable or precarious living arrangements that included living in a hostel or shelter or staying with friends or relatives. At baseline, eight (32 per cent) lived alone and six (24 per cent) lived with a partner and/or children. At follow-up, six (30 per cent) lived alone and seven (35 per cent) lived with a partner and/ or children Table III).

Prescription drug use

Of the 25 participants, 18 were receiving methadone. This included 13 individuals (52 per cent) who were receiving sugar free methadone and five (20 per cent) who were receiving methadone with sugar. The mean (SD) prescribed doses of methadone without sugar and with sugar were similar: 65.2 (32.2) mg/day vs 68.0 (23.9) mg/day. Seven participants (28 per cent) were receiving buprenorphine, with a mean dose of 10.5 (12.4) mg/day. In total, 11 participants (44 per cent) were also receiving two or more prescriptions for physical and/or mental health conditions: ten (40 per cent) were receiving anti-depressants (primarily citalopram, Mirtazapine, Sertraline and Fluoxetine); four (16 per cent) were receiving omeprazole for stomach acid and other stomach problems; and three (12 per cent) were receiving the anti-psychotics olanzapine or amisulpride. Three participants (12 per cent) also reported either diabetes mellitus 1 or 2.

At follow-up, one respondent (5 per cent) had started to use heroin again and was not receiving any OAT. In total, 15 participants (75 per cent) were receiving sugar free methadone (mean

Table I Demographic characteristics at baseline and follow-up

Demographic characteristics	*Baseline (N = 25)*	*Follow-up (N = 20)*
	Mean (SD)	Mean (SD)
	38.2 (8.8)	38.6 (9.8)
Age (years)	*n* (%)	*n* (%)
20-29	6 (24%)	4 (20)
30-39	7 (28%)	6 (30)
40-49	10 (40%)	7 (35)
50-59	2 (8%)	3 (15)
Sex	*n* (%)	*n* (%)
Males	15 (60.0%)	12 (48.0)
Females	10 (40.0%)	8 (32.0)
Ethnicity	*n* (%)	*n* (%)
White British	18 (72.0%)	15 (75.0)
Mixed background	4 (16.0%)	4 (20.0)
White Irish	2 (8.0%)	1 (5)
Any other Asian background	1 (4.0%)	n/a
Employment	*n* (%)	*n* (%)
Yes	2 (8%)	3 (15)
No	23 (92)	17 (85)
State benefits	24 (96)	18 (90)

Table II Education and qualifications

Education ($N = 25$)	Mean (SD)
Left school	15.6 (1.2)
Age (years)	*n* (%)
13 years	2 (8)
14 years	2 (8)
15 years	5 (20)
16 years	13 (52)
17 years	1 (4)
18 years	2 (8)
Highest qualification	*n* (%)
None	10 (40)
CSE/GCSEs	7 (28)
O levels	2 (8)
A levels/Irish leaving certificate	2 (8)
University degree	1 (4)

Table III Accommodation and living arrangements at baseline and follow-up

	Baseline ($N = 25$)	*Follow-up ($N = 20$)*
Accommodation	*n* (%)	*n* (%)
Own house/flat	1 (4)	1 (5)
Social housing (flat/house)	16 (64)	13 (65)
Bedsit	2 (8)	1 (5%)
Hostel/Shelter	4 (16)	2 (10)
House/Home of relatives	1 (4)	1 (5)
Friend's sofa	1 (4)	n/a
Rehabilitation	n/a	1 (5)
Shared house	n/a	1 (5)
Living arrangements	*n* (%)	*n* (%)
Alone	8 (32)	6 (30)
Partner/Children	6 (24)	7 (35)
Ex-offenders/Homeless	4 (16)	2 (10)
Siblings	3 (12)	2 (10)
Friends	2 (8)	2 (10)
Students/Shared house	2 (8)	1 (5)

(SD) = 64.4 (37.7) mg/day); three (15 per cent) were receiving buprenorphine (mean (SD) 13.4 (16.1) mg/day) and one (5 per cent) was receiving methadone with sugar (50 mg/day). Most of those on methadone reported that they had been on a reducing dosage since their first interview. Nine participants (45 per cent) were still receiving two or more prescriptions for physical and/or mental health conditions: ten (50 per cent) were receiving anti-depressants, such as mirtazapine, citalopram and sertraline and four (20 per cent) were receiving pain medications, including di-hydrocodeine, diclofenac, co-codamol or gabapentin. Others were being prescribed multi-vitamins and vitamin supplements, such as thiamine and fibre or laxatives. However, they mostly reported that they did not take these regularly or at all. Between their baseline and follow-up interview, two participants (10 per cent) reported that they had being "topping up" their methadone or buprenorphine by buying extra on the street.

Body composition

The mean (SD) BMI (kg/m^2) for both males and females exceeded the normal range at baseline (25.2 (±5.9) kg/m^2 (pre-obese class) and 33.3 (±8.6) kg/m^2 (obesity Class I), respectively) (Table IV). At follow-up, average BMI decreased for males [mean (SD) = 24.1 (±6.2) kg/m^2 (normal class)], but increased for females (mean (SD) = 35.1 (±8.0) kg/m^2 (obesity Class II)). The mean

Table IV Body composition characteristics of OST group at baseline and follow-up, separated by sex

	Males				*Females*			
	Baseline (n = 15)		*Follow-up (n = 12)*		*Baseline (n = 10)*		*Follow-up (n = 8)*	
Body composition	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*
Age (years)	41.6	7.2	43.3	7.3	33.4	9.1	31.8	9.2
Height (cm)	176.0	3.8	176.0	4.2	165.3	7.2	165.0	7.7
Body mass (kg)	77.5	17.3	74.3	17.8	91.4	27.0	96.1	27.1
BMI (kg/m²)	25.2	5.9	24.1	6.2	33.3	8.6	35.1	8.0
WC (cm)	90.9	15.7	90.5	16.8	96.6	20.0	101.3	16.5
WHR (w/h)	0.92	0.1	0.95	0.1	0.88	0.1	0.84	0.4
Estimated body fat (%)	24.0	10.2	20.0	9.7	39.3	6.3	40.3	5.3

(SD) body mass for males and females at baseline and follow-up were 77.5 (±17.3) kg and 91.4 (±27.0) kg and 74.3 (±17.8) kg and 96.1 (±27.1) kg, respectively. According to the Health and Social Care Information Centre (2014), the mean BMI for UK males and females in the general population was 27.3 and 27.0 kg/m^2, respectively. On average, males in the current study at both baseline and follow-up had a BMI lower than the general population mean. In contrast, the mean BMI for females was higher at both baseline and follow-up than the UK general population mean.

Eating and drinking events

The mean (SD) number of meals consumed over five days was 10.9 (3.4) and the mean (SD) number of snacks was 8.3 (7.7). Participants consumed approximately two meals and two snacks per day. The mean (SD) number of alcoholic and/or non-alcoholic drinks consumed was 30.1 (10.9). Participants consumed approximately six drinks a day. Two participants (8 per cent) experienced one day with no eating occasions at all. In contrast, three participants (12 per cent) had one day or more of ⩾2 meals and ⩾ 3 snacks or ⩾ 1 meal and ⩾ 6 snacks. Two participants (8 per cent) consumed 1-2 meals over the course of the day and also consumed ⩾4 snacks in the evenings from 6 p.m.-12 a.m. over three of the five days.

At follow-up, participants consumed a mean (SD) of 11.9 (4.0) meals and 9.5 (10.3) snacks over five days. The mean (SD) drinks consumed over five days was 28.1 (8.4). Participants consumed approximately two meals a day, two snacks a day and six drinks a day. One participant (5 per cent) experienced a day without any eating occasions. Eight participants (40 per cent) had one day or more of ⩾3 meals and ⩾3 snacks. Three participants (15 per cent) had ⩽ 1 meal and ⩾ 6 snacks. Seven participants (35 per cent) consumed 1-3 meals over the course of the day and additionally consumed ⩾3 snacks in the evenings from 6 p.m.-12 a.m. on at least one of the five days. Participants consumed meals and snacks more frequently at the follow-up stage.

Macro-and micro-nutrient intake and the RNI

Non-starch polysaccharides (NSPs) consumption was well below the daily RNI (Table V). The mean (SD) daily NSPs intake was 8.5 (3.9) g/day, significantly lower than the recommended intake ($t(24) = -12.319$, $p < 0.001$). At follow-up, the NSPs intake was also significantly lower than the RNI. The mean (SD) NSPs intake was 9.8 (4.9) g/day ($t(19) = -7.447$, $p < 0.001$). Significant differences were found between males and females at both baseline and follow-up. Males at baseline consumed a mean (SD) of 8.7 (3.6) g/day ($t(15) = -8.788$, $p < 0.001$) and 11.2 g (5.6) g/day at follow-up ($t(11) = -4.199$, $p = 0.001$). The mean (SD) of NSPs intake for females was 7.7 g (2.8) g/day at baseline ($t(9) = -8.483$, $p < 0.001$) and 8.2 (14.8) g/day ($t(7) = -10.320$, $p < 0.001$) at follow-up.

Participants also exceeded the daily SAT intake recommendation at both baseline and follow-up (Table VI). At baseline, males and females consumed a mean (SD) of 30.9 (14.8) g/day and 32.9 (8.8) g/day [110.9 per cent (52.2) and 147.4 per cent (44.8) of the RNI]. At follow-up, the mean

Table V Actual versus recommended intake of NSPs

NSPs intake (g/d)	*Mean intake (SD)*	*Baseline*	*Follow-up*
Overall		$N = 25$	$N = 20$
	Actual	8.5 (3.9)	9.8 (4.9)
	Recommended	18	18
	Difference[a]	−9.5 (3.9)	−8.2 (4.9)
	p-value[b]	< 0.001[c]	< 0.001
Males		$N = 15$	$N = 12$
	Actual	8.7 (4.1)	11.2 (5.6)
	Recommended	18	18
	Difference	− 9.3 (4.1)	− 6.8 (5.6)
	p-value	< 0.001	0.001
Females		$N = 10$	$N = 8$
	Actual	8.2 (3.6)	7.7 (2.8)
	Recommended	18	18
	Difference	−9.8 (3.6)	−10.3 (2.8)
	p-value	< 0.001	< 0.001

Notes: [a]Difference = actual intake−recommended intake; [b]*p*-value (independent samples *t*-test); [c]Statistical significance is set at $p < 0.05$

Table VI Actual versus recommended SAT intakes

SAT intake (g/d)	*Mean intake (SD)*	*Baseline*	*Follow-up*
Overall	Actual	31.7 (12.5)	35.2 (19.8)
	Recommended	20.0	20.0
	Difference	11.67 (12.5)	15.2 (19.8)
	p-value	*< 0.001*	*0.003*
Males	Actual	30.9 (14.8)	40.1 (20.5)
	Recommended	20.0	20.0
	Difference	10.9 (14.8)	20.1 (20.5)
	p-value	*0.012*	*0.006*
Females	Actual	32.9 (8.8)	28.0 (17.6)
	Recommended	20.0	20.0
	Difference	12.8 (8.8)	8.0 (17.6)
	p-value	*0.001*	*0.241*

(SD) SAT intake was 40.1 (20.5) g/day and 28.0 (17.6) g/day for males and females (143.0 per cent (70.5) and 148.0 per cent (76.4) of the RNI). Females' SAT consumption at baseline was significantly higher than the recommended SAT intake of 20 g/day ($t(9) = 4.618$, $p = 0.001$). The major contributors to SAT intake among males and females were full-fat dairy products (cheese, milk, yoghurt, ice cream, cream), confectionary (cakes, tarts, biscuits), meat products (beef, pork and meat topped pizza) and chocolate (chocolate covered granola bars, chocolate bars).

Within the general population, the RNI for iron is much higher for females than for males. The RNI for iron for females is 14.8 mg/day (Department of Health, 1991). According to the NDNS 2008/09-2010/11, females in the general population from ages 19-64 years were well below the RNI, reaching only 79 per cent of the daily RNI (Bates *et al.*, 2011). In the current study, females had a mean (SD) iron intake of 6.9 (3.4) mg/day (Table VII) and only reached 54.1 per cent of their daily RNI. Iron intake was significantly lower than the RNI ($t(9) = -7.456$, $p < 0.001$). At follow-up, the mean (SD) iron intake was 8.6 (3.9) mg/day. Iron intake reached 64.1 per cent of the RNI, but was still significantly lower ($t(7) = -4.433$, $p = 0.003$).

Selenium intakes for males and females at both baseline and follow-up were well below the daily RNI (Table VIII). Males at baseline obtained a mean (SD) daily intake of 40.9 (20.4) μg/d,

Table VII Actual versus recommended iron intakes			
Iron intake (g/d)	*Mean intake (SD)*	*Baseline*	*Follow-up*
Males		$N = 15$	$N = 12$
	Actual	12.3 (5.0)	17.0 (9.5)
	Recommended	8.7	8.7
	Difference	3.5 (5.0)	8.3 (9.5)
	p-value	0.019	0.012
Females		$N = 10$	$N = 8$
	Actual	6.9 (3.4)	8.6 (3.9)
	Recommended	14.8	14.8
	Difference	–7.5 (3.4)	–6.1 (3.9)
	p-value	*< 0.001*	*0.003*

Table VIII Actual versus recommended selenium intakes			
Selenium (μg/d)	*Mean intake (SD)*	*Baseline*	*Follow-up*
Males	Actual	40.9 (20.4)	35.5 (16.9)
	Recommended	75.0	75.0
	Difference	–34.2 (20.4)	–39.5 (16.9)
	p-value	*< 0.001*	*< 0.001*
Females	Actual	31.8 (15.4)	24.8 (6.3)
	Recommended	60.0	60.0
	Difference	–28.2 (15.4)	–35.2 (6.3)
	p-value	*< 0.001*	*< 0.001*

54.5 per cent (27.3) of the daily intake and, at follow-up, this fell well below the RNI at 35.5 (16.9) μg/d, or 47.3 per cent (22.5) of the daily intake. Females also had low intakes of selenium, a mean (SD) intake of 31.8 (15.4) μg/d at baseline and 24.8 (6.3) μg/d at follow-up. The difference in selenium intake compared to the RNI was significant for males at baseline and follow-up ($t(14) = -6.5$, $p < 0.001$; $t(11) = -8.095$, $p < 0.001$, respectively). Females also had a significantly lower intake than the RNI at baseline and follow-up ($t(9) = -5.778$, $p < 0.001$; $t(7) = -15.738$, $p < 0.001$, respectively).

The RNI for potassium is set at 3,500 mg/day (Department of Health, 1991). The NDNS reports lower mean intakes of potassium in the general population (Bates *et al.*, 2011). Potassium intakes in the current study were also well below the RNI (Table IX). Males at baseline had a mean (SD) intake of 2,696.2 (909.6) mg/day which was significantly less than the RNI ($t(14) = -3.422$, $p = 0.004$). At follow-up, potassium intake for males met the RNI at a mean of 2925.9 (1204.5) mg/day. Females did not meet dietary potassium sufficiency. Females at baseline had a mean (SD) intake of 2,263.7 (1,109.0) mg/day and, at follow-up, the mean (SD) intake was 2,108.6 (248.9) mg/day. The difference in females' potassium intake and the RNI was significantly lower at both stages ($t(9) = -3.525$, $p = 0.006$; $t(7) = -5.590$, $p = 0.001$).

Maximum recommended intake of salt for the general population is 6 g/day; however over consumption is common. In the current study, both males and females at baseline and follow-up exceeded the RNI for salt (Table X). At baseline, males had a mean estimated salt intake of 7.6 g/day and females had a mean daily estimated salt intake of 5.8 g/day. At follow-up, males had a mean estimated salt intake of 9.8 g/day and women had a mean estimated salt intake of 6.3 g/day. Sodium intakes for males and females were significantly greater than the RNI at baseline ($t(14) = 4.884$, $p < 0.001$; $t(9) = 2.725$, $p = 0.023$, respectively) and follow-up ($t(11) = 3.885$, $p = 0.003$; $t(7) = 3.365$, $p = 0.012$, respectively). Males, in particular, exceeded the maximum recommended daily salt intake.

Table IX Actual versus recommended potassium intakes

Potassium (mg/d)	*Mean intake (SD)*	*Baseline*	*Follow-up*
Overall	Actual	2,523.2 (995.3)	2,925.9 (1204.5)
	Recommended	3,500.0	3,500.0
	Difference	–976.8 (995.3)	–547.1 (1204.5)
	p-value	*< 0.001*	*0.046*
Males	Actual	2,696.2 (909.6)	3,470.7 (1175.1)
	Recommended	3,500.0	3,500.00
	Difference	–803.8 (909.6)	–29.3 (1175.1)
	p-value	*0.004*	*0.933*
Females	Actual	2,263.7 (1109.0)	2,108.6 (248.9)
	Recommended	3,500.0	3,500.0
	Difference	–1,236.3 (1109.0)	–1,391.4 (248.9)
	p-value	*0.006*	*0.001*

Table X Actual versus recommended sodium intakes

Sodium (mg/d)	*Mean intake (SD)*	*Baseline*	*Follow-up*
Overall	Actual	2,741.4 (1066.6)	3,346.4 (1808.3)
	Recommended	1,600.0	1,600.0
	Difference	1146.9 (1066.6)	1746.4 (1808.3)
	p-value	< 0.001	< 0.001
Males	Actual	3,014.7 (1121.8)	3,940.8 (2087.1)
	Recommended	1,600.0	1,600.0
	Difference	1,414.7 (1121.8)	2,340 (2087.1)
	p-value	< 0.001	0.003
Females	Actual	2,345.3 (864.9)	2,454.8 (718.5)
	Recommended	1,600.0	1,600.0
	Difference	854.8 (864.9)	745.3 (718.5)
	p-value	*0.012*	*0.023*

Discussion

Males in the study were approximately ten years older than females. The majority of participants identified as White British and had left school at approximately 16 years of age. Unstable housing circumstances were common. Almost half were receiving two or more prescriptions for multiple physical and/or mental health conditions, indicating overall poor health. Many participants were also being prescribed multi-vitamin supplements or dietary fibre or laxatives, suggesting that they had at some point complained of poor bowel functioning and constipation (even though they did not use these medications regularly or at all). According to the BMI classification, males were in the pre-obese class and females were in obesity Class I. At follow-up, males decreased to the normal class, however females increased to obesity Class II.

Taking males and females together, intakes of the key nutrients NSPs, selenium and potassium were significantly deficient. Opiates including prescribed opiates such as methadone inhibit the transit of secretion in the gut which can result in constipation (Camilleri, 2011). This is likely to be exacerbated by low NSP consumption, which can also compromise gut functioning and create constipation symptoms and bowel issues. Selenium content in food varies widely due to the soil content and its geochemical makeup where the foods originated. However, the Scientific Advisory Committee on Nutrition has indicated that a preventative association potentially exists between selenium and conditions such as cancer, cardiovascular disease, diseases related to thyroid function, reproduction and infertility

(Scientific Advisory Committee on Nutrition, 2013; Rayman, 1997; Rayman, 2000). Potassium deficiency is associated with hypokalaemia which can also be associated with stomach pains and cramping as well as other muscle problems, dizziness, fainting, frequent urination, extreme thirst and numbness or tingling.

Females were also not reaching the recommended nutrient intake for iron; their iron intake being much lower than the average iron intake for females in the UK general population. If the bioavailability of dietary iron is unable to meet the physiological requirements over a long-term period, nutritional iron deficiency can arise, with symptoms including weakness, fatigue, headaches and trouble concentrating (Zimmermann and Hurrell, 2007). In contrast, male and female participants consumed over their recommended intake in salt and saturated fats. BMI was also high, especially amongst females. The risk of developing cardiovascular diseases increases with the intake of salt and saturated fats and further increases with higher BMI.

In contrast to other studies (Best *et al.*, 1998), we found that the frequency of eating events was close to a three-meal a day routine. However, participants reported a very high level of snack consumption, including multiple snacking in the evening. High intakes of ice cream, cakes, tarts, biscuits and chocolate were associated with the high levels of SAT reported. Too much saturated fat in the diet can increase the amount of cholesterol in the blood, which can in turn increase the risk of developing coronary heart disease. In contrast, a small number of participants reported not eating at all some days. Not eating for 24 hours can cause multiple minor problems including headaches, constipation and nausea; whilst not eating for longer periods can have more serious health consequences, including slowed metabolism, hypoglycaemia and nutritional deficiencies.

Study limitations

Our sample size was small and a larger study is required in order to yield precise estimates and reliable results. In addition, the quantitative data presented do not capture the many social, cultural, economic and environmental factors that affect eating patterns and food choices. For example, poor diet and compromised nutrition are associated with low socio-economic status, poverty and social marginalization (Bhattacharya *et al.*, 2004; Drewnowski and Specter, 2004; Marmot, 2005; Marmot *et al.*, 2008). It is therefore likely that our findings relate, at least in part, to the socio-demographic profile of our participants (particularly, their low levels of educational attainment, high levels of housing insecurity and poor physical health). Despite this, the significant changes in BMI, diet and nutrient intakes that we identified over a short four-month period are not characteristic of the general population or of people experiencing social exclusion; yet, they are consistent with previous research on opiate users in treatment and "recovery" (Rajs *et al.*, 2004; Neale *et al.*, 2012). Such findings are suggestive of associations between diet/nutrition and opiate use independent of those related to wider socio-economic inequalities. Moreover, these associations are consistent with the pharmacokinetic literature on drug-nutrient interactions and the known physiological effects of opiates on gut functioning that our data also identified.

Conclusions

There is a need for increased attention to the diet and nutrition of people receiving OAT in order to facilitate recovery processes and good recovery outcomes. Diet and nutrition are fundamental to general wellness and are core aspects of self-care. Poor diet and nutrition place people at increased risk of chronic conditions. Meanwhile, multiple morbidities can cause further complications to health and undermine other well-being outcomes. Our participants, and especially our female participants, seemed to be at increased risk of NCDs and a wide range of other morbidities because of their poor diet and nutrient intake at both baseline and follow-up. For women, this was likely to have been compounded by increased BMI and SAT intakes over the four-month study period.

Whilst we recognize that complex personal, social and economic circumstances (such as unstable housing, low income and even poor health itself) may constrain the food choices of many people receiving OAT, this is not a valid reason for ignoring their diet or nutrient intake

Our findings indicate that a recovery-oriented system of treatment and care would benefit from:

1. Further research, with larger sample sizes, to provide more robust data on nutritional deficiencies, including differences between males and females and other sub-groups of people receiving OAT, and greater insights into changes over time.
2. Nutritional recommendations or guidelines specific to people receiving OAT that, in so far as possible, take account of socio-economic status, sub-group differences, individual differences and stage of recovery.
3. Increased attention to nutrition and diet within both community and residential treatment programmes. This might include a dietary lifestyle assessment to assess current food consumption and provide appropriate personalized guidance alongside nutritional education, support with cooking skills and the actual provision of healthy meals and snacks (Neale *et al.*, 2012; Kolarzyk *et al.*, 2010; Zador *et al.*, 1996; Gambera and Clarke, 1976).

References

ACMD (2013), "What recovery outcomes does the evidence tell us we can expect? Second report of the Recovery Committee", Advisory Council on the Misuse of Drugs, London.

Alves, D., Costa, A.F., Custódio, D., Natário, L., Ferro-Lebres, V. and Andrade, F. (2011), "Housing and employment situation, body mass index and dietary habits of heroin addicts in methadone maintenance treatment", *Heroin Addiction and Related Clinical Problems*, Vol. 13 No. 1, pp. 11-14.

Arnold-Reed, D.E., Brett, T., Troeung, L., O'Neill, J., Backhouse, R. and Bulsara, M.K. (2014), "Multimorbidity in patients enrolled in a community-based methadone maintenance treatment programme delivered through primary care", *Journal of Comorbidity*, Vol. 4 No. 1, pp. 46-54.

Bates, B., Lennox, A., Prentice, A., Bates, C. and Swan, G. (2011), "National diet and nutrition survey: headline results from years 1 and 2 (combined) of the rolling programme 2008/2009-2009/2010", Department of Health, London.

Beaglehole, R. and Yach, D. (2003), "Globalisation and the prevention and control of non-communicable disease: the neglected chronic diseases of adults", *The Lancet*, Vol. 362 No. 9387, pp. 903-8.

Best, D., Lehmann, P., Gossop, M., Harris, J., Noble, A. and Strang, J. (1998), "Eating too little, smoking and drinking too much: wider lifestyle problems among methadone maintenance patients", *Addiction Research*, Vol. 6 No. 6, pp. 489-98.

Bhattacharya, J., Currie, J. and Haider, S. (2004), "Poverty, food insecurity, and nutritional outcomes in children and adults", *Journal of Health Economics*, Vol. 23 No. 4, pp. 839-62.

Camilleri, M. (2011), "Opioid-induced constipation: challenges and therapeutic opportunities", *The American Journal of Gastroenterology*, Vol. 106 No. 5, pp. 835-42.

Creswell, J.W. (2013), *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*, Sage Publications, Thousand Oaks, CA.

Cullen, W., O'Brien, S., O'Carroll, A., D O'Kelly, F. and Bury, G. (2009), "Chronic illness and multimorbidity among problem drug users: a comparative cross-sectional pilot study in primary care", *BMC Family Practice*, Vol. 10 No. 1, p. 1.

Daar, A.S., Singer, P.A., Persad, D.L., Pramming, S.K., Matthews, D.R., Beaglehole, R., Bernstein, A., Borysiewicz, L.K., Colagiuri, S., Ganguly, N. and Glass, R.I. (2007), "Grand challenges in chronic non-communicable diseases", *Nature*, Vol. 450 No. 7169, pp. 494-6.

Department Of Health (1991), *Dietary Reference Values for Food Energy and Nutrients for the United Kingdom*, HMSO, London.

de Winter, J.C. (2013), "Using the student's *t*-test with extremely small sample sizes", *Practical Assessment, Research & Evaluation*, Vol. 18 No. 10, pp. 1-12.

Drewnowski, A. and Specter, S.E. (2004), "Poverty and obesity: the role of energy density and energy costs", *The American Journal of Clinical Nutrition*, Vol. 79 No. 1, pp. 6-16.

Food Standards Agency (1988), *Food Portion Sizes: Third Edition*, The Stationery Office, London.

Gambera, S.E. and Clarke, J.A. (1976), "Dietary intake of drug-dependent persons", *Journal of the American Dietetic Association*, Vol. 68 No. 2, pp. 155-7.

Health and Social Care Information Centre (2014), "Statistics on obesity, physical activity and diet: England 2014", Health and Social Care Information Centre, Leeds.

Hillebrand, J., Marsden, J., Finch, E. and Strang, J. (2001), "Excessive alcohol consumption and drinking expectations among clients in methadone maintenance", *Journal of Substance Abuse Treatment*, Vol. 21 No. 3, pp. 155-60.

HM Government (2010), "Drug strategy 2010. Reducing demand, restricting supply, building recovery: supporting people to live a drug free life", available at: www.gov.uk/government/uploads/system/uploads/attachment_data/file/118336/drug-strategy-2010.pdf (accessed 8 December 2014).

Kolarzyk, E., Szpanowska-Wohn, A. and Chrostek-Maj, J. (2010), "Zinc, copper and magnesium intake in a daily diet in opiate-addicted persons before and after 5 years of methadone treatment", *Problemy Higieny i Epidemiologii*, Vol. 91 No. 2, pp. 243-7.

Kolarzyk, E., Pach, D., Wojtowicz, B., Szpanowska-Wohn, A. and Szurkowska, M. (2004a), "Nutritional status of the opiate dependent persons after 4 years of methadone maintenance treatment", *Przegląd lekarski*, Vol. 62 No. 6, pp. 373-7.

Kolarzyk, E., Chrostek, M.J., Pach, D., Janik, A., Kwiatkowski, J. and Szurkowska, M. (2004b), "Assessment of daily nutrition ratios of opiate-dependent persons before and after 4 years of methadone maintenance treatment", *Przegląd lekarski*, Vol. 62 No. 6, pp. 368-72.

Marmot, M. (2005), "Social determinants of health inequalities", *The Lancet*, Vol. 365 No. 9464, pp. 1099-104.

Marmot, M., Friel, S., Bell, R., Houweling, T.A., Taylor, S. and Commission on Social Determinants of Health (2008), "Closing the gap in a generation: health equity through action on the social determinants of health", *The Lancet*, Vol. 372 No. 9650, pp. 1661-9.

Marsden, J., Gossop, M., Stewart, D., Best, D., Farrell, M., Lehmann, P., Edwards, C. and Strang, J. (1998), "The Maudsley Addiction Profile (MAP): a brief instrument for assessing treatment outcome", *Addiction*, Vol. 93 No. 12, pp. 1857-67.

Murray, C.J.L., Richards, M.A., Newton, J.N., Fenton, K.A., Anderson, H.R., Atkinson, C., Bennett, D., Bernabé, E., Blencowe, H., Bourne, R., Braithwaite, T., Brayne, C., Bruce, N.G., Brugha, T.S., Burney, P., Dherani, M., Dolk, H., Edmond, K., Ezzati, M., Flaxman, A.D., Fleming, T.D., Freedman, G., Gunnell, D., Hay, R.J., Hutchings, S.J., Ohno, S.L., Lozano, R., Lyons, R.A., Marcenes, W., Naghavi, M., Newton, C.R., Pearce, N., Pope, D., Rushton, L., Salomon, J.A., Shibuya, K., Vos, T., Wang, H., Williams, H.C., Woolf, A.D., Lopez, A.D. and Davis, A. (2013), "UK health performance: findings of the global burden of disease study 2010", *Lancet*, Vol. 381 No. 9871, pp. 997-1020. doi: 10.1016/S0140-6736(13)60355-4.

Nahvi, S., Richter, K., Li, X., Modali, L. and Arnsten, J. (2006), "Cigarette smoking and interest in quitting in methadone maintenance patients", *Addictive Behaviors*, Vol. 31 No. 11, pp. 2127-34.

Neale, J., Nettleton, S., Pickering, L. and Fischer, J. (2012), "Eating patterns among heroin users: a qualitative study with implications for nutritional interventions", *Addiction*, Vol. 107 No. 3, pp. 635-41.

Nelson, M., Atkinson, M., Meyer, J., Britain, G. and Britain, G. (1997), *Food Portion Sizes: A Photographic Atlas*, MAFF publications, London.

Nelson, M., Erens, B., Bates, B., Church, S. and Boshier, T. (2007), *Low Income Diet and Nutrition Survey: Volume 2 Food Consumption and Nutrient Intake*, Food Standards Agency, London.

Nolan, L.J. and Scagnelli, L.M. (2007), "Preference for sweet foods and higher body mass index in patients being treated in long-term methadone maintenance", *Substance Use & Misuse*, Vol. 42 No. 10, pp. 1555-66.

O'Toole, J., Hambly, R., Cox, A.M., O'Shea, B. and Darker, C. (2014), "Methadone-maintained patients in primary care have higher rates of chronic disease and multimorbidity, and use health services more intensively than matched controls", *The European Journal of General Practice*, Vol. 20 No. 4, pp. 275-80.

Open Data Communities (2015), "Indices of multiple deprivation", available at: http://dclgapps.communities.gov.uk/imd/idmap.html (accessed 1 June 2015).

Pajusco, B., Chiamulera, C., Quaglio, G., Moro, L., Casari, R., Amen, G., Faccini, M. and Lugoboni, F. (2012), "Tobacco addiction and smoking status in heroin addicts under methadone vs. buprenorphine therapy", *International Journal of Environmental Research and Public Health*, Vol. 9 No. 3, pp. 932-42.

Public Health England (2013), "Statistics for drug treatment activity in England 2012-13", available at: www.nta.nhs.uk/uploads/statisticsfromndtms2012-13adultstatsreleasefinal.pdf (accessed 11 March 2014).

Rajs, J., Petersson, A., Thiblin, I., Olsson-Mortlock, C., Fredriksson, A. and Eksborg, S. (2004), "Nutritional status of deceased illicit drug addicts in Stockholm, Sweden – a longitudinal medicolegal study", *Journal of Forensic Sciences*, Vol. 49 No. 2, pp. 320-9.

Rayman, M.P. (1997), "Dietary selenium: time to act", *BMJ: British Medical Journal*, Vol. 314 No. 7078, p. 387.

Rayman, M.P. (2000), "The importance of selenium to human health", *The Lancet*, Vol. 356 No. 9225, pp. 233-41.

Recovery Orientated Drug Treatment Expert Group (2012), *Medications in Recovery: Re-Orientating Drug Dependence Treatment*, National Drug Treatment Agency for Substance Misuse, London.

Rengade, C.E., Kahn, J.P. and Schwan, R. (2009), "Misuse of alcohol among methadone patients", *The American Journal on Addictions*, Vol. 18 No. 2, pp. 162-6.

Richter, K.P. and Arnsten, J.H. (2006), "A rationale and model for addressing tobacco dependence in substance abuse treatment", *Substance Abuse Treatment, Prevention, and Policy*, Vol. 1 No. 1, pp. 23.

Scientific Advisory Committee on Nutrition (2013), "SACN postition statement on selenium and health", available at: www.sacn.gov.uk/pdfs/sacn_selenium_statement_may_2013.pdf (Accessed 13 April 2014).

Scottish Government (2008), *The Road to Recovery: A New Approach to Tackling Scotland's Drug Problem*, Scottish Government, Edinburgh.

Senbanjo, R., Wolff, K. and Marshall, J. (2007), "Excessive alcohol consumption is associated with reduced quality of life among methadone patients", *Addiction*, Vol. 102 No. 2, pp. 257-63.

Stewart, A., Marfell-Jones, M., Olds, T. and De Ridder, H. (2011), *International Standards for Anthropometric Assessment*, ISAK, Lower Hutt.

Tacke, U., Wolff, K., Finch, E. and Strang, J. (2001), "The effect of tobacco smoking on subjective symptoms of inadequacy ("not holding") of methadone dose among opiate addicts in methadone maintenance treatment", *Addiction Biology*, Vol. 6 No. 2, pp. 137-45.

Umali, M.N., Llido, L.O., Francisco, E.M.P., Sioson, M.S., Gutierrez, E.C., Navarrette, E.G. and Encarnacion, M.J. (2006), "Recommended and actual calorie intake of intensive care unit patients in a private tertiary care hospital in the Philippines", *Nutrition*, Vol. 22 No. 4, pp. 345-9.

VanVoorhis, C.R.W. and Morgan, B.L. (2007), "Understanding power and rules of thumb for determining sample sizes", *Tutorials in Quantitative Methods for Psychology*, Vol. 3 No. 2, pp. 43-50.

Zador, D., Wall, P.L. and Webster, I. (1996), "High sugar intake in a group of women on methadone maintenance in South Western Sydney, Australia", *Addiction*, Vol. 91 No. 7, pp. 1053-61.

Zimmermann, M.B. and Hurrell, R.F. (2007), "Nutritional iron deficiency", *The Lancet*, Vol. 370 No. 9586, pp. 511-20.

Corresponding author

Suzanne Sayuri Ii can be contacted at: suzanne.ii@kcl.ac.uk