Lessons from a publicly funded tier 2 healthy weight programme in Cornwall, UK

Williams, A.J.[1] Barter, T.[2] & Sharpe, R.A.[1&2]

[1]European Centre for Environment and Human Health, University of Exeter Medical School, Truro, United Kingdom TR1 3HD and [2]Wellbeing and Public Health Service, Cornwall Council, Truro United Kingdom TR1 3AY.

Correspondence: Dr Richard A. Sharpe, Advanced Public Health Practitioner, Health and Well-being Service, Cornwall Council, New County Hall, Truro, Cornwall TR1 3AY. Telephone 01872 323116 and Email richard.sharpe@cornwall.gov.uk

Abstract

Background: The UK has one of the highest prevalence rates of obesity worldwide. Public health departments have a duty to provide some obesity treatment and prevention services. With evidence of effective programmes lacking, we investigate lessons learned from a healthy weight programme in Cornwall, UK.

Methods: Data from the 12-week multi-component adult healthy weight management programme were obtained for 2012-2016. Descriptive statistics and statistical tests were used to describe participants' demographics; health status; and anthropometric measures to explore the enrolment and retention of the programme as well as the impact.

Results: A total of 1,872 adults were referred into the programme. 646 completed the programme and, 48.8% achieved the programme's aim of a >3% reduction in weight. Those who completed and met the programme aim tended to have had healthier outcomes at baseline.

Conclusions: For those who engage with the programme the impact can be meaningful. However, less than 1% of the population of Cornwall with overweight or obesity enrolled in the programme, and those who benefitted most might have been in least need. Providing services that meet the needs of the population is challenging when a variety of services is needed, and the evidence base is poor.

Keywords:

Public health, obesity, healthy weight, service evaluation, recruitment, retention

Introduction

The rise in obesity and associated non-communicable diseases (e.g. co-morbidities including type II diabetes, some cancers and cardiovascular diseases) represents a major global public health challenge (1, 2). The UK has one of the highest prevalence rates of obesity worldwide, which reached 27% of the adult population in 2015 (3). Wang, McPherson (4) predicted that this would rise to over 40% by 2030 with an additional 11 million more obese adults (3.3 million of whom could be older than 60 years). They estimated that this increase in prevalence would cost the NHS an additional £1.9-2 billion/year to treat the associated burden of disease (5).

The causes of obesity are many and extremely complex, involving a diverse range of direct (e.g. biology, food consumption, activity levels and psychology) and indirect (e.g. food production, wider environment and societal influences) factors, with levels of physical activity and diet playing an important role (1, 6). Despite the potential of prevention programmes, there appears to be limited robust evidence on successful population-level intervention strategies to reduce obesity levels (7-12).

This is crucial as identifying effective strategies has the potential to prevent larger disease burden on society and healthcare systems (2). Even a 1% BMI reduction (approximately 1 kg weight reduction per person) across the UK could avoid 179,000–202,000 incident cases of diabetes, 122,000 cardiovascular diseases, and 32,000–33,000 incident cases of cancer (5). Consequently, obesity prevention is a UK public health priority (13).

Following the UKs Health and Social Care Act 2012, Public Health services were integrated into local authorities to improve the health of the local population. Public Health departments have the remit to provide healthy weight programmes, including both obesity prevention and treatment services. However, healthy weight programmes vary across the country, with local authorities choosing to focus primarily on promoting healthy eating (e.g. reducing energy intake) and/or increasing physical activity (e.g. increasing energy expenditure) (13). The evidence on the potential of these different approaches to increase quality of life, reduce morbidity and premature all-cause mortality in adults with obesity varies and does not necessarily support local decision making about the most appropriate approach to adopt (10, 14, 15).

Four years of administrative / operative data from the evidence based Healthy Weight Adults Programme adopted by Cornwall Council, South West of England have been examined in order to assess the impact of the programme and identify opportunities for programme development.

Methods

Context

Cornwall is a predominantly rural county, with many small dispersed settlements. Some of the most deprived communities in England (16) are in Cornwall and are associated with lower life expectancies (17). Addressing physical inactivity and unhealthy diets in adult populations are current public health priorities because 64.3% of adults in 2016/17 fall within the overweight and obese category across Cornwall (18). Details of the care pathway for adults with overweight or obesity in the county can be found in online repository #1.

Healthy weight adult programme

The programme is a lifestyle management programme for adults aged 18+ years who are above a healthy weight (BMI >25 kg/m^2). The aims of the programme were to achieve a 3 to 5% weight loss through 6- and 12-month follow up appointments as well as increasing physical activity and improving diet. It is a 12-week multi-component lifestyle weight management programme, employing motivational interviewing and health coaching techniques to promote healthy eating and physical activity. Each weekly session consists of a two-hour intervention focusing on education and physical activity (an hour on each). The physical activity and exercise advice are based on Chief Medical Officer's recommendations (e.g. type, frequency and intensity of activity for health) for Physical Activity for Adults (20). Dietary advice is based around the Eatwell Guide (21). Sessions are held in a community setting and delivered by two trained Healthy Lifestyle delivery advisors. Participants are offered the opportunity to attend 3-, 6-, 12- and 24-month reunions for the assessment of longer term changes in behaviour and weight.

Written consent from participating adults is obtained from each of the registration days, which requires a commitment to completing the 12-week programme, as well as, being motivated and ready to change. Adults are not registered onto the

programme if they have; an underlying medical cause for obesity and would benefit from more intensive clinical management than a tier 2 service; significant co-morbidity or complex needs as identified by their GP or healthcare professional; an eating disorder; or a BMI <25 kg/m^2.

Data

This study was an analysis of the operational data from the Healthy Weight Adults programme. The following anthropometric measures were taken at registration (week 1), programme completion (week 12) and then at each reunion; height (Seca 213 Portable Height Measure), waist circumference (Seca measurement tape), weight, fat mass, muscle mass, visceral fat and metabolic age (Tanita Body Composition Analyser). On entry to the programme, the advisor completes a registration form and check list with each participant. This includes asking information about previous or ongoing weight management strategies, importance of making long-term changes, realistic weight-loss goals and commitment to completing the programme. The registration form captures participant demographic characteristics including, age, gender, ethnicity, level of deprivation (22) and presence of any disability. Participant peak flow, systolic and diastolic blood pressure were also taken (using CareFusion PulmoLife COPD Screening Device and the Omron 705IT, respectively) during registration and on completion of the programme. Participant physical activity was assessed during the programme using the validated New Zealand Physical Activity Questionnaires and dietary behaviour using the validated Short Form Food Frequency Questionnaire, but these measures are not included in the current study.

Statistical analyses

Body Mass Index (BMI) was calculated as follows for each participant; weight (kg) divided by height^2 (m^2), and categorised as shown in online repository #2. Waist-Height ratio (WHtR) was also calculated as waist circumference (cm) divided by height (cm) as another measure of obesity which particularly reflects abdominal obesity. The nature of the association between WHtR and morbidity and mortality is

not confirmed, but as a rule of thumb a WHtR over 0.5 is considered to indicate increased risk (23-25).

Descriptive statistics were used to examine participant flow through the programme and data completeness. In order to compare participants in the programme with non-participants, baseline data for those who completed the programme were compared with those who dropped out after registration.

The difference between each participant's baseline and follow-up measures was calculated for each outcome at each time point (completion, 3-, 6-, 12- and 24-month). These differences were then averaged to give a mean difference and 95% confidence interval. Changes in weight status were also categorised according to BMI and WHtR.

Finally, as sustained weight loss was the goal of the programme, a comparison was made in the baseline demographics and anthropometrics between those who had and had not demonstrated >3% reduction in weight at 12 months.

Ethical approval for this study was granted by Cornwall Councils Research Governance Framework panel on the 16th August 2017, and the University of Exeter Medical Schools ethics committee on the 28th September 2017 (reference number 17/08/133).

Results

Eligible adults could self-refer into the healthy weight programme or be referred from primary care or other health professionals. Of those being referred into the programme during 2016, 82% had self-referred and only 9% had been referred by GP's or practice nurses (19). Between 2012 and 2016, a total of 1,872 adults were referred into the programme.

Of the 1,872 adults being referred onto the programme, 74 (4.0%) cancelled before registering and 101 (5.4%) failed to attend the registration appointment (Figure 1). A total of 1,697 people were reported to have registered on the programme, but anthropometric measures were only recorded for at most 952 (56.1%) people. Only 646 (38.1%) people completed the 12-week programme with anthropometry

176 available for at most 644 adults (99.7%). There appears to have been an early drop
177 out around week 2 and then a later one around half way through the programme.
178 Some participants were measured at follow-up without being measured at
179 registration (baseline) and therefore, have not been included in any further analysis.
180 The number of participants attending each reunion fell, with only 80 participants
181 attending their 24-month reunion (Figure 1).

182 Participants completing the programme had a mean age of 57.4 years with a mean
183 weight of 99.2 kg and 92.3% were from a White British background (Table 1). Nearly
184 a quarter (23%) of participants had a disability and 77.3% of participants completing
185 the programme were women. Levels of obesity and waist-height ratio varied, and
186 despite the inclusion criteria a small number of people with BMI<25kg/m^2 appear to
187 have participated in the programme.

188 There were no statistically significant differences between completers and non-
189 completers in terms of gender, ethnicity, Waist-Height ratio category, visceral fat,
190 blood pressure or peak flow. Blood pressure and peak flow measures were available
191 for less than 20% of the sample and therefore may be more biased than the other
192 measures. There was a borderline significant difference in the proportion reporting a
193 physical or learning disability, where a higher proportion dropped out. People who
194 completed the programme tended to be older ($p<0.01$) and were more likely to be
195 from deprivation quintiles 1-3 (highest deprivation) than 4 or 5 ($p=0.03$). In terms of
196 the anthropometric measures those who dropped out had less healthy measures.
197 Metabolic age was around 2 years higher among the completers ($p<0.01$), but they
198 were around 5 years chronologically older ($p<0.01$), demonstrating that completers
199 tended to be healthier. Understandably as a referral programme, participants in the
200 programme had a poorer weight profile than the general public, however, people
201 who remained in the programme tended to be healthier than those who dropped out.

202 Of the 642 participants with data on weight at programme completion, 48.8% had
203 achieved the aim of greater than 3% reduction in weight compared to when they
204 registered (24.6% had achieved greater than 5%). Twelve-month reunion data were
205 only available for 185 participants, of whom 49.2% (>5% 38.4%) were demonstrating
206 greater than 3% weight loss compared with registration. A quarter (>5% 45.1%) of
207 these participants achieved this loss after programme completion. However, these

figures mean that only 14.2% of those completing are known to have achieved the goal 12-months following programme completion with data unavailable for 71.4% of participants. None of the mean differences in any of the outcomes were found to be statistically significant at any of the time points (Table 2). Overall, apart from peak flow and muscle mass which would increase if they were improving, the mean difference for each measure indicated improvement. There were demographic and anthropogenic measure differences in adults who had and had not achieved a meaningful (<3%) reduction in weight at 12-months (Table 3).

In our analyses of changes in weight status (Online repositories #3-7), the results tended to be poorer in terms of WHtR but, there were anomalous changes (shown highlighted in blue) which may indicate an issue with data collection. The majority of people remained the same weight status between time points, but a minority of people did move into a healthier weight status. In terms of BMI, around one third of people who were obese category 1 or 2 moved to a lower weight status.

Discussion

Main findings of this study

Over a four-year period, out of an adult population of around 434,000 (mid-2017 estimates (26)) almost 1,900 adults in Cornwall were referred to the Tier 2 healthy weights adults programme with the majority being self-referrals, however, only a third completed the programme. Those who completed the programme were older, from more deprived areas, and had healthier anthropometric measures at baseline. Almost 50% of those who completed the programme achieved the aim of greater than 3% weight reduction, with 75% of those maintaining the weight loss for 12 months. However, these changes did not result in statistically significant impacts on any of the other outcome measures assessed, with significant loss to follow up reducing the sample size (Table 2). The small number of potential harms from the programme may include reductions in peak flow and muscle mass. However, without information on age related decline in these measures it is not possible to assess whether these are consistent with age related decline. Those who had achieved greater than 3% weight loss by the 12-month reunion were more likely to be female and had lower levels of visceral fat at baseline (registration).

As the data analysed did not originate from a trial the objective of this study was to investigate how the programme and other programmes serving similar populations could be improved. There are a wide number of reasons that someone may not have attended a reunion which may have biased the findings to a greater and lesser extent (e.g. prior commitments or avoidance due to fear of having regained weight). The comparison between the baseline characteristics of those who did and did not complete the programme suggest that those who dropped out were less healthy. Those who had achieved or maintained a >3% weight reduction by 12-months also appear to have been healthier than those who did not meet that programme aim. This may suggest that the programme struggled to have an impact upon those at greatest need for intervention.

What is already known on this topic

According to Public Health Profiles 64.3% (95% confidence interval 60.5% to 68.1%) of the adult population are overweight or obese (18). However, over a four-year period 0.4% of that adult population were referred into the Cornwall Healthy Weight Adults programme. The majority of these were self-referrals, which suggest that people are seeking interventions to improve their weight status, and also that health care professionals were not referring patients to the programme. This may reflect a lack of awareness of the programme, a lack of confidence amongst healthcare professions around discussing weight status, or that those with overweight or obesity are not ready to change.

While the National Institute for Health and Care Excellence 2014 guidance on obesity identification, assessment and management include a number of recommendations regarding behavioural and lifestyle interventions, the evidence on effective interventions remains lacking (27-33). Therefore, while local authorities have a duty to provide services, the selection of an effective intervention is difficult, especially when budgets continue to be cut, and these services are competing with more evidence-based services. This issue is compounded in counties like Cornwall where there is a need to provide public health programmes across a large rural area with limited transport links and pockets of high deprivation. These issues may have resulted in the low and potentially inappropriate uptake of the programme. A small number of people with healthy weight and larger numbers of people with (category 2

or 3) obesity undertook the programme, (Table 1), for this latter group Tier 3 or 4 services may have been more beneficial but these services require the patient to meet more specific referral criteria (34). The reviews of behavioural interventions to date have excluded people with morbid obesity (BMI≥40kg/m^2) (27, 32, 33), whereas Tier 3 interventions have been found to achieve at least a 5% reduction in initial body weight in those completing the programme (35).

What this study adds

We conducted this study to refine the ongoing delivery of the tier 2 healthy weights adult's programme. While participants primarily self-referred into the programme, these represented less than 1% of the adult population of Cornwall with overweight or obesity. Drop out and incomplete data were significant issues, particularly as the data available suggest that those who remained with the programme tended to be healthier at baseline. Around half of those who completed the programme met the aim of achieving greater than 3% weight reduction, indicating that there may be some benefit of the programme for specific individuals. However, the factors that contribute to the development of overweight and obesity vary between individuals and therefore the most effective treatment varies. This is an important challenge to future service design, delivery and commissioning, which is exacerbated when the service needs to be delivered across a sparse rural area. Although, the level of deprivation and rural isolation in Cornwall is unusual, most counties in the UK have rural and aging populations in need of obesity prevention services and therefore face the challenge of identifying and providing suitable interventions. However, interventions to impact on those socioeconomic conditions which contribute to many poor health outcomes (including obesity) would be preferable to high-effort approaches like this tier 2 programme (36). In the absence of such interventions based on this research tier 2 healthy weight programmes in sparse rural areas would benefit from including online options and integrating into workplaces. Tailoring the scale and intensity of programmes according to different levels of need may also help improve retention rates and intervention outcomes.

Limitations of this study

A number of limitations exist in this study. Firstly, the study was limited due to the number of drop outs across the programme, as well as, quality control issues such

as missing or invalid data. For example, following this study it was discovered that the method used to collect waist circumference data was not reliable and no longer recommended by the National Institute for Health and Care Excellence (NICE). Consequently, this measure is no longer used which might explain the unusual results in terms of Waist-Height ratio categories. The greatest challenge to interpreting these data is that they do not originate from an experimental study, and therefore we cannot attribute the results to the programme. A preferably randomised controlled study would be required; however, such an experiment could be logistically challenging due to limited venues and resources. Moreover, an experiment is ethically challenging, as we would need to be uncertain about whether a programme is beneficial. Can we deny someone the opportunity to lose weight, even if it is uncertain if the specific programme will lead to meaningful weight loss for them? With funding for programmes and research limited we need to learn whatever lessons we can from the interventions being implemented by local public health departments, potentially identifying new programmes to be rigorously evaluated.

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Conflict of interests

We declare that none of the authors involved in writing this paper have any conflict of interests with respect to the content of this article

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Tables and figures

Figure 1 – Flow of participants through the Cornwall Health Weights Adult programme 2012-2016

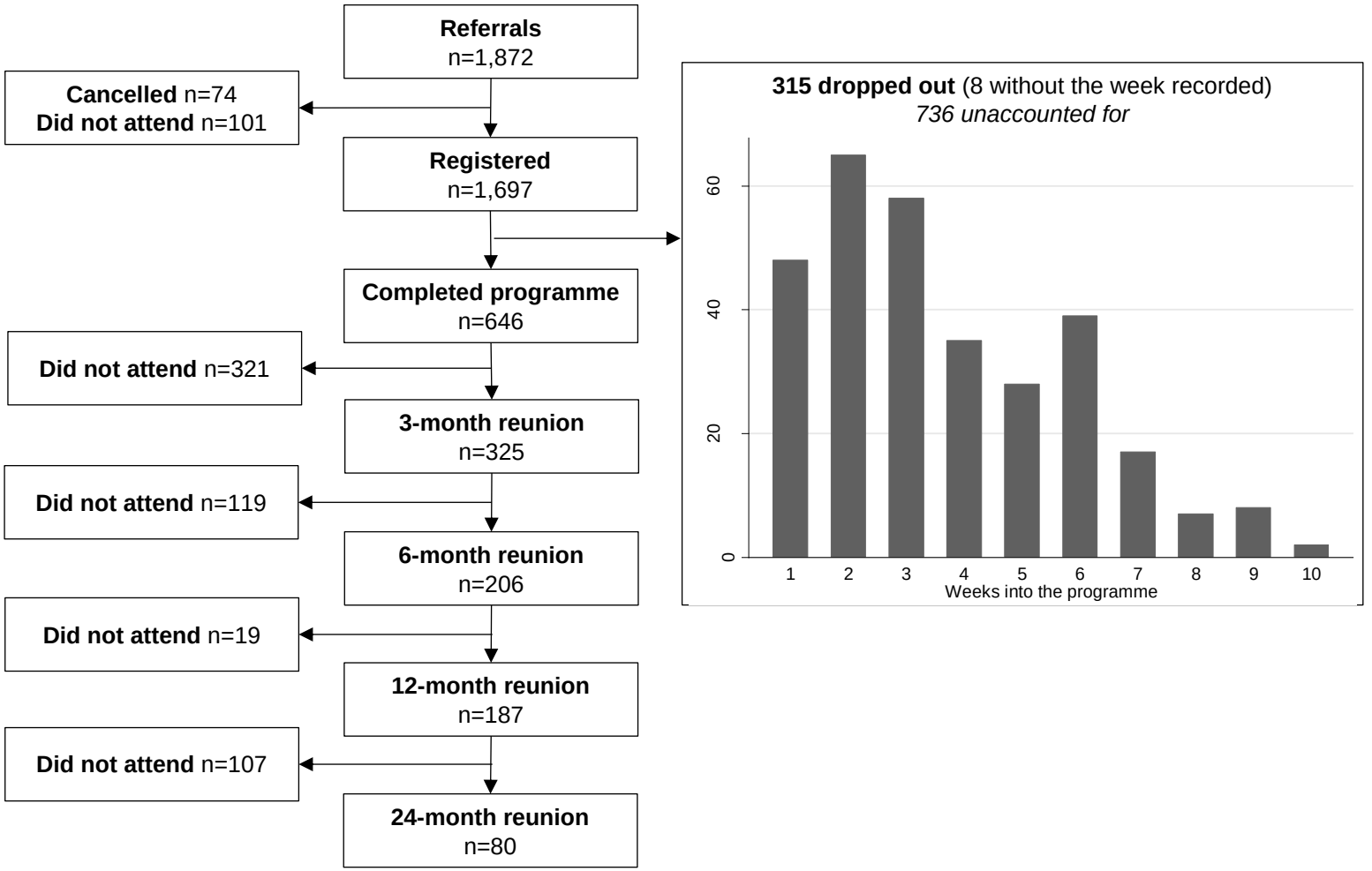


Table 1 – Comparison of baseline demographic and anthropometric characteristics of those who did and did not complete the 12-week programme

		Completed programme Summary statistic*	n	Dropped out Summary statistic*	n	p†
Gender (% women)		77.3%	633	76.0%	304	0.67
Age (years)		57.4±13.5	613	51.8±14.5	283	<0.01
Ethnicity (% White British)		92.3%	595	94.3%	282	0.27
Deprivation	**Q1**	18.8%	613	13.8%	291	0.03
	Q2	21.0%		17.2%		
	Q3	23.7%		21.7%		
	Q4	17.3%		20.6%		
	Q5	19.3%		26.8%		
Disability (%)		23.0%	635	28.5%	305	0.07
Weight (kg)		99.2±22.3	635	106.3±25.0	305	<0.01
BMI		36.7±7.1	635	38.8±8.1	305	<0.01
BMI	**Healthy weight**	0.9%	635	2.0%	305	<0.01
	Overweight	14.8%		11.2%		
	Obese (cat 1)	28.7%		19.3%		
	Obese (cat 2)	28.7%		27.2%		
	Obese (cat 3)	26.9%		40.3%		
Waist (cm)		111.7±15.7	617	116.3±18.2	294	<0.01
Waist-Height ratio (WHtR)		0.69±0.09	617	0.70±0.10	294	<0.01
WHtR	**Underweight**	0.3%	616‡	0.0%	294	0.26
	Healthy weight	1.3%		1.7%		
	Overweight	6.3%		6.5%		
	Obese (cat 1)	14.3%		9.5%		
	Obese (cat 3)	77.8%		82.3%		
Fat mass		43.4±14.8	617	47.4±15.7	286	<0.01
Muscle mass		52.8±11.2	615	54.7±11.2	286	0.02
Visceral fat		15.3±5.7	616	15.7±6.7	286	0.27
Metabolic age		68.7±13.0	615	64.1±13.8	286	<0.01
Systolic blood pressure		146.1±22.4	123	140.7±17.3	35	0.19
Diastolic blood pressure		82.8±11.4	124	82.0±9.6	35	0.70
Peak flow		90.7±19.9	78	88.4±16.2	22	0.61

*mean±standard deviation for continuous outcomes and percentages for categorical outcomes

†p-values comparing completers and non-completers using t-tests for continuous outcomes and chi-squared tests for categorical outcomes

‡One person did not have information on their gender, which is required to categorise their Waist-Height ratio

Table 2 – Mean difference in anthropometric outcomes at each follow-up time point of the Cornwall Health Weights Adult programme

	Completed programme				**3-month reunion**				**6-month reunion**			
	n	%	Mean difference	95% CI	n	%	Mean difference	95% CI	n	%	Mean difference	95% CI
Weight (kg)	641	99.2%	-3.15	-9.85 to 3.55	328	100.0%	-4.70	-14.93 to 5.53	229	100.0%	-4.89	-17.28 to 7.49
BMI (kg/m^2)	635	98.3%	-1.15	-3.52 to 1.22	326	99.4%	-1.73	-5.49 to 2.02	225	98.3%	-1.81	-6.29 to 2.67
Waist circumference (cm)	584	90.4%	-3.78	-14.34 to 6.79	310	94.5%	-5.37	-16.13 to 5.40	208	90.8%	-5.52	-18.87 to 7.83
Waist-to-Height ratio	578	89.5%	-0.02	-0.12 to 0.07	308	93.9%	-0.03	-0.10 to 0.03	204	89.1%	-0.03	-0.11 to 0.05
Fat mass	611	94.6%	-2.14	-8.10 to 3.82	301	91.8%	-3.65	-12.30 to 5.00	189	82.5%	-3.62	-13.82 to 6.59
Muscle mass	610	94.4%	0.95	-4.83 to 6.72	300	91.5%	0.98	-3.49 to 5.44	189	82.5%	1.33	-4.48 to 7.15
Visceral fat	610	94.4%	-0.65	-3.14 to 1.84	298	90.9%	-1.19	-4.48 to 2.10	189	82.5%	-1.05	-4.68 to 2.57
Metabolic age (years)	610	94.4%	-1.06	-10.04 to 7.92	299	91.2%	-2.19	-13.19 to 8.82	189	82.5%	-1.34	-13.10 to 10.41
Systolic blood pressure (mmHg)	97	15.0%	-4.59	-42.00 to 32.83	-	-	-	-	-	-	-	-
Diastolic blood pressure (mmHg)	98	15.2%	-1.67	-21.86 to 18.51	-	-	-	-	-	-	-	-
Peak Flow (L/min)	53	8.2%	1.62	-41.59 to 44.83	-	-	-	-	-	-	-	-

	12-month reunion				**24-month reunion**			
	n	%	Mean difference	95% CI	n	%	Mean difference	95% CI
Weight (kg)	205	100.0%	-4.45	-19.49 to 10.59	80	100.0%	-4.43	-25.49 to 16.64
BMI (kg/m^2)	201	98.0%	-1.66	-7.16 to 3.84	79	98.8%	-1.62	-9.34 to 6.10
Waist circumference (cm)	177	86.3%	-5.14	-21.06 to 10.77	60	75.0%	-4.28	-21.82 to 13.25
Waist-to-Height ratio	174	84.9%	-0.03	-0.13 to 0.07	59	73.8%	-0.03	-0.13 to 0.08
Fat mass	173	84.4%	-3.28	-17.41 to 10.84	73	91.3%	-2.46	-17.35 to 12.44
Muscle mass	174	84.9%	1.30	-6.10 to 8.70	73	91.3%	0.66	-6.35 to 7.66
Visceral fat	173	84.4%	-0.87	-5.80 to 4.05	73	91.3%	-0.52	-5.56 to 4.52
Metabolic age (years)	174	84.9%	-0.97	-13.67 to 11.73	72	90.0%	0.31	-14.40 to 15.01
Systolic blood pressure (mmHg)	-	-	-	-	-	-	-	-
Diastolic blood pressure (mmHg)	-	-	-	-	-	-	-	-
Peak Flow (L/min)	-	-	-	-	-	-	-	-

Table 3 – Comparison of the baseline demographic and anthropometric characteristics of those at 12 month who had and had not achieved a 3% reduction in weight at 12 months

		Meaningful reduction (>3% reduction) Summary statistic*	n	Non-meaningful change Summary statistic*	n	p†
Gender (% female)		81.3%	91	64.9%	94	0.01
Age (years)		60.6±10.5	88	58.7±14.6	93	0.34
Ethnicity (% White British)		94.2%	84	92.9%	84	0.76
Deprivation	**Q1**	19.8%	91	18.9%	90	0.55
	Q2	19.8%		16.7%		
	Q3	26.4%		18.9%		
	Q4	14.3%		21.1%		
	Q5	19.8%		24.4%		
Disability (%)		20.9%	91	24.5%	94	0.56
Weight (kg)		97.7±19.3	91	100.7±21.9	94	0.33
BMI		36.6±6.7	90	36.6±6.9	92	0.94
BMI	**Healthy weight**	0.0%	90	1.1%	92	0.80
	Overweight	13.3%		14.1%		
	Obese (cat 1)	32.2%		27.2%		
	Obese (cat 2)	28.9%		28.3%		
	Obese (cat 3)	25.6%		29.4%		
Waist (cm)		110.0±12.4	87	113.6±15.5	91	0.09
Waist-Height ratio (WHtR)		0.7±0.1	86	0.7±0.1	89	0.19
WHtR	**Healthy weight**	1.2%	86	2.3%	89	0.67
	Overweight	7.0%		3.4%		
	Obese (cat 1)	10.5%		12.4%		
	Obese (cat 3)	81.4%		82.0%		
Fat mass		43.0±12.8	86	43.4±14.8	91	0.82
Muscle mass		51.7±10.1	86	53.7±10.0	91	0.20
Visceral fat		14.9±4.0	86	16.8±6.6	91	0.02
Metabolic age		71.3±10.8	86	70.8±13.4	92	0.78
Systolic blood pressure		153.6±22.0	29	146.5±24.5	18	0.31
Diastolic blood pressure		81.9±11.8	29	80.1±12.3	18	0.63
Peak flow		88.1±24.2	16	80.6±21.0	12	0.40

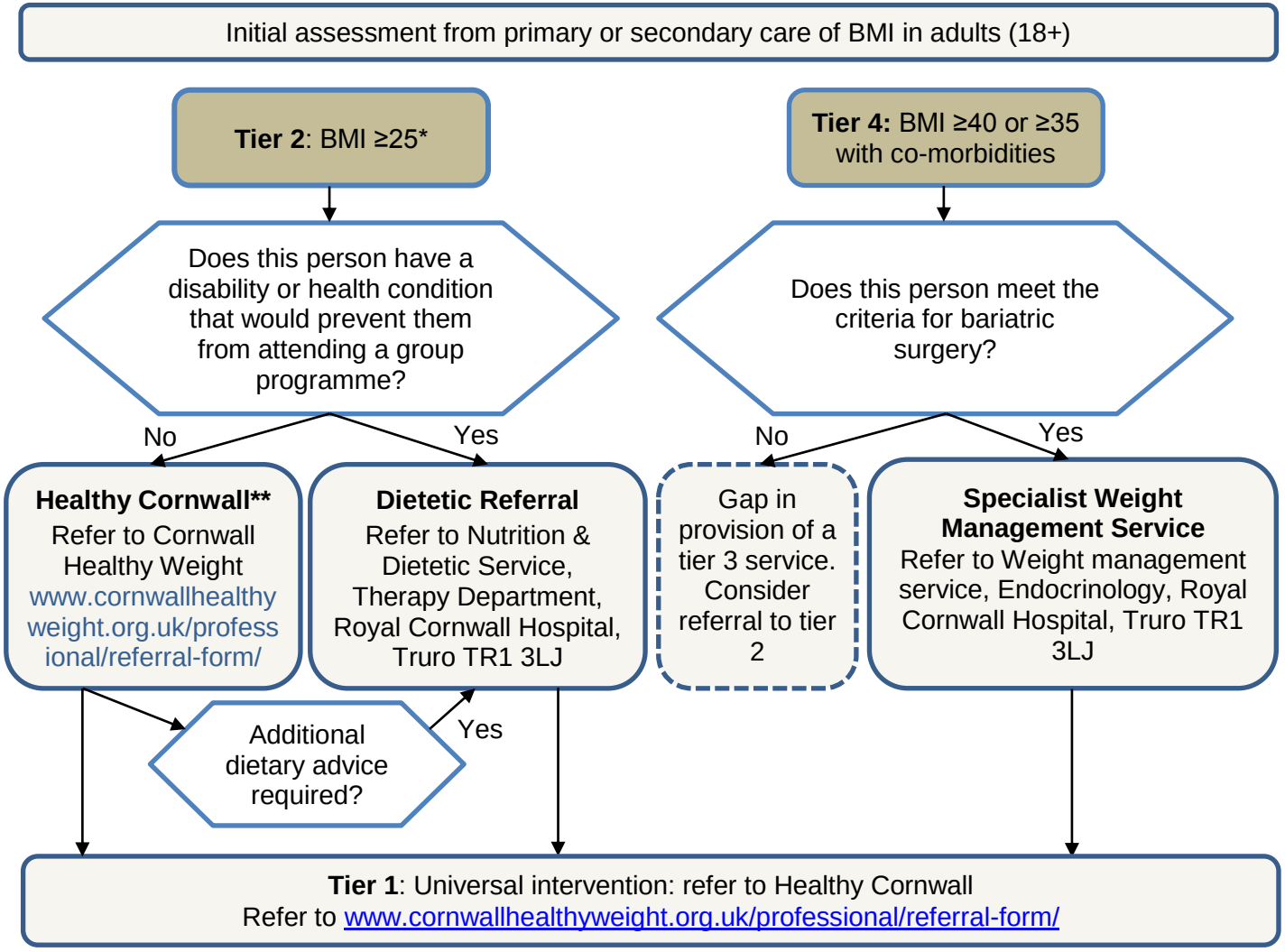
*mean±standard deviation for continuous outcomes and percentages for categorical outcomes

†p-values comparing those who had and had not achieved a meaningful reduction in BMI using t-tests for continuous outcomes and chi-squared tests for categorical outcomes

Online repository

#1 – Cornwall and Isles of Scilly Care Pathway for overweight and obese adults

September 2018



***BMI thresholds**
For patients that are South Asian, Chinese, Black African or Caribbean, lower BMI thresholds should be applied. For all BMI thresholds use 2.5 kg/m^2 less.

****Patients will be screened for uncontrolled comorbidities**.
If identified a GP letter is required to state that it is appropriate for the person to attend healthy weight group.

Step by step guide to brief interventions with adults:
Guide to talking about weight

#2 – Weight status cut-points for body mass index and waist-height ratio

	Body Mass Index (BMI)*	Waist-Height ratio (WHtR)	
		Male	Female
Underweight	<18.5	<0.43	<0.42
Healthy weight	≥18.5 and <25	≥0.43 and <0.52	≥0.42 and <0.48
Overweight	≥25 and <30	≥0.52 and <0.57	≥0.48 and <0.53
Obese category 1 (cat 1)	≥30 and <35	≥0.57 and <0.62	≥0.53 and <0.57
Obese category 2 (cat 2)	≥35 and <40	-	-
Obese category 3 (cat 3, morbid)	≥40	≥0.62	≥0.58

*These BMI cut points apply to adults (≥18 years old); the youngest people in the dataset are 17 but these cut points have still been used.

#3 – Changes in weight status from registration (baseline) to completion in terms of (a) body mass index (BMI) and (b) Waist-Height ratio (WHtR)

a **BMI**

BASELINE	COMPLETION (12 weeks)					
	Healthy weight	**Overweight**	**Obese – category 1**	**Obese – category 2**	**Obese – category 3**	**TOTAL**
Healthy weight	100.0%	0.0%	0.0%	0.0%	0.0%	0.9%
Overweight	4.3%	91.5%	4.3%	0.0%	0.0%	10.1%
Obese – cat 1	0.0%	23.1%	76.4%	0.6%	0.0%	28.7%
Obese – cat 2	0.0%	0.0%	33.0%	67.0%	0.0%	28.7%
Obese – cat 3	0.0%	0.0%	0.0%	15.2%	84.8%	26.9%
TOTAL	1.6%	20.2%	32.0%	24.5%	22.8%	635

b **WHtR**

BASELINE	COMPLETION (12 weeks)				
	Healthy weight	**Overweight**	**Obese – category 1**	**Obese – category 3**	**TOTAL**
Underweight	50.0%	0.0%	0.0%	50.0%	0.9%
Healthy weight	50.0%	50.0%	0.0%	0.0%	1.4%
Overweight	2.9%	47.1%	44.1%	5.9%	5.9%
Obese – cat 1	0.0%	6.1%	30.5%	63.4%	14.2%
Obese – cat 3	0.0%	1.3%	6.7%	92.0%	78.2%
TOTAL	1.0%	5.4%	12.1%	81.5%	577

#4 – Changes in weight status from registration (baseline) to 3 month reunion in terms of (a) body mass index (BMI) and (b) Waist-Height ratio (WHtR)

a **BMI**

BASELINE	3-MONTH REUNION					
	Healthy weight	**Overweight**	**Obese – category 1**	**Obese – category 2**	**Obese – category 3**	**TOTAL**
Healthy weight	100.0%	0.0%	0.0%	0.0%	0.0%	1.2%
Overweight	13.5%	80.8%	3.9%	0.0%	1.9%	16.0%
Obese – cat 1	1.0%	31.7%	65.4%	1.9%	0.0%	31.9%
Obese – cat 2	0.0%	1.1%	43.2%	55.7%	0.0%	27.0%
Obese – cat 3	0.0%	0.0%	0.0%	21.8%	78.2%	23.9%
TOTAL	3.7%	23.3%	33.1%	24.5%	22.8%	326

b **WHtR**

BASELINE	3-MONTH REUNION				
	Healthy weight	**Overweight**	**Obese – category 1**	**Obese – category 3**	**TOTAL**
Healthy weight	60.0%	40.0%	0.0%	0.0%	1.6%
Overweight	20.0%	50.0%	20.0%	10.0%	6.5%
Obese – cat 1	0.0%	4.2%	37.5%	58.3%	15.6%
Obese – cat 3	0.4%	3.0%	8.6%	88.0%	76.2%
TOTAL	2.6%	6.8%	13.7%	76.9%	307

#5 – Changes in weight status from registration (baseline) to 6 month reunion in terms of (a) body mass index (BMI) and (b) Waist-Height ratio (WHtR)

a **BMI**

BASELINE	6-MONTH REUNION					
	Healthy weight	**Overweight**	**Obese – category 1**	**Obese – category 2**	**Obese – category 3**	**TOTAL**
Healthy weight	100.0%	0.0%	0.0%	0.0%	0.0%	0.4%
Overweight	11.4%	86.4%	2.3%	0.0%	0.0%	19.6%
Obese – cat 1	1.5%	31.9%	66.7%	0.0%	0.0%	30.7%
Obese – cat 2	0.0%	1.7%	32.2%	62.7%	0.0%	26.2%
Obese – cat 3	0.0%	0.0%	0.0%	25.0%	75.0%	23.1%
TOTAL	3.1%	27.1%	29.3%	22.2%	18.2%	225

b **WHtR**

BASELINE	6-MONTH REUNION				
	Healthy weight	**Overweight**	**Obese – category 1**	**Obese – category 3**	**TOTAL**
Healthy weight	50.0%	45.0%	0.0%	0.0%	2.0%
Overweight	17.7%	41.2%	29.4%	11.8%	8.3%
Obese – cat 1	0.0%	6.6%	36.7%	56.7%	14.7%
Obese – cat 3	0.7%	3.3%	10.5%	85.6%	75.0%
TOTAL	2.9%	7.8%	15.7%	73.5%	204

#6 – Changes in weight status from registration (baseline) to 12 month reunion in terms of (a) body mass index (BMI) and (b) Waist-Height ratio (WHtR)

a **BMI**

BASELINE	12-MONTH REUNION					
	Healthy weight	**Overweight**	**Obese – category 1**	**Obese – category 2**	**Obese – category 3**	**TOTAL**
Healthy weight	100.0%	0.0%	0.0%	0.0%	0.0%	0.5%
Overweight	27.6%	65.5%	6.9%	0.0%	0.0%	14.4%
Obese – cat 1	0.0%	25.4%	69.8%	4.8%	0.0%	31.3%
Obese – cat 2	0.0%	5.5%	38.2%	52.7%	3.6%	27.4%
Obese – cat 3	0.0%	0.0%	3.8%	18.9%	77.4%	26.4%
TOTAL	4.5%	18.9%	34.3%	20.9%	21.4%	201

b **WHtR**

BASELINE	12-MONTH REUNION				
	Healthy weight	**Overweight**	**Obese – category 1**	**Obese – category 3**	**TOTAL**
Healthy weight	0.0%	75.0%	25.0%	0.0%	2.3%
Overweight	33.3%	22.2%	33.3%	11.1%	5.2%
Obese – cat 1	0.0%	13.0%	13.0%	73.9%	13.2%
Obese – cat 3	0.7%	5.8%	8.7%	84.8%	79.3%
TOTAL	2.3%	9.2%	10.9%	77.6%	174

#7 – Changes in weight status from registration (baseline) to 24 month reunion in terms of (a) body mass index (BMI) and (b) Waist-Height ratio (WHtR)

a **BMI**

BASELINE	24-MONTH REUNION					
	Healthy weight	**Overweight**	**Obese – category 1**	**Obese – category 2**	**Obese – category 3**	**TOTAL**
Healthy weight	100.0%	0.0%	0.0%	0.0%	0.0%	2.5%
Overweight	14.3%	85.7%	0.0%	0.0%	0.0%	8.9%
Obese – cat 1	0.0%	25.0%	75.0%	0.0%	0.0%	35.4%
Obese – cat 2	0.0%	4.8%	38.1%	47.6%	9.5%	26.6%
Obese – cat 3	0.0%	9.5%	4.8%	19.1%	66.7%	26.6%
TOTAL	3.8%	20.3%	38.0%	17.7%	20.3%	79

b **WHtR**

BASELINE	24-MONTH REUNION				
	Healthy weight	**Overweight**	**Obese – category 1**	**Obese – category 3**	**TOTAL**
Healthy weight	100.0%	0.0%	0.0%	0.0%	1.7%
Overweight	0.0%	33.3%	33.3%	33.3%	5.1%
Obese – cat 1	0.0%	0.0%	0.0%	100.0%	5.1%
Obese – cat 3	0.0%	1.9%	7.7%	90.4%	88.1%
TOTAL	1.7%	3.4%	8.5%	86.4%	59