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Patient and practice characteristics predicting attendance and completion at a specialist weight management service: a cross-sectional study

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2017-018286
Article Type:	Research
Date Submitted by the Author:	19-Jun-2017
Complete List of Authors:	Blane, David; University of Glasgow, General Practice and Primary Care McLoone, Philip; University of Glasgow, Public Health Morrison, David; Glasgow University, Institute of Health and Well-being MacDonald, Sara; University of Glasgow, O'Donnell, Catherine; University of Glasgow, General Practice & Primary Care
Primary Subject Heading:	General practice / Family practice
Secondary Subject Heading:	Epidemiology, Public health
Keywords:	Obesity, PRIMARY CARE, Weight management, Co-morbidity, Socioeconomic status, Disparities

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**Patient and practice characteristics predicting attendance and completion at a specialist
weight management service: a cross-sectional study**

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Key words: Obesity, Primary Health Care, Weight Management, Comorbidity,
Socioeconomic status, Disparities

Word count 2966

Abstract

Objective: To determine the association between patient and referring practice characteristics and attendance and completion at a specialist health service weight management service (WMS).

Design: Cross-sectional study.

Setting: Regional specialist WMS located in the West of Scotland.

Participants: 9,677 adults with obesity referred between 2012 and 2015; 3250 attending service and 2252 completing.

Primary and secondary outcome measures: Primary outcome measure was attendance at the weight management service; secondary outcome was completion, defined as attending 4 or more sessions.

Analysis: Multilevel binary logistic regression models constructed to determine the association between patient and practice characteristics and attendance and completion.

Results: Approximately one-third of the 9,677 obese adults referred attended at least one session (n = 3250, 33.6%); only 2252 (23%) completed by attending 4 or more sessions. Practice referrals ranged from 1 to 257. Patient-level characteristics were strongest predictors of attendance; odds of attendance increased with age (OR 4.14, 95% CI 3.27 to 5.26 for adults aged 65+ compared to those aged 18-24), BMI category (OR 1.83, 95% CI 1.56 to 2.15 for BMI 45+ compared to BMI 30-35), and increasing affluence (OR 1.96, 95% CI 1.17 to 3.28). Practice-level characteristics most strongly associated with attendance were being a non-training practice, having a larger list size, and not being located in the most deprived areas.

Conclusions: There was wide variation in referral rates across general practice, suggesting that there is still much to do to improve engagement with weight management by primary care practitioners. The high attrition rate from referral to attendance, and from attendance to completion, suggests ongoing barriers for patients, particularly those from the most socio-economically deprived areas. Patient and practice-level characteristics can help us understand the observed variation in attendance at specialist WMS following GP referral and the underlying explanations for these differences merit further investigation.

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Article Summary

Strengths and Limitations of This Study

- Data obtained from a large urban weight management service with data collected from 2012 to 2015.
- Complete data on referrals, attendances and completion (defined as 4 or more attendances) for 9,677 patients with obesity.
- Patient-level data linked to the characteristics of the 262 general practices in the Health Board area who make referrals to the service
- Co-founders, including socioeconomic status of both patients and practice population, and distance to the weight management service accounted for in the analysis.

INTRODUCTION

Obesity is a major global public health concern with considerable health and economic consequences.¹⁻³ International guidelines recommend that practitioners opportunistically identify overweight and obese patients, with the aim of encouraging weight loss.^{4,5} Much of this work takes place in primary care.⁶ However, obesity remains under-treated in primary care,^{7,8} and patient identification is only the first part of the journey. Current UK policy recommends a comprehensive tiered approach to weight management, (Box 1)^{5,9} but there is marked variation in referrals to weight management services from primary care, and a high attrition rate between referral and attendance.¹⁰ The reasons for this are unclear. One factor is patient characteristics, such as socioeconomic status, with more affluent patients more likely to be referred.¹¹ Previous research on referral variation has suggested that only 40% of variation can be explained by patient characteristics.¹² Practitioner factors such as views of risk and clinical experience, as well as system factors, such as distance to services, also explain some of the variation observed in referral rates to secondary care.^{12,13} These factors may also contribute to an individual's likeliness to both attend a service and complete the course of treatment on offer – each of these are important issues in weight management, where patients are being asked to make significant changes to their lifestyle and behaviour.

Box 1 Tiered approach to weight management

Tier 1 - Population wide health improvement work (e.g. pre-healthcare lifestyle advice, community pharmacies, and commercial weight management);
Tier 2 - Lifestyle interventions delivered in the community (e.g. healthy eating, exercise referral, community dietetic service);
Tier 3 - Specialist weight management services;
Tier 4 - Bariatric surgery

Several previous studies have explored individual practitioner views on referral to weight management services.¹⁴⁻¹⁶ Issues raised included patient factors such as motivation and expectations, and practitioner factors such as previous experience and pessimism. However, there are no quantitative studies that have explored the predictors of attendance at weight management services taking account of both individual factors and practice characteristics. The aim of this study, therefore, was to use individual and practice level data to explore predictors of attendance and completion at a specialist weight management service, using multilevel binary logistic regression models.

METHODS

Setting

The Glasgow and Clyde Weight Management Service (GCWMS) is the most well established, well-funded, and well-evaluated NHS-based non-commercial service in Scotland.^{10 17 18} It is a multi-component weight management programme, which includes structured lifestyle advice, prescribed low-calorie diet, cognitive behavioural therapy techniques, and physical activity advice, and is available to patients aged 18 years and over with complex obesity (defined as body mass index (BMI) of ≥ 30 kg/m² with obesity-related co-morbidities, or BMI of ≥ 35 kg/m² alone).¹⁰ It receives the majority of its referrals from the 262 general practices in the NHS Greater Glasgow and Clyde (GGC) health board area, with a small proportion coming from practices in other health boards and directly from hospital specialities.

Study design and population

An observational cross-sectional study design was applied using data from GP electronic referrals to GCWMS. The dataset was received from GCWMS in February 2016 and included

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data on the earliest referral per patient from 2012 onwards in order to avoid patients appearing more than once. Data cleaning ensured that the included cases were adults (aged 18 and over), had a diagnosis of obesity (BMI ≥ 30) and had complete data on sex, height and weight. The final dataset comprised 9,677 adults with obesity referred from 262 general practices in GGC. The small number of referrals from out with GGC and from specialist services were excluded.

Study variables

Referral, attendance and 'completion'

The main outcome of interest was attendance at weight management, defined as attending at least one group session, after the initial assessment. A further outcome was 'completion', defined as attendance at 4 or more sessions. This was based on a definition used in a previous published study of the GCWMS.¹⁰

Patient characteristics

Patient characteristics included sex, age (grouped into four categories: 18-24, 25-44, 45-64, 65+), socio-economic status (based on the Scottish Index of Multiple Deprivation (SIMD) 2012 quintiles¹⁹), and BMI (grouped into four categories: 30-35, >35-40, >40-45, and 45+).

Practice characteristics

Practice characteristics included GP training practice status, practice list size, distance from nearest weight management service (WMS) centre, achievement in the Quality and Outcome Framework (QOF) in the year April 2014 to March 2015, practice deprivation status, and referral rate to the GCWMS.

Data on training practice status were derived from the West Scotland GP training website.²⁰ Practice list size was taken from Information Services Division (ISD) Scotland²¹ and divided into 3 groups: <4,000, 4000-8000, and >8000. Distance from the nearest weight management service centre was calculated using GPS mapping software using practice postcode and the postcodes of the 12 weight management service satellite clinics that were in operation during the referral period. The three groupings for this variable were under 1 mile, 1 to 2 miles, and over 2 miles. QOF achievement data were taken from the ISD website²² and grouped into <95, 95-98, 99, 100 points (out of a possible 100 points). Practice deprivation status was based on the % of the practice population living in the most deprived 15% of postcodes and categorised as: <15%, 15-40%, and >40% of practice population. Referral rate to GCWMS was per 1000 practice population (≤ 5 , 5-10, and >10).

Statistical analysis

Descriptive analysis of the study population examined how referral, attendance and completion varied by patient and practice characteristics. Multilevel binary logistic regression models were constructed in order to account for the clustering of patients within practices. Results are presented as univariable (crude) and multivariable (adjusted) odds ratios (ORs) and 95% confidence intervals (95% CI), with adjustment made for all patient and practice-level characteristics. Analysis was carried out using STATA-MP version 14.0 (Texas, USA).

Patient involvement

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There was no patient involvement in this study.

RESULTS

9,677 adults with obesity were referred to the regional specialist weight management service from January 2012 to February 2016. This is about 4% of the approximately 260,000 adults with obesity estimated to live in NHS GGC.²³

Table 1 shows the individual-level characteristics of the total GGC population and of the study population (for those referred, attenders (attending at least one session), and 'completers' (attending 4 or more sessions)). The majority of those referred to the weight management service were female, aged 45 to 64, and from the most deprived population quintile. The mean age of those referred was 46.5 (SD 14.3, 18, 88); the mean BMI was 41.4 (SD 6.9, 30, 97.3). Approximately one third of those referred attended at least one session (n = 3250, 33.6%); of attenders, 69.3% (n = 2252) completed.

There was a similar picture for those attending the weight management service and those attending four or more sessions ('completers'). Over 70% were female and over half were aged 45 to 64, with the mean age of those attending 49.8 (SD 13.5, 18, 84) and the mean age of 'completers' 50.6 (13.2, 18, 83). Over 40% were from the most deprived population quintile. The mean BMI of attenders was 42.0 (SD 7.1, 30, 97.3) and the mean BMI of 'completers' was 42.1 (SD 7.2, 30, 97.3).

Table 1: Individual characteristics of total GG&C population, those referred, attenders and completers (Number, (%))

	GGC Adult Population N= 924,727	Referrals N = 9677	Attenders N = 3250	Completers N = 2252
Sex†				
Women	485,629 (52.5)	6870 (71.0)	2331 (71.7)	1607 (71.4)
Men	439,098 (47.5)	2807 (29.0)	919 (28.3)	645 (28.6)
Age groupst				
18-24	118,069 (12.8)	694 (7.2)	118 (3.6)	66 (2.9)
25-44	313,970 (34.0)	3543 (36.6)	1006 (31.0)	657 (29.2)
45-64	305,659 (33.1)	4369 (45.1)	1652 (50.8)	1179 (52.4)
65+	187,029 (20.2)	1071 (11.1)	474 (14.6)	350 (15.5)
SIMD 2012 quintile ^a				
Q1 – most deprived	331,977 (35.9)	4778 (49.4)	1388 (42.7)	922 (41.3)
Q2	163,677 (17.7)	1770 (18.3)	600 (18.5)	419 (18.7)
Q3	133,160 (14.4)	1254 (13.0)	481 (14.8)	339 (15.2)
Q4	122,064 (13.2)	970 (10.0)	368 (11.3)	265 (11.9)
Q5 – most affluent	173,848 (18.8)	844 (8.7)	386 (11.9)	290 (13.0)
Missing	-	61 (0.6)	27 (0.8)	17 (0.8)
BMI category ^b				
30-35	}231,182 (25%)	1232 (12.7)	329 (10.1)	225 (10.0)
>35-40		3465 (35.8)	1152 (35.4)	764 (33.9)
>40-45	}27,742 (3%)	2611 (27.0)	920 (28.3)	658 (29.2)
45+		2369 (24.5)	849 (26.1)	605 (26.9)

†National Records of Scotland Small Area Population Estimates (SAPE) mid-2014.²⁴

^a Based on estimates from NHS GGC Director of Public Health report 2015-17.²⁵

^b Based on estimates from Scottish Health Survey 2014.²³

Table 2 shows the distribution of patients by the characteristics of their referring practice, compared to all GGC practices. In GGC, less than one-third of practices were training practices (n=80, 30.5%). The average list size was 5009 patients (range from 1227 to 16,825). Roughly half (n=130, 49.6%) of all practices were within 1 mile of the nearest WMS

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clinic. The mean number of referrals per practice was 42 (range from 1 to 257), with a mean referral rate of 8.5 per 1000 population (range from 0.7 to 26.3).

Just over 40% of all patients were referred from training practices (n=4013, 41.4%) and a little under half were from medium-sized practices with list sizes between 4000 and 8000 patients (n=4633, 47.8%). Over half of patients (n=5486, 56.6%) were from referring practices within 1 mile of the nearest weight management service clinic. Practices generally scored very highly on QOF, with 66.2% of patients being referred by a practice that achieved 99 or 100 points out of a possible 100. The characteristics of those attending or 'completing' were broadly similar to those initially referred.

Table 2: Practice characteristics for referrals, attenders and completers (Number (%))

	GGC Referring Practices N = 262	Referrals N = 9677	Attenders N = 3250	Completers N = 2252
Training practice				
No	158 (60.3)	4920 (50.8)	1664 (51.1)	1123 (54.8)
Yes	80 (30.5)	4013 (41.4)	1310 (40.3)	926 (45.2)
Missing	24 (9.2)	752 (7.8)	280 (8.6)	203 (9.0)
List size				
<4000	110 (42.0)	2249 (23.2)	641 (19.7)	465 (20.6)
4000-8000	113 (43.1)	4633 (47.8)	1655 (50.9)	1130 (50.2)
8000+	39 (14.9)	2795 (28.9)	954 (29.3)	657 (29.2)
Distance from WMS				
Within 1 mile	130 (49.6)	5486 (56.6)	1784 (54.8)	1214 (53.9)
Between 1-2 miles	88 (33.6)	2738 (28.3)	919 (28.2)	654 (29.0)
2 miles or more	44 (16.8)	1453 (15.0)	547 (16.8)	384 (17.1)
QOF points				
<95	7 (2.7)	231 (2.4)	72 (2.2)	52 (2.3)
95-98	38 (14.5)	820 (8.5)	280 (8.6)	186 (8.3)
99	44 (16.8)	1597 (16.5)	533 (16.4)	373 (16.6)
100	110 (42.0)	4812 (49.7)	1611 (49.5)	1111 (49.3)
Missing	63 (24.0)	2225 (23.0)	758 (23.3)	530 (23.5)
Deprivation status (% of practice population defined as most deprived)				
<15%	67 (25.6)	2068 (21.4)	795 (24.4)	581 (25.8)
15-40%	100 (38.2)	4171 (43.1)	1506 (46.3)	1034 (45.9)
>40%	95 (36.2)	3438 (35.5)	949 (29.2)	637 (28.3)
Referral Rate per 1000 practice population				
10+	75 (28.6)	4178 (43.1)	1328 (40.8)	938 (41.7)
5-10	104 (39.7)	4553 (47.0)	1550 (47.6)	1062 (47.2)
<5	83 (31.7)	946 (9.8)	372 (11.4)	252 (11.2)

Overall 34% of those referred actually attended the service, and 2252 (23%) completed by attending for 4 or more sessions. There were, however, particular groups within the referred population that were more likely to both attend and to complete (Table 3). Those aged 65 and over had a higher attendance rate (44.3%), as did those from the least deprived quintile (45.7%) and those in the highest BMI category (BMI 45+; 35.8%). There were a

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higher proportion of attenders from larger and less deprived practices and from practices further away from weight management centres (37.6% attendance from those referred from practices 2 or more miles away). A similar pattern was observed for those completing 4 or more sessions at the WMS (Table 3).

Table 3. Profile of service attenders and completers compared to those referred, by patient and practice characteristics, as a percentage of those referred (Number, percentage of those referred)

	Referrals N = 9677	Attendances N = 3250	Completers N = 2252
Patient characteristics			
Sex			
Women	6870	2331 (33.9)	1607 (23.4)
Men	2807	919 (32.7)	645 (23.0)
Age group			
18-24	694	118 (17.0)	66 (9.5)
25-44	3543	1006 (28.4)	657 (18.5)
45-64	4369	1652 (37.8)	1179 (27.0)
65+	1071	474 (44.3)	350 (32.7)
SIMD 2012 quintile			
Q1 – most deprived	4778	1388 (29.0)	922 (19.3)
Q2	1770	600 (33.9)	419 (23.7)
Q3	1254	481 (38.4)	339 (27.0)
Q4	970	368 (37.9)	265 (27.3)
Q5 – most affluent	844	386 (45.7)	290 (34.4)
Missing	61	37	17
BMI category			
30-35	1232	329 (26.7)	225 (18.3)
>35-40	3465	1152 (33.2)	764 (22.0)
>40-45	2611	920 (35.2)	658 (25.2)
45+	2369	849 (35.8)	605 (25.5)
Practice characteristics			
Training practice			
No	4920	1664 (33.8)	1123 (22.8)
Yes	4013	1310 (32.6)	926 (23.1)
Missing	744	276	203
List size			
<4000	2249	641 (28.5)	465 (20.7)
4000-8000	4633	1655 (35.7)	1130 (24.4)
8000+	2795	954 (34.1)	657 (23.5)
Distance from WMS			

Within 1 mile	5486	1784 (32.5)	1214 (22.1)
Within 2 miles	2738	919 (33.6)	654 (23.9)
2 miles or more	1453	547 (37.6)	384 (26.4)
QOF points			
<95	231	72 (31.2)	52 (22.5)
95-98	820	280 (34.1)	186 (22.7)
99	1597	533 (33.4)	373 (23.4)
100	4812	1611 (33.5)	1111 (23.1)
Missing	2217	754	530
Deprivation status (% of practice population defined as most deprived)			
<15%	2068	795 (38.4)	581 (28.1)
15-40%	4171	1506 (36.1)	1034 (24.8)
>40%	3438	949 (27.6)	637 (18.5)
Referral rate per 1000 practice population			
>10	4178	1328 (31.8)	938 (22.5)
5-10	4553	1550 (34.0)	1062 (23.3)
<5	946	372 (39.3)	252 (26.6)

Table 4 presents the logistic regression models of attendance and completion, with individual and practice characteristics, and taking account of clustering within practices. Patient-level characteristics were the strongest predictors of attendance at the specialist weight management service, with the odds of attendance increasing with age (OR 4.15, 95% CI 3.27 to 5.26 for adults aged 65 and over compared to those aged 18-24), BMI category (OR 1.83, 95% CI 1.56 to 2.14 for those with a BMI 45+ compared to BMI 30-35), and increasing affluence (OR 1.74, 95% CI 1.47 to 2.06). Men had a lower odds of attendance than women (OR 0.87, 95% CI 0.79 to 0.96).

Practice-level characteristics that were most strongly associated with attendance were being a non-training practice, having a larger list size, and having a more affluent patient population. Those patients referred from training practices had a slightly lower odds of attending (OR 0.89, 95% CI 0.81 to 0.99) than those referred from non-training practices. Those from a practice with a list size of 4000-8000 were more likely to attend than those

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from a practice with a list size of under 4000 (OR 1.41, 95% CI 1.25 to 1.59). Similarly, those from a practice with a list size greater than 8000 were also more likely to attend at least one of the weight management appointments following referral (OR 1.29, 95% CI 1.12 to 1.48). Patients referred from practices serving the most deprived populations (where more than 40% of the practice population live in the most deprived postcodes) were less likely to attend the WMS (OR 0.82, 95% CI 0.71 to 0.95).

Similar patterns were observed for those who completed a course of sessions at the WMS (Table 4), with the same patient-level characteristics the strongest predictors of 'completion'. The likelihood of attending four or more sessions increased with increasing age, such that those aged 65 and over were almost five times as likely to attend 4 or more sessions compared to those aged 18-24 (OR 4.83, 95% CI 3.62 to 6.45).

As with attendance, there was a social gradient in 'completing' with increasing odds from the most deprived to the most affluent quintiles (OR 1.83, 95% CI 1.53 to 2.19 for patients from the most affluent practices compared to the most deprived). Similarly, the odds of attending four or more sessions also increased with each increase in BMI category, with the highest odds being for those from the BMI 45 and over category (OR 1.88, 95% CI 1.58 to 2.25) compared to the reference group of BMI 30-35.

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Table 4. Logistic regression models for attenders and completers at the WMS

	Attenders			Completers		
	Unadjusted OR (95% CI)	Adjusted OR† (95% CI)	P-value	Unadjusted OR (95% CI)	Adjusted OR† (95% CI)	P-value
Sex						
Women	1.00	1.00		1.00	1.00	
Men	0.95 (0.86 to 1.04)	0.87 (0.79 to 0.96)	0.005	0.98 (0.88 to 1.09)	0.89 (0.80 to 0.99)	0.036
Age group						
18-24	1.00	1.00		1.00	1.00	
25-44	1.96 (1.58 to 2.43)	1.93 (1.56 to 2.39)	<0.001	2.20 (1.68 to 2.87)	2.15 (1.64 to 2.81)	<0.001
45-64	3.02 (2.45 to 3.73)	3.04 (2.46 to 3.75)	<0.001	3.59 (2.76 to 4.67)	3.54 (2.72 to 4.61)	<0.001
65+	3.88 (3.07 to 4.90)	4.15 (3.27 to 5.26)	<0.001	4.59 (3.45 to 6.11)	4.83 (3.62 to 6.45)	<0.001
SIMD 2012 quintile						
Q1 – most deprived	1.00	1.00		1.00	1.00	
Q2	1.24 (1.10 to 1.40)	1.15 (1.02 to 1.30)	0.023	1.29 (1.13 to 1.47)	1.19 (1.04 to 1.36)	0.014
Q3	1.48 (1.29 to 1.69)	1.33 (1.16 to 1.53)	<0.001	1.53 (1.32 to 1.77)	1.37 (1.18 to 1.60)	<0.001
Q4	1.46 (1.26 to 1.69)	1.32 (1.13 to 1.55)	<0.001	1.55 (1.32 to 1.83)	1.39 (1.17 to 1.65)	<0.001
Q5 – most affluent	1.99 (1.70 to 2.33)	1.74 (1.47 to 2.06)	<0.001	2.14 (1.82 to 2.53)	1.83 (1.53 to 2.19)	<0.001
Missing	1.95 (1.17 to 3.26)	1.96 (1.17 to 3.28)	0.01	1.61 (0.91 to 2.84)	1.61 (0.91 to 2.86)	0.101
BMI category						
30-35	1.00	1.00		1.00	1.00	
>35-40	1.38 (1.19 to 1.60)	1.53 (1.32 to 1.78)	<0.001	1.28 (1.08 to 1.51)	1.43 (1.21 to 1.70)	<0.001
>40-45	1.51 (1.29 to 1.75)	1.74 (1.49 to 2.03)	<0.001	1.53 (1.29 to 1.81)	1.79 (1.50 to 2.13)	<0.001
45+	1.56 (1.34 to 1.82)	1.83 (1.56 to 2.14)	<0.001	1.57 (1.32 to 1.86)	1.88 (1.58 to 2.25)	<0.001
Training practice						
No	1.00	1.00		1.00	1.00	
Yes	0.96 (0.85 to 1.08)	0.89 (0.81 to 0.99)	0.029	1.01 (0.89 to 1.15)	0.97 (0.86 to 1.08)	0.550
Missing	1.13 (0.92 to 1.40)	1.13 (0.91 to 1.39)	0.268	1.29 (1.04 to 1.61)	1.23 (0.98 to 1.57)	0.074

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List size							
<4000	1.00	1.00	1.00	1.00	1.00		
4000-8000	1.37 (1.21 to 1.57)	1.41 (1.25 to 1.59)	<0.001	1.21 (1.05 to 1.40)	1.21 (1.06 to 1.39)	0.006	
8000+	1.31 (1.12 to 1.53)	1.29 (1.12 to 1.48)	<0.001	1.17 (0.99 to 1.39)	1.14 (0.98 to 1.34)	0.097	
Distance from WMS							
Within 1 mile	1.00	1.00	1.00	1.00	1.00		
Within 2 miles	1.04 (0.91 to 1.18)	1.03 (0.92 to 1.14)	0.621	1.10 (0.96 to 1.26)	1.09 (0.97 to 1.24)	0.149	
2 miles or more	1.29 (1.09 to 1.51)	1.06 (0.93 to 1.21)	0.399	1.32 (1.11 to 1.57)	1.06 (0.91 to 1.23)	0.469	
QOF points							
<95	1.00	1.00	1.00	1.00	1.00		
95-98	1.11 (0.76 to 1.63)	0.97 (0.70 to 1.34)	0.849	0.99 (0.66 to 1.49)	0.81 (0.56 to 1.17)	0.254	
99	1.09 (0.76 to 1.57)	0.85 (0.62 to 1.16)	0.314	1.02 (0.69 to 1.50)	0.82 (0.58 to 1.16)	0.258	
100	1.12 (0.79 to 1.59)	0.89 (0.66 to 1.20)	0.454	1.03 (0.71 to 1.50)	0.82 (0.58 to 1.14)	0.238	
Missing	1.14 (0.80 to 1.62)	0.90 (0.66 to 1.23)	0.506	1.09 (0.75 to 1.60)	0.80 (0.57 to 1.14)	0.219	
Deprivation status (% of practice population defined as most deprived)							
<15%	1.00	1.00	1.00	1.00	1.00		
15-40%	0.88 (0.78 to 1.00)	1.09 ([0.95 to 1.23)	0.212	0.83 (0.72 to 0.95)	0.96 (0.83 to 1.11)	0.561	
>40%	0.60 (0.53 to 0.69)	0.82 (0.71 to 0.95)	0.008	0.57 (0.50 to 0.66)	0.74 (0.63 to 0.87)	<0.001	
Referral rate per 1000 practice population							
>10	1.00	1.00	1.00	1.00	1.00		
5-10	0.79 (0.67 to 0.95)	0.92 (0.79 to 1.08)	0.311	0.83 (0.69 to 1.01)	0.99 (0.83 to 1.18)	0.915	
<5	0.71 (0.59 to 0.85)	0.91 (0.77 to 1.08)	0.269	0.79 (0.65 to 0.96)	1.07 (0.88 to 1.29)	0.516	

CI: confidence interval, OR: odds ratio

† Adjusted for all other variables

DISCUSSION

Statement of principal findings

In this observational cross-sectional study of GP referrals to an NHS Health Board specialist weight management service, we found that just over a third of the 9,677 adults with obesity who were referred between 2012 and February 2016 attended at least one session. There was another marked attrition rate after first attendance, with less than a quarter ‘completing’ treatment, defined here as attending four or more sessions. Patient-level characteristics were the strongest predictors of attendance and completion, with the odds of attendance increasing with age, BMI category, and increasing affluence. Practice-level characteristics most strongly associated with attendance and completion were being a non-training practice, having a larger list size, and not being in areas of extreme deprivation.

Strengths and weaknesses of the study

There are no previous studies that we are aware of that have explored the predictors of attendance at weight management services taking account of both individual patient factors and referring practice characteristics. This study used individual patient level data and practice level data to explore predictors of attendance and completion at a specialist weight management service, using multilevel binary logistic regression models. As with any secondary data analysis, the quality and validity of the findings are only as good as the quality of the original data. In this case, confidence in the accuracy and consistency of the data is increased as the main outcome variables of interest were referral, attendance and completion, which are reliably recorded. There was, however, no available data on weight loss outcomes in this study population, which is a limitation. However, previous work

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conducted in this weight management service found that 26% of those completing Phase 1 attendance had lost at least 5kg.¹⁰ Similarly, there was no available data on the total population of adults with obesity in the NHS GGC area, which makes it difficult to comment on the representativeness of the study population. In this study, we used a definition of 'completers' (i.e. attending 4 or more sessions) which is perhaps lower than in some other studies. However, the attrition rate was even greater if the threshold for the number of sessions attended was increased. In addition, higher thresholds for completion tend to be used when describing weight outcomes, rather than being used as an indicator of attendance, as in this study.

Comparison with existing literature

This study of GP referrals to a large regional weight management service found that patient characteristics were more significant predictors of attendance than practice characteristics. This is in keeping with previous research on variation in GP referrals to secondary care services.^{11 12} The powerful effect of socio-economic deprivation – both at the individual level and at the practice level – also resonates with existing literature on barriers to access.²⁶

Meaning of the study: possible explanations and implications for clinicians and policymakers

This study has highlighted several important issues related to the health service response to obesity. First, the wide variation in referral rates across general practice, despite similar prevalence of obesity, suggests that there is still much to be done to improve engagement with weight management by primary care practitioners. Second, the high attrition rate from referral to attendance, and from attendance to completion, at this large regional weight management service suggests there are ongoing barriers for patients. Third, the

observation that those from the most socio-economically deprived areas are least likely to attend suggests structural barriers and the need for a more targeted response. Finally, the practice characteristics of quality (as measured by QOF achievement) and distance from the nearest WMS were not associated with attendance in this study, and these negative findings are of interest suggesting that practice quality and proximity are not major drivers of attendance. This work was based in the largest health board in Scotland, with data available for all referrals made by primary care practitioners based in general practice, between 2012 and 2015. Thus the findings are broadly generalizable to other parts of the NHS and beyond, particularly in terms of gender, age and socioeconomic status; however there were no data on ethnicity. While Scotland overall has a lower percentage of the population who are from minority ethnic groups – at 4% overall - this Health Board region has the highest percentage of minority ethnic groups, with the Asian background (defined as Asian/Asian Scottish/Asian British) the largest population group.²⁷

Unanswered questions and future research

The underlying explanation for the observed findings merits further investigation. In terms of patient characteristics, one might hypothesise, for instance, that attendance is more likely for older adults because they are less likely to be working and may be more able to attend appointments during working hours. Similarly, it is possible that those adults with a higher BMI may be more motivated to attend as they are experiencing more problems (functional or health-related) as a result of their weight, and may need more support to manage their weight.

With regard to practice characteristics, lower attendance by patients referred from training practices could be related to more referrals done by GP trainees, without perhaps knowing

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the patient well or fully discussing the implications of referral. Lower attendance from more deprived practices, over and above the effect of individual deprivation status, could point to area-based barriers to attendance such as poorer transport infrastructure or an unwillingness to cross territorial boundaries. Lower attendance by patients referred from smaller practices is harder to explain and may be related to other confounding factors, such as smaller practices being more likely to be situated in more deprived areas.^{28 29} Qualitative research conducted alongside this study may shed more light on these findings. What these finding do indicate is that more work is required to fully understand the role and response of primary care practitioners to obesity management in their practice populations.

Acknowledgments

We thank the Glasgow and Clyde Weight Management Service for collaborating with data sharing. We are also grateful to Paula Barton from NHS Health Scotland for help with the mapping of practices and WMS used to calculate the distance from WMS variable.

Funding

This work was supported by DB’s Clinical Academic Training Fellowship funded by the Chief Scientist Office of the Scottish Government Health Directorate (CAF 13/13)

Ethical approval

Ethical approval for this study was obtained from the West of Scotland Research Ethics Committee REC5 [Ref: 15/WS/0057]

Competing interests

All authors have completed the ICMJE uniform disclosure form at www.icmje.org/coi_disclosure.pdf and declare: no support from any organisation for the submitted work; no financial relationships with any organisations that might have an interest in the submitted work in the previous three years; no other relationships or activities that could appear to have influenced the submitted work.

Authors’ contributions

DB, COD, SMcD and DM conceived the original idea. DB and PMcL carried out the statistical analyses. DB drafted the initial manuscript and all other authors contributed to subsequent drafts. All authors read and approved the final manuscript.

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Transparency declaration

The lead author affirms that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

Data Sharing

Datasets currently held by lead author, DB, and can be made available on request.

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Blane et al. Patient and practice characteristics predicting attendance and completion at a specialist weight management service: a cross-sectional study
STROBE Statement.

	Item No	Recommendation	Manuscript
Title and abstract	1	(a) Indicate the study’s design with a commonly used term in the title or the abstract	Patient and practice characteristics predicting attendance and completion at a specialist weight management service: a cross-sectional study
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	Abstract contains description of setting; participants; main outcome measures; and analysis, as follows: Setting: Regional specialist weight management service, delivered within the UK National Health Service, receiving referrals from 262 general practices in NHS Greater Glasgow and Clyde, Scotland. Participants: 9,677 adults with obesity referred between 2012 and 2015. Main outcome measures: Data on individual patient characteristics were combined with practice-level characteristics extracted from routinely available sources. The main outcome measures of interest were: i) attendance, and ii) completion, defined as attending 4 or more sessions. Analysis: Multilevel binary logistic regression models were constructed to determine the association between patient and practice characteristics and attendance and completion.
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	Introduction explains both the background and rationale for this study.
Objectives	3	State specific objectives, including any prespecified hypotheses	Objectives: To determine the association between patient and referring practice characteristics and attendance and completion at a specialist health service weight management service.
Methods			
Study design	4	Present key elements of study design early in the paper	Title and abstract both state that this is a cross-sectional study.
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up,	Abstract: Setting: Regional specialist weight management service, delivered

		and data collection	<p>within the UK National Health Service, receiving referrals from 262 general practices in NHS Greater Glasgow and Clyde, Scotland.</p> <p>Participants: 9,677 adults with obesity referred between 2012 and 2015.</p> <p>This study used routinely available data, including GP electronic referral data collected by the weight management service and publically available data on general practice characteristics. This is fully detailed in the Methods Section.</p>
Participants	6	<p>(a) <i>Cohort study</i>—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up</p> <p><i>Case-control study</i>—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls</p> <p><i>Cross-sectional study</i>—Give the eligibility criteria, and the sources and methods of selection of participants</p>	<p>Methods.</p> <p>Patient eligibility: Data were collected for earliest referral per patient collected by the Glasgow and Clyde Weight Management Service. Included cases were adults (aged 18 and over), had a diagnosis of obesity (BMI ≥ 30) and had complete data on sex, height and weight. The final dataset comprised 9,677 adults with obesity referred from 262 general practices in NHS Greater Glasgow & Clyde (GGC). The small number of referrals from out with GGC and from specialist services were excluded.</p>
		<p>(b) <i>Cohort study</i>—For matched studies, give matching criteria and number of exposed and unexposed</p> <p><i>Case-control study</i>—For matched studies, give matching criteria and the number of controls per case</p>	N/A.
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	<p>Methods.</p> <p>The main outcome of interest was attendance at weight management, defined as attending at least one group session, after the initial assessment. A further outcome was ‘completion’, defined as attendance at 4 or more sessions. This was based on a definition used in a previous published study of the GCWMS Logue et al. BMJ Open 2014; 4 (1) doi: 10.1136/bmjopen-2013-003747.</p> <p>Patient-level predictors.</p> <p>Patient characteristics included sex, age (grouped into four</p>

			<p>categories: 18-24, 25-44, 45-64, 65+), socio-economic status (based on the Scottish Index of Multiple Deprivation (SIMD) 2012 quintiles), and BMI (grouped into four categories: 30-35, >35-40, >40-45, and 45+).</p> <p>Practice-level predictors.</p> <p>Practice characteristics included GP training practice status, practice list size, distance from nearest weight management service (WMS) centre, achievement in the Quality and Outcome Framework (QOF) in the year April 2014 to March 2015, practice deprivation status, and referral rate to the GCWMS.</p> <p>These are fully defined in the Methods.</p>
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	<p>Patient-level predictors.</p> <p>Patient characteristics included sex, age (grouped into four categories: 18-24, 25-44, 45-64, 65+), socio-economic status (based on the Scottish Index of Multiple Deprivation (SIMD) 2012 quintiles), and BMI (grouped into four categories: 30-35, >35-40, >40-45, and 45+).</p> <p>Practice-level predictors.</p> <p>Data on training practice status were derived from the West Scotland GP training website. Practice list size was taken from Information Services Division (ISD) Scotland and divided into 3 groups: <4,000, 4000-8000, and >8000. Distance from the nearest weight management service centre was calculated using GPS mapping software using practice postcode and the postcodes of the 12 weight management service satellite clinics that were in operation during the referral period. The three groupings for this variable were under 1 mile, 1 to 2 miles, and over 2 miles. QOF achievement data were taken from the ISD website and grouped into <95, 95-98, 99, 100 points (out of a possible 100 points). Practice deprivation status was based on the % of the practice population living in the most deprived 15% of postcodes and categorised as: <15%, 15-40%, and >40% of practice population.</p>

			Referral rate to GCWMS was per 1000 practice population (≤ 5 , 5-10, and >10).
Bias	9	Describe any efforts to address potential sources of bias	N/A
Study size	10	Explain how the study size was arrived at	N/A – all first referrals meeting the patient eligibility criteria defined at Item 6 were included.
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	<p>Patient-level predictors.</p> <p>Patient characteristics included sex, age (grouped into four categories: 18-24, 25-44, 45-64, 65+), socio-economic status (based on the Scottish Index of Multiple Deprivation (SIMD) 2012 quintiles), and BMI (grouped into four categories: 30-35, >35-40, >40-45, and 45+).</p> <p>Practice-level predictors.</p> <p>Data on training practice status were derived from the West Scotland GP training website. Practice list size was taken from Information Services Division (ISD) Scotland and divided into 3 groups: $<4,000$, 4000-8000, and >8000. Distance from the nearest weight management service centre was calculated using GPS mapping software using practice postcode and the postcodes of the 12 weight management service satellite clinics that were in operation during the referral period. The three groupings for this variable were under 1 mile, 1 to 2 miles, and over 2 miles. QOF achievement data were taken from the ISD website and grouped into <95, 95-98, 99, 100 points (out of a possible 100 points). Practice deprivation status was based on the % of the practice population living in the most deprived 15% of postcodes and categorised as: $<15\%$, 15-40%, and $>40\%$ of practice population. Referral rate to GCWMS was per 1000 practice population (≤ 5, 5-10, and >10).</p>
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	Descriptive analysis of the study population examined how referral, attendance and completion varied by patient and

			practice characteristics. Multilevel binary logistic regression models were constructed in order to account for the clustering of patients within practices. Results are presented as univariable (crude) and multivariable (adjusted) odds ratios (ORs) and 95% confidence intervals (95% CI), with adjustment made for all patient and practice-level characteristics. Analysis was carried out using STATA-MP version 14.0 (Texas, USA).
		(b) Describe any methods used to examine subgroups and interactions	N/A.
		(c) Explain how missing data were addressed	N/A.
		(d) Cohort study—If applicable, explain how loss to follow-up was addressed Case-control study—If applicable, explain how matching of cases and controls was addressed Cross-sectional study—If applicable, describe analytical methods taking account of sampling strategy	See above.
		(e) Describe any sensitivity analyses	N/A.
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	The final dataset comprised 9,677 adults with obesity referred from 262 general practices in NHS Greater Glasgow & Clyde. 3250 patients attended weight management service ('attenders'). 2252 patients completed at weight management service – defined as attending 4 or more sessions ('completers').
		(b) Give reasons for non-participation at each stage	N/A.
		(c) Consider use of a flow diagram	No flow diagram – Table 1 describes characteristics of each group included in the analysis.
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	Table 1 describes the characteristics of the overall population, those referred, attending weight management service and completing.
		(b) Indicate number of participants with missing data for each variable of interest	N/A – final dataset included all adults with a diagnosis of obesity and with complete data on sex, height and weight.
		(c) Cohort study—Summarise follow-up time (eg, average	N/A.

		and total amount)	
Outcome data	15*	<i>Cohort study</i> —Report numbers of outcome events or summary measures over time	N/A.
		<i>Case-control study</i> —Report numbers in each exposure category, or summary measures of exposure	N/A.
		<i>Cross-sectional study</i> —Report numbers of outcome events or summary measures	Number referred to weight management service = 9677. Number attending weight management service = 3250. Number completing at weight management = 2252.
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	Unadjusted and adjusted odds ratios are reported in Table 4 with 95% confidence intervals for each estimate.
		(b) Report category boundaries when continuous variables were categorized	See Tables throughout.
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	-
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	-
Discussion			
Key results	18	Summarise key results with reference to study objectives	Key results are summarised on page 17 : In this observational cross-sectional study of GP referrals to an NHS Health Board specialist weight management service, we found that just over a third of the 9,677 adults with obesity who were referred between 2012 and February 2016 attended at least one session. There was another marked attrition rate after first attendance, with less than a quarter ‘completing’ treatment, defined here as attending four or more sessions. Patient-level characteristics were the strongest predictors of attendance and completion, with the odds of attendance increasing with age, BMI category, and increasing affluence. Practice-level characteristics most strongly associated with attendance and completion were being a non-training practice, having a larger list size, and not being in areas of extreme deprivation.

Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	Limitations discussed on pages 17-18 : There are no previous studies that we are aware of that have explored the predictors of attendance at weight management services taking account of both individual patient factors and referring practice characteristics. This study used individual patient level data and practice level data to explore predictors of attendance and completion at a specialist weight management service, using multilevel binary logistic regression models. As with any secondary data analysis, the quality and validity of the findings are only as good as the quality of the original data. In this case, confidence in the accuracy and consistency of the data is increased as the main outcome variables of interest were referral, attendance and completion, which are reliably recorded. There was, however, no available data on weight loss outcomes in this study population, which is a limitation. However, previous work conducted in this weight management service found that 26% of those completing Phase 1 attendance had lost at least 5kg. ¹⁰ Similarly, there was no available data on the total population of adults with obesity in the NHS GGC area, which makes it difficult to comment on the representativeness of the study population. In this study, we used a definition of ‘completers’ (i.e. attending 4 or more sessions) which is perhaps lower than in some other studies. However, the attrition rate was even greater if the threshold for the number of sessions attended was increased. In addition, higher thresholds for completion tend to be used when describing weight outcomes, rather than being used as an indicator of attendance, as in this study.
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	Interpretation of findings laid out on pages 18-19 : This study has highlighted several important issues related to the health service response to obesity. First, the wide variation in referral rates across general practice, despite similar prevalence of

			obesity, suggests that there is still much to be done to improve engagement with weight management by primary care practitioners. Second, the high attrition rate from referral to attendance, and from attendance to completion, at this large regional weight management service suggests there are ongoing barriers for patients. Third, the observation that those from the most socio-economically deprived areas are least likely to attend suggests structural barriers and the need for a more targeted response. Finally, the practice characteristics of quality (as measured by QOF achievement) and distance from the nearest WMS were not associated with attendance in this study, and these negative findings are of interest suggesting that practice quality and proximity are not major drivers of attendance.
Generalisability	21	Discuss the generalisability (external validity) of the study results	Generalisability discussed within the discussion section. Page 19 , in particular, states: Thus the findings are broadly generalizable to other parts of the NHS and beyond, particularly in terms of gender, age and socioeconomic status; however there were no data on ethnicity. While Scotland overall has a lower percentage of the population who are from minority ethnic groups – at 4% overall - this Health Board region has the highest percentage of minority ethnic groups, with the Asian background (defined as Asian/Asian Scottish/Asian British) the largest population group (Scottish Government 2016).
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	Page 21: This study is part of DB's PhD Fellowship funded by the Chief Scientist Office of the Scottish Government Health Directorates (CAF 13/13)

BMJ Open

Patient and practice characteristics predicting attendance and completion at a specialist weight management service in the UK: a cross-sectional study

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2017-018286.R1
Article Type:	Research
Date Submitted by the Author:	31-Aug-2017
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Primary Subject Heading:	General practice / Family practice
Secondary Subject Heading:	Epidemiology, Public health
Keywords:	Obesity, PRIMARY CARE, Weight management, Co-morbidity, Socioeconomic status, Disparities

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**Patient and practice characteristics predicting attendance and completion at a specialist
weight management service in the UK: a cross-sectional study**

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Key words: Obesity, Primary Health Care, Weight Management, Comorbidity,
Socioeconomic status, Disparities

Abstract

Objective: To determine the association between patient and referring practice characteristics and attendance and completion at a specialist health service weight management service (WMS).

Design: Cross-sectional study.

Setting: Regional specialist WMS located in the West of Scotland.

Participants: 9,677 adults with obesity referred between 2012 and 2014; 3250 attending service and 2252 completing.

Primary and secondary outcome measures: Primary outcome measure was attendance at the weight management service; secondary outcome was completion, defined as attending 4 or more sessions.

Analysis: Multilevel binary logistic regression models constructed to determine the association between patient and practice characteristics and attendance and completion.

Results: Approximately one-third of the 9,677 obese adults referred attended at least one session (n = 3250, 33.6%); only 2252 (23%) completed by attending 4 or more sessions. Practice referrals ranged from 1 to 257. Patient-level characteristics were strongest predictors of attendance; odds of attendance increased with age (OR 4.14, 95% CI 3.27 to 5.26 for adults aged 65+ compared to those aged 18-24), BMI category (OR 1.83, 95% CI 1.56 to 2.15 for BMI 45+ compared to BMI 30-35), and increasing affluence (OR 1.96, 95% CI 1.17 to 3.28). Practice-level characteristics most strongly associated with attendance were being a non-training practice, having a larger list size, and not being located in the most deprived areas.

Conclusions: There was wide variation in referral rates across general practice, suggesting that there is still much to do to improve engagement with weight management by primary care practitioners. The high attrition rate from referral to attendance, and from attendance to completion, suggests ongoing barriers for patients, particularly those from the most socio-economically deprived areas. Patient and practice-level characteristics can help us understand the observed variation in attendance at specialist WMS following GP referral and the underlying explanations for these differences merit further investigation.

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Article Summary

Strengths and Limitations of This Study

- Explores the predictors of attendance and completion at adult weight management services taking account of both individual patient factors and referring practice characteristics
- Data were obtained from a large urban weight management service between 2012 to 2014, with data on referrals, attendances and completion.
- Patient-level data linked to the characteristics of the 262 general practices in the Health Board area who make referrals to the service
- There were no available data on weight loss outcomes in this study population, which is a limitation

INTRODUCTION

Obesity is a major global public health concern with considerable health and economic consequences.¹⁻³ International guidelines recommend that practitioners opportunistically identify overweight and obese patients, with the aim of encouraging weight loss.^{4,5} Much of this work takes place in primary care.⁶ However, obesity remains under-treated in primary care,^{7,8} and patient identification is only the first part of the journey. Current UK policy recommends a comprehensive tiered approach to weight management (Box 1),^{5,9} but there is marked variation in referrals to weight management services from primary care, and a high attrition rate between referral and attendance.¹⁰ The reasons for this are unclear. One factor is patient characteristics, such as socioeconomic status, with more affluent patients more likely to be referred.¹¹ Previous research on referral variation has suggested that only 40% of variation can be explained by patient characteristics.¹² Practitioner factors such as views of risk and clinical experience, as well as system factors, such as distance to services, also explain some of the variation observed in referral rates to secondary care.^{12,13} These factors may also contribute to an individual's likeliness to both attend a service and complete the course of treatment on offer – each of these are important issues in weight management, where patients are being asked to make significant changes to their lifestyle and behaviour.

Box 1 Tiered approach to weight management

Tier 1 - Population wide health improvement work (e.g. pre-healthcare lifestyle advice, community pharmacies, and commercial weight management);
Tier 2 - Lifestyle interventions delivered in the community (e.g. healthy eating, exercise referral, community dietetic service);
Tier 3 - Specialist weight management services;
Tier 4 - Bariatric surgery

Several previous studies have explored individual practitioner views on referral to weight management services.¹⁴⁻¹⁶ Issues raised included patient factors such as motivation and expectations, and practitioner factors such as previous experience and pessimism. However, there are no quantitative studies that have explored the predictors of attendance at weight management services taking account of both individual factors and practice characteristics. The aim of this study, therefore, was to use individual and practice level data to explore predictors of attendance and completion at a specialist weight management service (Tier 3), using multilevel binary logistic regression models.

METHODS

Setting

The Glasgow and Clyde Weight Management Service (GCWMS) is the most well established, well-funded, and well-evaluated NHS-based non-commercial service in Scotland.^{10 17 18} It is a multi-component weight management programme, which includes structured lifestyle advice, underpinned by psychological approaches, and is available to patients aged 18 years and over with complex obesity (defined as body mass index (BMI) of ≥ 30 kg/m² with obesity-related co-morbidities, or BMI of ≥ 35 kg/m² alone).¹⁰ For those patients with obesity that do not meet the eligibility criteria (i.e. BMI 30-35 kg/m² without weight-related co-morbidities), GPs and practice nurses can signpost patients to healthy eating classes or physical activity resources, where available.

Eligible patients are referred electronically by their GP or practice nurse (a small proportion come from secondary care referrals) and are required to 'opt in' to the service within 2

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3 weeks of referral. They are then seen (usually within 1 or 2 months) by a dietitian at an
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5 initial assessment, who helps to direct them to an appropriate group or professional. Some
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7 patients (e.g. those with possible binge eating disorder) may receive further input from a
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9 clinical psychologist or physiotherapist. Most patients are seen in groups of no more than
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11 16 people, led by a NHS dietitian, at a number of venues throughout Glasgow and Clyde.
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13 Phase 1 of the intervention includes nine sessions (90 mins each) delivered fortnightly over
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15 a 16-week period. Further treatment options, including prescribed low-calorie diet,
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17 pharmacotherapy (orlistat), and bariatric surgery, are only available after completion of
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19 phase 1 of the programme. A previous paper has described the service and its weight loss
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21 outcomes in more detail.¹⁰
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29 It receives the majority of its referrals from the 262 general practices in the NHS Greater
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31 Glasgow and Clyde (GGC) health board area, with a small proportion (<2% of total referrals)
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33 coming from practices in other health boards and directly from hospital specialities.
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39 **Study design and population**

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41 An observational cross-sectional study design was applied using data from GP electronic
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43 referrals to GCWMS. The dataset was received from GCWMS in February 2016 and included
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45 data on the earliest referral per patient from 2012 to 2014 in order to avoid patients
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47 appearing more than once. Data cleaning ensured that the included cases were adults
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49 (aged 18 years and over), had a diagnosis of obesity (BMI ≥ 30 kg/m²) and had complete data
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51 on sex, height and weight. 146 cases (1.5%) were excluded in this process. The final dataset
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53 comprised 9,677 adults with obesity referred from 262 general practices in GGC. The small
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number of referrals (<2% of total referrals) from outside GGC and from specialist services were excluded prior to receiving the data.

Study variables

Referral, attendance and ‘completion’

The main outcome of interest was attendance at weight management, defined as attending at least one group session, after the initial assessment. A further outcome was ‘completion’, defined as attendance at 4 or more sessions. This was based on a definition used in a previous published study of the GCWMS.¹⁰

Patient characteristics

Patient characteristics included sex, age (grouped into four categories: 18-24 years, 25-44 years, 45-64 years, 65+ years), socio-economic status (based on the Scottish Index of Multiple Deprivation (SIMD) 2012 quintiles¹⁹), and BMI (grouped into four categories: 30-35 kg/m², >35-40 kg/m², >40-45 kg/m², and 45+ kg/m²). Data on co-morbidities of the referred patients were incomplete so were not included in the final analysis. There were no data on other variables that may have been of interest, such as ethnicity or smoking status.

Practice characteristics

Practice characteristics included GP training practice status, practice list size, distance from nearest weight management service (WMS) centre, achievement in the Quality and Outcome Framework (QOF) in the year April 2014 to March 2015, practice deprivation status, and referral rate to the GCWMS.

Data on training practice status were derived from the West Scotland GP training website.²⁰ Practice list size was taken from Information Services Division (ISD) Scotland²¹ and divided into 3 groups: <4,000, 4000-8000, and >8000. Distance from the nearest weight management service centre was calculated using GPS mapping software using practice postcode and the postcodes of the 12 weight management service satellite clinics that were in operation during the referral period. The three groupings for this variable were under 1 mile, 1 to 2 miles, and over 2 miles. QOF achievement data were taken from the ISD website²² and grouped into <95, 95-98, 99, 100 points (out of a possible 100 points). Practice deprivation status was based on the % of the practice population living in the most deprived 15% of postcodes and categorised as: <15%, 15-40%, and >40% of practice population. Referral rate to GCWMS was per 1000 practice population (≤ 5 , 5-10, and >10).

Statistical analysis

Descriptive analysis of the study population examined how referral, attendance and completion varied by patient and practice characteristics. Multilevel binary logistic regression models were constructed in order to account for the clustering of patients within practices. Results are presented as univariable (crude) and multivariable (adjusted) odds ratios (ORs) and 95% confidence intervals (95% CI), with adjustment made for all patient and practice-level characteristics. Analysis was carried out using STATA-MP version 14.0 (Texas, USA).

Patient involvement

There was no patient involvement in this study.

RESULTS

9,677 adults with obesity were referred to the regional specialist weight management service from 262 practices in NHS GGC between January 2012 and December 2014. This is about 4% of the approximately 260,000 adults with obesity estimated to live in NHS GGC.²³

Table 1 shows the individual-level characteristics of the total GGC population and of the study population (for those referred, attenders (attending at least one session), and ‘completers’ (attending 4 or more sessions)). The majority of those referred to the weight management service were female, aged 45 to 64 years, and from the most deprived population quintile. The mean age of those referred was 46.5 years (SD 14.3, range 18 to 88); the mean BMI was 41.4 kg/m² (SD 6.9, range 30 to 97.3). Approximately one third of those referred attended at least one session (n = 3250, 33.6%); of attenders, 69.3% (n = 2252) completed.

There was a similar picture for those attending the weight management service and those attending four or more sessions (‘completers’). Over 70% were female and over half were aged 45 to 64, with the mean age of those attending 49.8 years (SD 13.5, range 18 to 84) and the mean age of ‘completers’ 50.6 years (13.2, range 18 to 83). Over 40% were from the most deprived population quintile. The mean BMI of attenders was 42.0 kg/m² (SD 7.1,

range 30 to 97.3) and the mean BMI of 'completers' was 42.1 kg/m² (SD 7.2, range 30 to 97.3).

Table 1: Individual characteristics of total GG&C population, those referred, attenders and completers (Number, (%))

	GGC Adult Population N= 924,727	Referrals N = 9677	Attenders N = 3250	Completers N = 2252
Sex†				
Women	485,629 (52.5)	6870 (71.0)	2331 (71.7)	1607 (71.4)
Men	439,098 (47.5)	2807 (29.0)	919 (28.3)	645 (28.6)
Age groups (years)†				
18-24	118,069 (12.8)	694 (7.2)	118 (3.6)	66 (2.9)
25-44	313,970 (34.0)	3543 (36.6)	1006 (31.0)	657 (29.2)
45-64	305,659 (33.1)	4369 (45.1)	1652 (50.8)	1179 (52.4)
65+	187,029 (20.2)	1071 (11.1)	474 (14.6)	350 (15.5)
SIMD 2012 quintile^a				
Q1 – most deprived	331,977 (35.9)	4778 (49.4)	1388 (42.7)	922 (41.3)
Q2	163,677 (17.7)	1770 (18.3)	600 (18.5)	419 (18.7)
Q3	133,160 (14.4)	1254 (13.0)	481 (14.8)	339 (15.2)
Q4	122,064 (13.2)	970 (10.0)	368 (11.3)	265 (11.9)
Q5 – most affluent	173,848 (18.8)	844 (8.7)	386 (11.9)	290 (13.0)
Missing	-	61 (0.6)	27 (0.8)	17 (0.8)
BMI category^b (kg/m²)				
30-35	}231,182 (25%)	1232 (12.7)	329 (10.1)	225 (10.0)
>35-40		3465 (35.8)	1152 (35.4)	764 (33.9)
>40-45	}27,742 (3%)	2611 (27.0)	920 (28.3)	658 (29.2)
45+		2369 (24.5)	849 (26.1)	605 (26.9)

GGC: Greater Glasgow & Clyde, SIMD: Scottish Index of Multiple Deprivation, BMI: body mass index

†National Records of Scotland Small Area Population Estimates (SAPE) mid-2014.²⁴

^a Based on estimates from NHS GGC Director of Public Health report 2015-17.²⁵

^b Based on estimates from Scottish Health Survey 2014.²³

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Table 2 shows the distribution of patients by the characteristics of their referring practice, compared to all GGC practices. In GGC, less than one-third of practices were training practices (n=80, 30.5%). The average list size was 5009 patients (range from 1227 to 16,825). Roughly half (n=130, 49.6%) of all practices were within 1 mile of the nearest WMS clinic. The mean number of referrals per practice was 42 (range from 1 to 257), with a mean referral rate of 8.5 per 1000 population (range from 0.7 to 26.3).

Just over 40% of all patients were referred from training practices (n=4013, 41.4%) and a little under half were from medium-sized practices with list sizes between 4000 and 8000 patients (n=4633, 47.8%). Over half of patients (n=5486, 56.6%) were from referring practices within 1 mile of the nearest weight management service clinic. Practices generally scored very highly on QOF, with 66.2% of patients being referred by a practice that achieved 99 or 100 points out of a possible 100. The characteristics of those attending or ‘completing’ were broadly similar to those initially referred.

Table 2: Practice characteristics for referrals, attenders and completers (Number (%))

	GGC Referring Practices N = 262	Referrals N = 9677	Attenders N = 3250	Completers N = 2252
Training practice				
No	158 (60.3)	4920 (50.8)	1664 (51.1)	1123 (54.8)
Yes	80 (30.5)	4013 (41.4)	1310 (40.3)	926 (45.2)
Missing	24 (9.2)	752 (7.8)	280 (8.6)	203 (9.0)
List size				
<4000	110 (42.0)	2249 (23.2)	641 (19.7)	465 (20.6)
4000-8000	113 (43.1)	4633 (47.8)	1655 (50.9)	1130 (50.2)
8000+	39 (14.9)	2795 (28.9)	954 (29.3)	657 (29.2)
Distance from WMS				
Within 1 mile	130 (49.6)	5486 (56.6)	1784 (54.8)	1214 (53.9)
Between 1-2 miles	88 (33.6)	2738 (28.3)	919 (28.2)	654 (29.0)
2 miles or more	44 (16.8)	1453 (15.0)	547 (16.8)	384 (17.1)
QOF points				
<95	7 (2.7)	231 (2.4)	72 (2.2)	52 (2.3)
95-98	38 (14.5)	820 (8.5)	280 (8.6)	186 (8.3)
99	44 (16.8)	1597 (16.5)	533 (16.4)	373 (16.6)
100	110 (42.0)	4812 (49.7)	1611 (49.5)	1111 (49.3)
Missing	63 (24.0)	2225 (23.0)	758 (23.3)	530 (23.5)
Deprivation status (% of practice population defined as most deprived)				
<15%	67 (25.6)	2068 (21.4)	795 (24.4)	581 (25.8)
15-40%	100 (38.2)	4171 (43.1)	1506 (46.3)	1034 (45.9)
>40%	95 (36.2)	3438 (35.5)	949 (29.2)	637 (28.3)
Referral Rate per 1000 practice population				
10+	75 (28.6)	4178 (43.1)	1328 (40.8)	938 (41.7)
5-10	104 (39.7)	4553 (47.0)	1550 (47.6)	1062 (47.2)
<5	83 (31.7)	946 (9.8)	372 (11.4)	252 (11.2)

GGC: Greater Glasgow & Clyde, WMS: weight management service, QOF: Quality and Outcome Framework

Overall 34% of those referred actually attended the service, and 2252 (23%) completed by attending for 4 or more sessions. There were, however, particular groups within the referred population that were more likely to both attend and to complete (Table 3). Those aged 65 years and over had a higher attendance rate (44.3%), as did those from the least deprived quintile (45.7%) and those in the highest BMI category (BMI 45+ kg/m²; 35.8%).

There were a higher proportion of attenders from larger and less deprived practices and from practices further away from weight management centres (37.6% attendance from those referred from practices 2 or more miles away). A similar pattern was observed for those completing 4 or more sessions at the WMS (Table 3).

Table 3. Profile of service attenders and completers compared to those referred, by patient and practice characteristics, as a percentage of those referred (Number, percentage of those referred)

	Referrals N = 9677	Attendances N = 3250	Completers N = 2252
Patient characteristics			
Sex			
Women	6870	2331 (33.9)	1607 (23.4)
Men	2807	919 (32.7)	645 (23.0)
Age group (years)			
18-24	694	118 (17.0)	66 (9.5)
25-44	3543	1006 (28.4)	657 (18.5)
45-64	4369	1652 (37.8)	1179 (27.0)
65+	1071	474 (44.3)	350 (32.7)
SIMD 2012 quintile			
Q1 – most deprived	4778	1388 (29.0)	922 (19.3)
Q2	1770	600 (33.9)	419 (23.7)
Q3	1254	481 (38.4)	339 (27.0)
Q4	970	368 (37.9)	265 (27.3)
Q5 – most affluent	844	386 (45.7)	290 (34.4)
Missing	61	37	17
BMI category (kg/m ²)			
30-35	1232	329 (26.7)	225 (18.3)
>35-40	3465	1152 (33.2)	764 (22.0)
>40-45	2611	920 (35.2)	658 (25.2)
45+	2369	849 (35.8)	605 (25.5)
Practice characteristics			
Training practice			
No	4920	1664 (33.8)	1123 (22.8)
Yes	4013	1310 (32.6)	926 (23.1)
Missing	744	276	203
List size			
<4000	2249	641 (28.5)	465 (20.7)
4000-8000	4633	1655 (35.7)	1130 (24.4)
8000+	2795	954 (34.1)	657 (23.5)
Distance from WMS			

Within 1 mile	5486	1784 (32.5)	1214 (22.1)
Within 2 miles	2738	919 (33.6)	654 (23.9)
2 miles or more	1453	547 (37.6)	384 (26.4)
QOF points			
<95	231	72 (31.2)	52 (22.5)
95-98	820	280 (34.1)	186 (22.7)
99	1597	533 (33.4)	373 (23.4)
100	4812	1611 (33.5)	1111 (23.1)
Missing	2217	754	530
Deprivation status (% of practice population defined as most deprived)			
<15%	2068	795 (38.4)	581 (28.1)
15-40%	4171	1506 (36.1)	1034 (24.8)
>40%	3438	949 (27.6)	637 (18.5)
Referral rate per 1000 practice population			
>10	4178	1328 (31.8)	938 (22.5)
5-10	4553	1550 (34.0)	1062 (23.3)
<5	946	372 (39.3)	252 (26.6)

SIMD: Scottish Index of Multiple Deprivation, BMI: body mass index, WMS: weight management service, QOF: Quality and Outcome Framework

Table 4 presents the logistic regression models of attendance and completion, with individual and practice characteristics, and taking account of clustering within practices. Patient-level characteristics were the strongest predictors of attendance at the specialist weight management service, with the odds of attendance increasing with age (OR 4.15, 95% CI 3.27 to 5.26 for adults aged 65 years and over compared to those aged 18-24 years), BMI category (OR 1.83, 95% CI 1.56 to 2.14 for those with a BMI 45+ kg/m² compared to BMI 30-35 kg/m²), and increasing affluence (OR 1.74, 95% CI 1.47 to 2.06 for patients from the most affluent practices compared to the most deprived). Men had a lower odds of attendance than women (OR 0.87, 95% CI 0.79 to 0.96).

Practice-level characteristics that were most strongly associated with attendance were being a non-training practice, having a larger list size, and having a more affluent patient population. Those patients referred from training practices had a slightly lower odds of

attending (OR 0.89, 95% CI 0.81 to 0.99) than those referred from non-training practices.

Those from a practice with a list size of 4000-8000 were more likely to attend than those from a practice with a list size of under 4000 (OR 1.41, 95% CI 1.25 to 1.59). Similarly, those from a practice with a list size greater than 8000 were also more likely to attend at least one of the weight management appointments following referral (OR 1.29, 95% CI 1.12 to 1.48).

Patients referred from practices serving the most deprived populations (where more than 40% of the practice population live in the most deprived postcodes) were less likely to attend the WMS (OR 0.82, 95% CI 0.71 to 0.95).

Similar patterns were observed for those who completed a course of sessions at the WMS (Table 4), with the same patient-level characteristics the strongest predictors of 'completion'. The likelihood of attending four or more sessions increased with increasing age, such that those aged 65 years and over were almost five times as likely to attend 4 or more sessions compared to those aged 18-24 years (OR 4.83, 95% CI 3.62 to 6.45).

As with attendance, there was a social gradient in 'completing' with increasing odds from the most deprived to the most affluent quintiles (OR 1.83, 95% CI 1.53 to 2.19 for patients from the most affluent practices compared to the most deprived). Similarly, the odds of attending four or more sessions also increased with each increase in BMI category, with the highest odds being for those from the BMI 45 kg/m² and over category (OR 1.88, 95% CI 1.58 to 2.25) compared to the reference group of BMI 30-35 kg/m².

Table 4. Logistic regression models for attenders and completers at the WMS

	Attenders			Completers		
	Unadjusted OR (95% CI)	Adjusted OR† (95% CI)	P-value	Unadjusted OR (95% CI)	Adjusted OR† (95% CI)	P-value
Sex						
Women	1.00	1.00		1.00	1.00	
Men	0.95 (0.86 to 1.04)	0.87 (0.79 to 0.96)	0.005	0.98 (0.88 to 1.09)	0.89 (0.80 to 0.99)	0.036
Age group (years)						
18-24	1.00	1.00		1.00	1.00	
25-44	1.96 (1.58 to 2.43)	1.93 (1.56 to 2.39)	<0.001	2.20 (1.68 to 2.87)	2.15 (1.64 to 2.81)	<0.001
45-64	3.02 (2.45 to 3.73)	3.04 (2.46 to 3.75)	<0.001	3.59 (2.76 to 4.67)	3.54 (2.72 to 4.61)	<0.001
65+	3.88 (3.07 to 4.90)	4.15 (3.27 to 5.26)	<0.001	4.59 (3.45 to 6.11)	4.83 (3.62 to 6.45)	<0.001
SIMD 2012 quintile						
Q1 – most deprived	1.00	1.00		1.00	1.00	
Q2	1.24 (1.10 to 1.40)	1.15 (1.02 to 1.30)	0.023	1.29 (1.13 to 1.47)	1.19 (1.04 to 1.36)	0.014
Q3	1.48 (1.29 to 1.69)	1.33 (1.16 to 1.53)	<0.001	1.53 (1.32 to 1.77)	1.37 (1.18 to 1.60)	<0.001
Q4	1.46 (1.26 to 1.69)	1.32 (1.13 to 1.55)	<0.001	1.55 (1.32 to 1.83)	1.39 (1.17 to 1.65)	<0.001
Q5 – most affluent	1.99 (1.70 to 2.33)	1.74 (1.47 to 2.06)	<0.001	2.14 (1.82 to 2.53)	1.83 (1.53 to 2.19)	<0.001
Missing	1.95 (1.17 to 3.26)	1.96 (1.17 to 3.28)	0.01	1.61 (0.91 to 2.84)	1.61 (0.91 to 2.86)	0.101
BMI category (kg/m ²)						
30-35	1.00	1.00		1.00	1.00	
>35-40	1.38 (1.19 to 1.60)	1.53 (1.32 to 1.78)	<0.001	1.28 (1.08 to 1.51)	1.43 (1.21 to 1.70)	<0.001
>40-45	1.51 (1.29 to 1.75)	1.74 (1.49 to 2.03)	<0.001	1.53 (1.29 to 1.81)	1.79 (1.50 to 2.13)	<0.001
45+	1.56 (1.34 to 1.82)	1.83 (1.56 to 2.14)	<0.001	1.57 (1.32 to 1.86)	1.88 (1.58 to 2.25)	<0.001
Training practice						
No	1.00	1.00		1.00	1.00	
Yes	0.96 (0.85 to 1.08)	0.89 (0.81 to 0.99)	0.029	1.01 (0.89 to 1.15)	0.97 (0.86 to 1.08)	0.550
Missing	1.13 (0.92 to 1.40)	1.13 (0.91 to 1.39)	0.268	1.29 (1.04 to 1.61)	1.23 (0.98 to 1.57)	0.074

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List size							
<4000	1.00	1.00	1.00	1.00	1.00	1.00	
4000-8000	1.37 (1.21 to 1.57)	1.41 (1.25 to 1.59)	<0.001	1.21 (1.05 to 1.40)	1.21 (1.06 to 1.39)	0.006	
8000+	1.31 (1.12 to 1.53)	1.29 (1.12 to 1.48)	<0.001	1.17 (0.99 to 1.39)	1.14 (0.98 to 1.34)	0.097	
Distance from WMS							
Within 1 mile	1.00	1.00	1.00	1.00	1.00		
Within 2 miles	1.04 (0.91 to 1.18)	1.03 (0.92 to 1.14)	0.621	1.10 (0.96 to 1.26)	1.09 (0.97 to 1.24)	0.149	
2 miles or more	1.29 (1.09 to 1.51)	1.06 (0.93 to 1.21)	0.399	1.32 (1.11 to 1.57)	1.06 (0.91 to 1.23)	0.469	
QOF points							
<95	1.00	1.00	1.00	1.00	1.00		
95-98	1.11 (0.76 to 1.63)	0.97 (0.70 to 1.34)	0.849	0.99 (0.66 to 1.49)	0.81 (0.56 to 1.17)	0.254	
99	1.09 (0.76 to 1.57)	0.85 (0.62 to 1.16)	0.314	1.02 (0.69 to 1.50)	0.82 (0.58 to 1.16)	0.258	
100	1.12 (0.79 to 1.59)	0.89 (0.66 to 1.20)	0.454	1.03 (0.71 to 1.50)	0.82 (0.58 to 1.14)	0.238	
Missing	1.14 (0.80 to 1.62)	0.90 (0.66 to 1.23)	0.506	1.09 (0.75 to 1.60)	0.80 (0.57 to 1.14)	0.219	
Deprivation status (% of practice population defined as most deprived)							
<15%	1.00	1.00	1.00	1.00	1.00		
15-40%	0.88 (0.78 to 1.00)	1.09 ([0.95 to 1.23)	0.212	0.83 (0.72 to 0.95)	0.96 (0.83 to 1.11)	0.561	
>40%	0.60 (0.53 to 0.69)	0.82 (0.71 to 0.95)	0.008	0.57 (0.50 to 0.66)	0.74 (0.63 to 0.87)	<0.001	
Referral rate per 1000 practice population							
>10	1.00	1.00	1.00	1.00	1.00		
5-10	0.79 (0.67 to 0.95)	0.92 (0.79 to 1.08)	0.311	0.83 (0.69 to 1.01)	0.99 (0.83 to 1.18)	0.915	
<5	0.71 (0.59 to 0.85)	0.91 (0.77 to 1.08)	0.269	0.79 (0.65 to 0.96)	1.07 (0.88 to 1.29)	0.516	

CI: confidence interval, OR: odds ratio, SIMD: Scottish Index of Multiple Deprivation, BMI: body mass index, WMS: weight management service, QOF: Quality and Outcome Framework
† Adjusted for all other variables

DISCUSSION

Statement of principal findings

In this observational cross-sectional study of GP referrals to an NHS Health Board specialist weight management service, we found that just over a third of the 9,677 adults with obesity who were referred between 2012 and 2014 attended at least one session. There was another marked attrition rate after first attendance, with less than a quarter 'completing' treatment, defined here as attending four or more sessions. Patient-level characteristics were the strongest predictors of attendance and completion, with the odds of attendance increasing with age, BMI category, and increasing affluence. Practice-level characteristics most strongly associated with attendance and completion were being a non-training practice, having a larger list size, and not being in areas of extreme deprivation.

Strengths and weaknesses of the study

There are no previous studies that we are aware of that have explored the predictors of attendance at weight management services taking account of both individual patient factors and referring practice characteristics. This study used individual patient level data and practice level data to explore predictors of attendance and completion at a specialist weight management service, using multilevel binary logistic regression models. As with any secondary data analysis, the quality and validity of the findings are only as good as the quality of the original data. In this case, confidence in the accuracy and consistency of the data is increased as the main outcome variables of interest were referral, attendance and completion, which are reliably recorded.

There were no available data on weight loss outcomes in this study population, which is a limitation. However, previous work conducted in this weight management service found that 26% of those completing Phase 1 attendance had lost at least 5kg.¹⁰ Similarly, there were no available data on the total population of adults with obesity in the NHS GGC area, which makes it difficult to comment on the representativeness of the study population. In this study, we used a definition of ‘completers’ (i.e. attending 4 or more sessions) which is perhaps lower than in some other studies. However, the attrition rate was even greater if the threshold for the number of sessions attended was increased. In addition, higher thresholds for completion tend to be used when describing weight outcomes, rather than being used as an indicator of attendance, as in this study.

Comparison with existing literature

This study of GP referrals to a large regional weight management service found that patient characteristics were more significant predictors of attendance than practice characteristics. This is in keeping with previous research on variation in GP referrals to secondary care services.^{11 12} The powerful effect of socio-economic deprivation – both at the individual level and at the practice level – also resonates with existing literature on barriers to access.²⁶

The low level of referral to adult weight management from primary care in this study – roughly 4% of the approximately 260,000 adults with obesity estimated to live in NHS GGC – is similar to previously published studies from the UK.^{8 27} The reasons for this low engagement with weight management are multifactorial, including patient, practitioner and health system factors.^{14-16 18}

Meaning of the study: possible explanations and implications for clinicians and policymakers

This study has highlighted several important issues related to the health service response to obesity. First, the wide variation in referral rates across general practice, despite similar prevalence of obesity, suggests that there is still much to be done to improve engagement with weight management by primary care practitioners. Second, the high attrition rate from referral to attendance, and from attendance to completion, at this large regional weight management service suggests there are ongoing barriers for patients. Third, the observation that those from the most socio-economically deprived areas are least likely to attend suggests structural barriers and the need for a more targeted response. Finally, the practice characteristics of quality (as measured by QOF achievement) and distance from the nearest WMS were not associated with attendance in this study, and these negative findings are of interest suggesting that practice quality and proximity are not major drivers of attendance.

This work was based in the largest health board in Scotland, with data available for all referrals made by primary care practitioners based in general practice, between 2012 and 2014. Thus the findings are broadly generalizable to other parts of the NHS and beyond, particularly in terms of gender, age and socioeconomic status; however there were no data on ethnicity. While Scotland overall has a lower percentage of the population who are from minority ethnic groups – at 4% overall – this Health Board region has the highest percentage of minority ethnic groups, with the Asian background (defined as Asian/Asian Scottish/Asian British) the largest population group.²⁸

Unanswered questions and future research

The underlying explanation for the observed findings merits further investigation. In terms of patient characteristics, one might hypothesise, for instance, that attendance is more likely for older adults because they are less likely to be working and may be more able to attend appointments during working hours. Similarly, it is possible that those adults with a higher BMI may be more motivated to attend as they are experiencing more problems (functional or health-related) as a result of their weight, and may need more support to manage their weight.

With regard to practice characteristics, lower attendance by patients referred from training practices could be related to more referrals done by GP trainees, without perhaps knowing the patient well or fully discussing the implications of referral. Lower attendance from more deprived practices, over and above the effect of individual deprivation status, could point to area-based barriers to attendance such as poorer transport infrastructure or an unwillingness to cross territorial boundaries. Lower attendance by patients referred from smaller practices is harder to explain and may be related to other confounding factors, such as smaller practices being more likely to be situated in more deprived areas.^{29 30} Qualitative research conducted alongside this study may shed more light on these findings. What these findings do indicate is that more work is required to fully understand the role and response of primary care practitioners to obesity management in their practice populations.

For peer review only

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Acknowledgments

We thank the Glasgow and Clyde Weight Management Service for collaborating with data sharing, and Billy Sloan for help with initial data cleaning. We are also grateful to Paula Barton from NHS Health Scotland for help with the mapping of practices and WMS used to calculate the distance from WMS variable.

Funding

This work was supported by DB’s Clinical Academic Training Fellowship funded by the Chief Scientist Office of the Scottish Government Health Directorate (CAF 13/13)

Ethical approval

Ethical approval for this study was obtained from the West of Scotland Research Ethics Committee REC5 [Ref: 15/WS/0057]

Competing interests

All authors have completed the ICMJE uniform disclosure form at www.icmje.org/coi_disclosure.pdf and declare: no support from any organisation for the submitted work; no financial relationships with any organisations that might have an interest in the submitted work in the previous three years; no other relationships or activities that could appear to have influenced the submitted work.

Authors' contributions

DB, COD, SMcD and DM conceived the original idea. DB and PMcL carried out the statistical analyses. DB drafted the initial manuscript and all other authors contributed to subsequent drafts. All authors read and approved the final manuscript.

Transparency declaration

The lead author affirms that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

Data Sharing

Datasets currently held by lead author, DB, and can be made available on request.

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Blane et al. Patient and practice characteristics predicting attendance and completion at a specialist weight management service in the UK: a cross-sectional study
BMJ Open, Manuscript ID bmjopen-2017-018286

STROBE Statement.

	Item No	Recommendation	Manuscript
Title and abstract	1	(a) Indicate the study’s design with a commonly used term in the title or the abstract	Study design clearly stated in both title and abstract.
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	A structured abstract has been included.
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	Introduction on Pages 4-5 explains both the background and rationale for this study.
Objectives	3	State specific objectives, including any prespecified hypotheses	Objective included in structured abstract and on page 5.
Methods			
Study design	4	Present key elements of study design early in the paper	Title and abstract both state that this is a cross-sectional study.
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	Abstract states setting, location, participants and dates of referral to the service. In paper: Setting – Page 5. Location – Page 5. Participants – Page 7. Data collection/Analysis – Pages 7 and 8.
Participants	6	(a) <i>Cohort study</i> —Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up <i>Case-control study</i> —Give the eligibility criteria, and the sources and methods of case ascertainment and control	Methods. Patient eligibility and data described on pages 5 to 8.

		selection. Give the rationale for the choice of cases and controls <i>Cross-sectional study</i> —Give the eligibility criteria, and the sources and methods of selection of participants	
		(b) <i>Cohort study</i> —For matched studies, give matching criteria and number of exposed and unexposed <i>Case-control study</i> —For matched studies, give matching criteria and the number of controls per case	N/A.
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	Main outcome of interest was attendance at weight management – see page 7. Patient-level predictors described on page 7. Practice-level predictors described on pages 7-8.
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	Patient-level predictors described on page 7. Practice-level predictors described on pages 7-8.
Bias	9	Describe any efforts to address potential sources of bias	N/A
Study size	10	Explain how the study size was arrived at	N/A – all first referrals meeting the patient eligibility criteria defined at Item 6 were included.
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	Grouping of patient and practice variables is described on pages 7-8. Statistical analysis is described on page 8.
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	Full description of the univariate and multivariate analysis is given on page 8.
		(b) Describe any methods used to examine subgroups and interactions	N/A.
		(c) Explain how missing data were addressed	N/A.
		(d) <i>Cohort study</i> —If applicable, explain how loss to follow-up was addressed <i>Case-control study</i> —If applicable, explain how matching of cases and controls was addressed <i>Cross-sectional study</i> —If applicable, describe analytical	See above.

		methods taking account of sampling strategy	
		(e) Describe any sensitivity analyses	N/A.
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	Final numbers of ‘attenders’ and ‘completers’ can be found on page 9.
		(b) Give reasons for non-participation at each stage	N/A.
		(c) Consider use of a flow diagram	No flow diagram – Table 1 describes characteristics of each group included in the analysis.
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	Table 1 describes the characteristics of the overall population, those referred, attending weight management service and completing.
		(b) Indicate number of participants with missing data for each variable of interest	N/A – final dataset included all adults with a diagnosis of obesity and with complete data on sex, height and weight.
		(c) <i>Cohort study</i> —Summarise follow-up time (eg, average and total amount)	N/A.
Outcome data	15*	<i>Cohort study</i> —Report numbers of outcome events or summary measures over time	N/A.
		<i>Case-control study</i> —Report numbers in each exposure category, or summary measures of exposure	N/A.
		<i>Cross-sectional study</i> —Report numbers of outcome events or summary measures	Number referred to weight management service = 9677. Number attending weight management service = 3250. Number completing at weight management = 2252.
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	Unadjusted and adjusted odds ratios are reported in Table 4 with 95% confidence intervals for each estimate.
		(b) Report category boundaries when continuous variables were categorized	See Tables throughout.
		(c) If relevant, consider translating estimates of relative	-

		risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	-
Discussion			
Key results	18	Summarise key results with reference to study objectives	Key results are summarised on page 18 :
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	Limitations discussed on pages 18-19 .
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	Interpretation of findings laid out on pages 19-20 :
Generalisability	21	Discuss the generalisability (external validity) of the study results	Generalisability discussed within the discussion section. Page 19-20 .
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	Page 22: This study is part of DB's PhD Fellowship funded by the Chief Scientist Office of the Scottish Government Health Directorates (CAF 13/13)