The Effectiveness of a Weight Maintenance Intervention for Adults with Intellectual Disabilities and Obesity: A Single Stranded Study

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1 **Accepted for publication** *xxxx*

Background The evidence base for weight management programmes incorporating a weight loss and a weight maintenance phase for adults with intellectual disabilities (ID) is limited. This study describes the weight maintenance phase of a multicomponent weight management programme for adults with intellectual disability and obesity (TAKE 5).

Materials and Methods Thirty-one participants who had completed the 16 week TAKE five weight loss intervention (Phase I) were invited to participate in a 12 month weight maintenance intervention (Phase II). Content included recommendations of the National Weight Control Registry.

Results Twenty-eight participants completed Phase II with 50.4% maintaining their weight (mean weight change −0.5 kg, SD 2.2), 28.7% gaining weight (mean weight gain 5.4 kg, SD 2.2) and 21.6% losing weight (mean weight loss −8.0 kg, SD 3.0) at 12 months.

Conclusion Further research is justified to investigate the efficacy of weight loss maintenance interventions in adults with intellectual disability and obesity, using controlled study designs.

Keywords: intellectual disabilities, obesity, single stranded, weight maintenance, weight management

Introduction

For an individual with obesity, losing a moderate amount of weight (5–10% of baseline weight) is associated with significant health improvement (National Institute for Health & Clinical Excellence (NICE) 2006). However, there is a need to maintain weight loss to sustain any health benefits (Ferland & Eckel 2011), which can be a challenging and a difficult process.

Evidence shows that 50–80% of individuals who have lost weight, tend to regain the weight they have lost, with 50% of the weight regain occurring within the first year (Collins *et al.* 2010). The need for individuals with obesity to receive ongoing support and guidance from health and non-health professionals to sustain their weight loss is widely recognized (Wadden *et al.* 2004). National clinical guidelines highlight the importance of a weight maintenance phase following immediately after intentional weight loss phase within weight management programmes (NICE 2006; Scottish Intercollegiate Guidelines Network (SIGN) 2010).

Definition of weight maintenance

Although there is considerable evidence to guide best practice in weight loss, much less is known about how people can sustain intentional weight loss over the long term (Stevens *et al.* 2006). The National Weight Control Registry (NWCR) is one of the few sources of information on weight maintenance in adults without intellectual disability and suggests that individuals are more likely to maintain their weight loss for at least a year when they monitor their weight at least once a week, continue to eat a low fat or low calorie diet, maintain a consistent eating pattern, be active by exercising for 1 h/day and reduce inactivity by watching <10 h of TV per week (Wing & Phelan 2005).

However, there are no universally accepted definitions of successful weight maintenance (Stevens *et al.* 2006) and clinical guidelines do not clearly define weight maintenance (NICE 2006; SIGN 2010). Weight maintenance has been defined 'either in relation to weight losses previously achieved or in terms of

10.1111/jar.12181

J A R | Journal Code | 12181 | Manuscript No. | WILEY | Dispatch: 2.2.15 | No. of pages: 13 | CE: Arockia Raj | PE: Jegadeesh

absolute or percentage weight change at points successively more distant in time' (Jeffery *et al.* 2000).

Stevens *et al.* (2006) identified the factors that lead to small fluctuations of weight at different points of measurement (e.g. measuring weight during menstrual cycle or after a physical activity, different clothing worn by the participants at the different points of measurement, meal consumption prior to the measurements) and defined weight maintenance as 'a weight change of <3% of a designated body weight under standardized conditions'.

Weight maintenance interventions in adults with intellectual disability

Obesity can be an important health issue for adults with intellectual disability (Hove 2004; Braunschweig *et al.* 2004; Maaskant *et al.* 2009), and evidence consistently shows that the prevalence of obesity can be equally high as in the general population (Stancliffe *et al.* 2011) or even higher than in the general population (Yamaki 2005; Robertson *et al.* 2014). However, there is a wide range of reported estimates, namely from 2 to 50.5%, for the levels of obesity in adults with intellectual disability (Haveman *et al.* 2010). Similar, to the general population, in adults with intellectual disability weight gain can be attributed to unhealthy dietary habits (Draheim *et al.* 2002), a high prevalence of inactivity and sedentary lifestyles (Havercamp *et al.* 2004; Bartlo & Klein 2011) but also to determinants associated to intellectual disability such as genetic pre-disposition (Farooqi & O'Rahilly 2005), use of psychotropic medication known for their obesogenic effects (Robertson *et al.* 2000) and type of living arrangements such as living in restrictive versus less restrictive environments (Rimmer & Yamaki 2006). In addition, adults with intellectual disability are more susceptible to the health risks associated to obesity such as coronary heart disease and diabetes (Draheim 2006; Straetmans *et al.* 2007) than the general population because they are also more likely to be exposed to health inequalities as a result of the ineffectiveness of health services to meet their needs (Robertson *et al.* 2014).

The evidence on the effectiveness of weight loss interventions in adults with intellectual disability is limited, and there is even less evidence to guide weight maintenance interventions for adults with intellectual disability after weight loss. According to a recent systematic review by Spanos *et al.* (2013a,b), only four of 22 identified weight management studies for adults with intellectual disability offered a structured weight loss maintenance phase. The limited number of studies and the poor methodological quality among the studies (e.g. inadequate sample sizes, poor reporting on components of weight maintenance) do not allow valid recommendations for an effective weight maintenance approach in adults with intellectual disability to be made.

This study presents the findings of a 12 month weight maintenance intervention comprising the second phase of the TAKE 5 multicomponent weight management programme for adults with intellectual disability and obesity (Melville *et al.* 2011). The two main research questions for the second phase of the weight management programme examined were whether participants achieve:

1. Do participants with intellectual disability in a multicomponent weight maintenance intervention achieve to maintain their weight loss (a weight change of <3%)?
2. Does a multicomponent weight loss maintenance intervention increase the level of physical activity to a significant level?

Materials and Methods

Study design

The TAKE 5 weight maintenance programme was a 12 month single stranded study. TAKE 5 was conducted according to the guidelines laid down in the Declaration of Helsinki. In keeping with the Adults with Incapacity (Scotland) Act 2000 (Scottish Executive 2000), all procedures involving human subjects/patients were approved by the Scotland Research Ethics Committee A and the relevant local research ethics committee (2009). Written informed consent was obtained from all participants or next of kin/welfare guardian.

Participants

Potential participants in Phase I of the TAKE 5 weight management programme, described in detail in Melville *et al.* (2011), were service users over 18 years old, with mild, moderate, severe or profound intellectual disability, identified as having obesity (BMI $\geq$ 30 kg/m^2), ambulatory and requesting support with weight loss by themselves or by their carers. These participants had been referred to intellectual disability specialist dietitians of the NHS Glasgow Learning Disability Partnership by general practitioners (family physicians) in primary care or by other specialist intellectual

disability professionals. Information sheets were sent to individuals that met the inclusion criteria to take part to a weight management intervention for adults with intellectual disability. Participants completing the 16 week weight loss intervention (Phase I) of the TAKE 5, were invited to join the 12 month weight maintenance phase (Phase II), provided that they had lost a minimum of 3% weight loss. Thirty-one adults with intellectual disability were eligible to participate in Phase II having completed Phase I of TAKE 5 and achieved a weight loss ≥3% of initial body weight and reported not planning further intentional weight loss at present.

Weight maintenance definition

The goal of Phase II was weight maintenance. Weight maintenance in this study was defined as 'a weight change of <3% of a designated body weight under standardized conditions' (Stevens *et al.* 2006). In this study designated body weight was defined as the weight immediately after a weight loss period of 16 weeks.

The TAKE 5 weight maintenance intervention

The TAKE 5 weight maintenance intervention was based on the recommendations of the National Weight Control Registry (NWCR), and the content of the sessions was based on the 12 monthly group sessions delivered at the Glasgow and Clyde Weight Management Service (GCWMS) (Morrison *et al.* 2012). However, the intervention was adapted and changed based on the ability levels of the participants with intellectual disability.

5 The intervention was delivered by a dietitian specialized in working with adults with intellectual disability and comprised 12 monthly (one session every 4 weeks for 12 months), individualized one to one sessions (40–50 min each). Sessions took place in the house of most participants but for two participants the intervention was delivered at a day centre the participants attended (due to insufficient space at home). Augmentative communication strategies ('Talking Mats') were incorporated where relevant (Brewster 2004) using pictures of clip arts of people doing activities and photos of foods, food models and fat and muscle models used to facilitate understanding.

The intervention also included once monthly contact via telephone with either the participants or with the carers who supported them, depending on the ability levels of the participants. The purpose of the monthly telephone contacts was used to:

1. Recap the main points of the previous sessions.
2. To provide ongoing motivation.
3. Support problem solving.

Dietary advice

Each participant was offered an energy prescription diet to maintain their weight, following the same principles used in the TAKE 5 weight loss intervention but without an energy deficit of 600 kilocalories (kcal) per day (Melville *et al.* 2011). This prescription was based on estimated total energy expenditure for each participant using the Schofield equations for basal metabolic rate, combined with an activity factor adapted from World Health Organisation (1985). Individual prescriptions ranged between 1800 and 3500 kcal (7536 kilojoule (kJ) to 14 654 kJ) daily.

The prescribed diet provided daily caloric intake from a specified number of daily portions of foods based on the recommendations of the 'eatwell plate' issued by the Government of the United Kingdom. Therefore, the prescribed diet was split up into six different food groups:

1. Starches (bread, other cereals and potatoes).
2. Fruit and vegetables (fresh, frozen, canned and dried).
3. Dairy (milk, cheese, yogurt).
4. Meat fish and alternatives (meat, poultry, fish, eggs, legumes and pulses).
5. Fat allowance (margarine, butter, olive oil and other spreads).
6. Extra allowance (foods and drinks containing sugar).

Starches made up the largest part of the diet (33%), followed by fruit and vegetables (33%), milk and dairy foods (15%), meat fish and alternatives (12%), foods and drinks high in sugar and fat (8%). Overall, the individualized prescribed diet aimed to ensure that 50% of daily energy intake was from carbohydrates, <35% from fats and <20% from protein, and necessary micronutrients (Scientific Advisory Committee on Nutrition 2011).

Physical activity

The advice delivered on physical activity in TAKE 5 weight maintenance was based on the recommendations of clinical guidelines and studies supporting the importance of physical activity in the maintenance of reduced weight (NICE 2006; Catenacci & Wyatt 2007;

SIGN 2010). This guidance suggests that people who have been obese and who have lost weight should be advised that they may need to do at least 60 minutes of moderate-intensity activity a day to sustain their weight loss (NICE 2006; Catenacci & Wyatt 2007; SIGN 2010). It was recognized that the participants in this study were quite far away from this level of activity (Matthews *et al.* 2011; Melville *et al.* 2011). Therefore, participants were supported to gradually increase their levels of physical activity in small increments; initially, working towards the public health recommendation of 30 min of moderate-intensity activity on 5 days a week (Chief Medical Officer 2011).

Behaviour change techniques

Self-monitoring has been shown to be a key behaviour change technique for effective weight management (Michie *et al.* 2009). Based on research evidence (Wing & Phelan 2005) and best practice recommendations for clinical practice (SIGN 2010), participants were asked to record their weight once per week. Regular weight monitoring provides an opportunity for individuals to reflect on how their lifestyle is affecting their weight and allows individuals to take action before weight changes significantly (Butryn *et al.* 2007). In individuals with intellectual disability, monitoring of the weight may require the support of the carers. Therefore, in session 1, the participants were supported from the dietitian and the carers to set the limits of healthy weight fluctuation based on the definition of Stevens *et al.* (2006), and they were asked to aim not to surpass these limits.

Participants were supported to continue with their weight management using additional behavioural change techniques used in the Phase I including goal setting, self-monitoring using food and activity diaries, relapse prevention strategies, stimulus control, assertiveness and problem solving (Melville *et al.* 2011).

The role of carers

Social support is very important in weight management and can have the form of emotional, instrumental, informational and appraisal support (Verheijden *et al.* 2005). This support can come from family members, friends and colleagues and in the case of people with intellectual disability sometimes from paid carers. Carers supporting adults with intellectual disabilities have been shown to have an important influence on successful weight management (Spanos *et al.* 2013a,b). During the TAKE 5, Phase II carers were encouraged to attend the sessions and were asked to:

1. Encourage and appreciate even minor changes in a participant's lifestyle.
2. Ensure that a participant takes an active role in making lifestyle changes.
3. Promote realistic changes in diet and activity if needed.
4. Support participants to keep weight records as part of the behaviour approach technique. These weight records were not used in the analysis of the study outcomes.

Study outcomes

1. Change in weight (kg), body mass index (BMI) and waist circumference (centimetres, cm) between baseline (end of the 16 weeks weight loss intervention) and 12 months (end of weight maintenance intervention).
2. Change in time (minutes) per day spent in light and moderate-to-vigorous physical activity at 12 months.
3. Change in time (minutes) spent in sedentary behaviour per day at 12 months.

Measures

At baseline and on completion of the TAKE 5 weight maintenance intervention, a research assistant met with the participant and carers to complete the measures of outcome.

Anthropometric measurements

Measurements were made in duplicate by the researcher, with the participant wearing light clothes without shoes and in triplicate if discrepancy between the two methods was observed. The weight change was calculated as the mean of the difference between the two measurements. Weight (kg) was measured to the nearest 100 g, using Seca 877 scales (CE approval class III; Seca, Hamburg, Germany). Height (m) was measured to the nearest 1 mm using the Seca Leicester stadiometer (Seca). Height (m) and weight (kg) were used to calculate BMI, and waist measurements were made according to the WHO (2008) protocol on anthropometric measurements.

Social support, ability and health status

A purpose-designed data collection form was used to collect demographic and health data on participants at

baseline and at 12 months. Source of information was the participants themselves if able to answer the questions or the carers for the participants that required support. The form consisted of two subsections that covered the following:

1. Section A: Social support and ability.
2. Section B: Physical health.

The level of intellectual disability was classified as mild, moderate, severe or profound. The assessment was based on a scores (5–25) obtained from five questions on the participants current ability levels in eating and drinking, in intimate care, personal safety, communication and decision making with or without support. The participants were asked about their type of support such as if they were living independently or lived with family carer or paid carer.

This questionnaire has been used before by Cooper (1997) assessing the psychiatric epidemiology in adults with intellectual disability. It has been also compared and shown to have a good level of agreement with the Vineland's Adaptive Behaviour Scale which is a validated structured assessment of functioning and ability level (Sparrow *et al.* 1984).

Physical health

The questionnaire included questions on health problems known to be commonly experienced by people with intellectual disability and people with obesity (Emerson 2010). These included high blood pressure, high cholesterol and type 2 diabetes. Information was based as reported by the carers based on diagnosis and prescribed medication from the GP.

Physical activity measurements

Physical activity measurements were made at the end of the weight maintenance using identical methods to the weight loss study, described in detail previously (Matthews *et al.* 2011; Melville *et al.* 2011). Physical activity was measured objectively with use of Actigraph GT1M accelerometers (Manufacturing Technology, Inc., Fort Walton Beach, FL, USA). The use of G1TM for the physical activity measurement has been validated in other studies (John *et al.* 2010; Kelly *et al.* 2013). Participants were invited to wear accelerometers for 7 days at the end of the Phase I and at the end of the Phase II. The accelerometer was worn at the hip, attached to a belt worn round the waist. Accelerometer data were expressed as three categories of physical activity intensity based on the following cut-offs points (Freedson *et al.* 1998):

1. Sedentary behaviour (0–499 counts/min).
2. Light-intensity activity (500–1951 counts/min).
3. Moderate-to-vigorous intensity activity (>1952 counts/min).

The accelerometer data for each of the three categories of activity were expressed as mean time/d in min and percentage of total monitoring time.

Additional data on walking frequency were collected using the International Physical Activity Questionnaire–short version (IPAQ-S). This type of self-report questionnaire has been used and validated in other studies and is positively accepted by investigators and respondents (Craig *et al.* 2003; Papathanasiou *et al.* 2009). Knowing the barriers that the participants with intellectual disability may have in answering questions regarding time and frequency (Finlay & Lyons 2001), the carers were asked to assist the participant where appropriate.

Statistical analysis

All data management and statistics were performed using SPSS for windows version 18 (SPSS, Chicago, IL, USA).

Means, standard deviations (SD) for continuous variables, for example weight, BMI, waist circumference were reported with mean difference (95% CI) and corresponding *P* value in text. Categorical variables, for example gender were reported in number and percentage in text and tables. Analysis of normality with Kolmogorov–Smirnov test showed that weight change was normally distributed. Paired t-test analyses were used to examine within group differences of measured outcomes.

Results

Results were presented against two main points of the TAKE 5 weight management intervention:

1. Baseline (end of the 16 week weight loss phase-Phase I).
2. 12 months (end of 12 months weight maintenance phase-Phase II).

Participants

Of the 31 individuals eligible, all agreed to participate in Phase II. However, one individual died and two

participants withdrew. One decided to follow a commercial weight management programme and one chose to take a break from weight management.

The characteristics of the 28 participants, 10 males (36%) and 18 females (64%) are shown in Table 1. Of the participants, none had profound intellectual disability, only one reported married, eight had Down syndrome (29%), two were partially sighted (7%), five had a hearing impairment (18%) and nine reported having epilepsy (32%). None of the participants lived independently but all lived with paid carers or family members.

Study outcomes

There was no statistically significant post-intervention change in weight (−0.6 kg; 95% CI = −2.8, +1.5), BMI (−0.1 kg/m^2; 95% CI = −0.9, +0.8) and waist circumference (−0.4 cm; 95% CI = −2.7, 1.9) at 12 months, as shown in Table 2.

Table 1 Demographic and health characteristics[1] of participants at baseline[2]

Variable	*n*	%
Gender		
Male	10	36
Female	18	64
5% weight loss	18	64
3% to <5% weight loss	10	36
Ethnicity		
Caucasian	27	96
Other Asian background	1	4
Type of support		
Lives independently	1	4
Family carer	9	32
Paid carer	18	64
Level of intellectual disability[3]		
Mild	10	36
Moderate	9	32
Severe	9	32
Hypertension or raised blood pressure[4]		
Yes	7	25
High cholesterol[4]		
Yes	6	21
Type 2 diabetes[4]		
Yes	2	7

[1]Data as number of participants and percentages, $n = 28$.
[2]End of Phase I.
[3]The assessment of level of intellectual disability is described in Melville *et al.* (2011).
[4]As reported by the carers based on diagnosis and prescribed medication from the GP.

At Phase I, 18 (64%) participants achieved a 5% weight loss. There was no statistically significant weight change ($P < 0.05$) at Phase II for participants that achieved a 5% weight loss at Phase I (+0.3 kg; 95% CI = −2.7, 3.4) or for those participants that did not achieve a 5% weight loss (−2.3 kg; CI = −5.0, 0.4).

In addition, there was no statistically significant difference ($P < 0.05$) in weight change at Phase 2 between males (−2.2 kg, 95% CI = −6.9, 2.5) and females (+0.3 kg; 95% CI = −2.1, 2.7).

Weight maintenance

Using the Stevens *et al.* (2006) definition for weight loss maintenance, the participants were classified in three categories based on weight changes between end of Phase I and end of Phase II:

1. Participants that had a weight gain of >3%.
2. Participants who maintained their weight ≤3%.
3. Participants that had a weight loss of >3%.

Table 3 shows the numbers and percentages identified in each category with the mean weight change in kg and SD at 12 months.

Around half of the participants (50%) maintained their weight (mean weight change −0.5 kg, SD 2.2) within ± 3% from initial body weight at baseline, eight participants (29%) gained weight (mean weight gain +5.4 kg, SD 2.2) and six participants lost weight (mean weight loss −8 kg, SD 3.0).

Change in physical activity

Accelerometer data at baseline and 12 months were available and eligible for inclusion in the analysis from 18 of the 28 participants. At 12 months, data from 10 participants were excluded due to a lack of recordings or recordings for <3 days and failure to wear the accelerometers at both time points. Issues with the use of accelerometers included: participants forgot to wear the accelerometers or they would remove them when in day centres or carers forgot to remind them to wear them.

Sedentary behaviour

Objective measurements collected from the accelerometers showed that participants lead sedentary lifestyles at baseline and at the end of the 12 months of the weight loss maintenance intervention. At the end of weight maintenance, intervention participants were spending a mean of 555.3 min/day (SD 139.6) in

Table 2 Weight (kg), WC (cm) and BMI (kg/m^2)[1] at baseline and 12 months and differences in outcome measures at 12 months

	Baseline[2]		12 months				
Outcome	Mean	SD	Mean	SD	Mean diff. (12 months – baseline)	SD	P‡
Change in weight (kg)	94.8	22.2	94.2	21.6	−0.6	5.5	0.5
Change in WC (cm)	113.2	14.5	112.8	15.6	−0.4	5.7	0.7
Change in BMI (kg/m^2)	38.2	7.6	38.1	7.9	−0.06	2.2	0.8

[1]Data as mean values and standard deviation, analysis set; n = 28 for BMI and weight, n = 27 for WC.
[2]End of Phase I.
‡Statistically significant difference between 12 months and baseline.

Table 3 Categories of weight changes[1] between baseline[2] and 12 months

Weight change	12 monthsn (%)	Mean weight (kg) change at 12 months	SD
Weight gain >3%	8 (29)	+5.4	2.2
Weight maintenance	14 (50)	−0.5	1.8
Weight loss >3%	6 (21)	−8.0	3.0

sedentary behaviour or a 80% (SD 6.8) of the time spent wearing the accelerometers.

There was no statistically significant decrease (P = 0.7) in the percentage of time spent in sedentary behaviour between baseline and 12 months, as shown in Table 4.

Light physical activity

At the end of the weight loss maintenance intervention, participants were spending 94.9 (SD 38.8) minutes per day in light physical activity, equal to 13% of the monitored time. There was no statistically significant increase in time spend in light physical activity (P = 0.09) (Table 4).

Moderate-to-vigorous physical activity

There was no statistically significant increase of time or percentage of time spent in moderate-to-vigorous physical activity at 12 months (P = 0.2). Participants were spending only 3% (SD 1.7) (21.8 min) of the recorded time in this type of physical activity (Table 4).

Walking

IPAQ data on walking were available for all participants (n = 28) at baseline and 12 months. According to Table 4, at 12 months, participants spent less days (mean days 4.5, SD 2.3) walking (at least 10 min per day) than at baseline (mean days 5.5, SD 2.1) (P < 0.05).

Discussion

A clinically significant weight loss and long-term weight loss maintenance can have a positive impact on the impaired health-related quality of life of adults with obesity (Blissmer *et al.* 2006; Karlsson *et al.* 2007). The TAKE 5 weight management intervention for adults with intellectual disability and obesity is a multicomponent intervention that included distinct weight loss phase and weight maintenance phases. According to the findings of this study, the majority of the participants maintained their weight loss for 12 months after the weight loss phase.

Weight maintenance

Few studies have examined weight maintenance in individuals with intellectual disability and methodological differences make the comparison to this study difficult (Spanos *et al.* 2013a,b). For example, Saunders *et al.* (2011) the only other multicomponent weight loss intervention in adults with intellectual disability that included a weight loss maintenance phase used different:

1. Duration of the weight maintenance interventions (6 months versus 12 months).
2. Type of initial weight loss intervention (1200 kcal/5024 kJ diet versus 600 kcal/2512 kJ energy deficit diet).
3. Intensity of the weight maintenance phase (monthly meetings with 24 hr dietary recalls versus monthly meetings with extensive behavioural and health education).

Table 4 Physical activity and walking[1] at baseline[2] and 12 months and physical activity and walking changes at 12 months

Outcome	Baseline[2]		12 months		Mean dif. (12 months – baseline)	SD	P‡
	Mean	SD	Mean	SD			
Time spent (min) in light-intensity physical activity/d	82.6	38.2	94.9	38.8	12.4	29.7	0.09
Time spent (min) in moderate-to-vigorous intensity physical activity/d	19.3	17.3	21.9	14.0	2.6	11.8	0.2
Time spent (min) in sedentary behaviour/d	576.5	145.9	555.3	139.6	−21.2	221.2	0.7
Percentage of time spent in light-intensity physical activity	12.6	6.2	12.7	4.5	0.03	4.8	0.9
Percentage of time spent in moderate-to-vigorous intensity physical activity	3.2	3.6	2.8	1.7	−0.4	2.9	0.6
Percentage of time spent in sedentary physical behaviour	84.2	8.7	79.8	6.8	−4.3	9.3	0.06
Number of days spend walking at least 10 minutes at a time in previous 7 days	5.5	2.2	4.5	2.3	−1.0	2.5	0.04
Time spent (min) walking in one of these days	60.3	55.0	75.5	65.5	15.2	72.4	0.3

[1]Data as mean values and standard deviations, analysis set for physical activity – accelerometer; $n = 18$ and analysis set for walking – IPAQ; $n = 28$.
[2]End of Phase I.
‡Statistically significant difference between 12 months and baseline.

Contrary to this study, Saunders *et al.* (2011) reported weight maintenance in reference to baseline and did not use a definition for weight maintenance, reporting results as a mean of weight loss and weight gain, with a total 9.4% weight loss of baseline.

Diet

The diet used for both phases of the TAKE weight management programme was based on the principles of a healthy balanced diet, recommending healthy portions of foods from all the food groups but avoiding significant changes that could challenge the routine and the compliance of an individual with intellectual disability (Emerson & Baines 2010; Wynne *et al.* 2005). A qualitative analysis of the TAKE 5 Phase I showed that the diet prescription and the pictorial tools used for education on healthy diet were embraced by the participants and their carers, assisting them to understand the principles of the healthy balanced diet (Spanos *et al.* 2013a,b).

The form of dietary advice offered to participants remained constant throughout the two phases of the study, weight loss and weight maintenance, although the quantities of food advocated to the individuals differed. This study did not attempt to assess the compliance of the participants to the dietary recommendations. Given the difficulties of assessing usual diet in adults with intellectual disability (Humphries *et al.* 2008) our only proxy for dietary compliance was body weight. The advice appeared to have been understood by both carers and participants, although the presence of weight loss and gain in a number of participants would indicated a less than optimal level of compliance.

Physical activity

Objective measurements of physical activity (accelerometers) showed that the TAKE 5 weight maintenance intervention did not have a significant effect on physical activity levels or sedentary behaviours. No participants in the current study met current physical activity recommendations (NICE 2006; SIGN 2010; Chief Medical Officer 2011) after the weight loss maintenance phase. These findings are surprising given the significant proportion of participants who maintained their weight. There was a significant amount of missing accelerometer data at 12 months which may have an influence on the results.

Our findings are novel, as no multicomponent or single component weight management intervention for adults with intellectual disability that provided a weight maintenance intervention has assessed the physical

activity levels of the participants (Fox *et al.* 1984, 1985; McCarran & Andrasik 1990; Saunders *et al.* 2011). In addition, in previous studies, the detail of information regarding advice on physical activity during the weight maintenance phase was scant and insufficient to allow replication of the advice. Only Fox *et al.* (1985) reported using reward systems to encourage changes in physical activity but similar to other studies did not assess the activity levels.

It possible that the TAKE 5 weight maintenance intervention was unable to overcome commonly reported barriers to physical activity and walking by people with intellectual disability and their carers including costs, participant's lack of knowledge of types of available physical activities and lack of understanding the benefits of physical activity (Hawkins & Look 2006; Mahy *et al.* 2010) and weather (Temple 2007). In a recent study by Caton *et al.* (2012), adults with intellectual disability reported joining walking clubs at day centres but the regularity doing the activity was uncertain and the lack of support from carers was identified as a barrier for the participants to go for a walk.

TAKE 5 aimed to improve the physical activity levels of the participants by providing advice on ways of overcoming potential barriers including advice to participate in suitable exercise programmes running at the day centres they attended and planning activities for their weekly routine. However, modifiable barriers to physical activity for people with intellectual disability such as lack of social support because of limitations in planning, transportation and staffing can be related to the lack of funding, policies and protocols of residential and day service programmes (Bodde & Seo 2009). These barriers can be difficult to be addressed just by a weight maintenance intervention and may require the substantial contribution of managers of care plans for a holistic restructure of the support of an individual with intellectual disability.

As increasing levels of physical activity are central to successful weight maintenance (NICE 2006; SIGN 2010), future studies of multicomponent weight management programmes for adults with intellectual disability should explore innovative ways to support participants to progressively increase levels of physical activity.

Limitations and strengths

The single stranded study was useful to determine the utility of this novel programme. Hence, no sample size calculation was undertaken, or control group recruited (Loveman *et al.* 2011), so the results in this study should be treated with a degree of caution. As with any study, a control group that did not receive an intervention could provide a robust evaluation of the weight maintenance phase (Stanley 2007). However, the TAKE 5 management programme was a feasibility study, first of its nature that would provide the evidence to justify a larger RCT (Melville *et al.* 2011). Cost-effectiveness, an important aspect to show the potentials of this intervention in real community or clinical settings (Loveman *et al.* 2011), could be examined in the context of an RCT, with a control group receiving 'care as usual' as defined by the local health services. It has to be noted that another RCT study has currently started exploring these research areas in intellectual disability in depth, potentially providing valid evidence on cost-effectiveness analysis and an estimation of the treatment effect on weight (Beeken *et al.* 2013).

Knowing the barriers that the participants with intellectual disability may have in answering IPAQ questions regarding time and frequency (Finlay & Lyons 2001), often paid carers were asked to assist the participant where appropriate. However, this may have allowed potential errors due to recall errors from the carers and the participants. It is possible that paid carers, who differ in the amount of time they spend with individuals over any week, may have underestimated or overestimated the walking frequency of the participants due to lack of information from other colleagues who supported the participants in the previous 7 days.

The health benefits of walking include primary and secondary prevention of cardiovascular disease (Murphy *et al.* 2007), in some cases modest weight loss (Richardson *et al.* 2008) and prevention of weight regain (Klem *et al.* 1997; Villanova *et al.* 2006; Nakade *et al.* 2012). However, the effects of walking on weight control depend on the total duration of the exercise and on the pace of walking (Votruba *et al.* 2000; Donnelly *et al.* 2009). The TAKE 5 promoted walking as a physical activity but did not collect any information regarding the pace of the walk, for example brisk walking or the distance achieved each day. Walking can be assessed with the use of pedometers but in adults that walk in a slow pace, measurements of steps can be inaccurate (Cyarto *et al.* 2004). This means that walking needs to be assessed with recent and potentially more valid methods such as a combination of physical activity diaries, accelerometers and global positioning systems (GPS) (Bassett 2012).

This study highlighted the importance of providing a service that is suitable to the cognitive and communication needs of people with intellectual disability. Therefore, the materials used in this study were designed based on recommendations on simplification of information using pictorial explanations. In addition, the researcher was trained in the use of augmentative communication (Murphy 2006) and used a photo-library specially developed for people with intellectual disability allowing the participants to express their feelings and show their knowledge. It would be valuable for the study if advocacy groups and service users or accessible information workers were approached at an early stage to evaluate the construction and layout of the materials used in the intervention (Ward & Townsley 2005). However, the technique used in the materials, and the technique of communication in the weight maintenance intervention was already tested and assessed during the 9 TAKE 5 weight loss intervention (Spanos *et al.* 2012).

There is lack of extensive information in this study on the participants' living arrangements and the impact these factors could have on weight maintenance. The environment that an individual lives in and the type of support provided to this person can play an important role in the prevalence and the treatment of obesity 10 (Emmerson *et al.* 2004; Rimmer & Yamaki 2006). For example, people with intellectual disability that live in family homes have a greater access to food availability than those who live in restrictive accommodations supported by paid carers (Geller & Crowley 2009). Bryan *et al.* (2000) assessed the nutritional vulnerability of people with intellectual disability in the community by measuring weight changes after 1 year of discharge from institutions. The level of overweight for males and females increased within 1 year by six per cent and five per cent, respectively.

In addition, people with intellectual disability are more likely to be obese when they live in settings where the service user has a tenancy, less sophisticated procedures are in place for the support of the resident and with less senior staff ratio (Robertson *et al.* 2000). It is suggested that families may facilitate psychological support for people with intellectual disability in weight management interventions better than paid carers (Geller & Crowley 2009). The small sample size could have affected the power of identifying any correlations between socio-clinical characteristics and weight maintenance. Underpowered studies with small samples cannot lead to real predictors of outcome (Van Voorhis & Morgan 2007; Stubbs *et al.* 2011).

Conclusion

The long-term effectiveness of a multicomponent weight management programme in adults without intellectual disability may rely on the holistic approach of the programme to promote changes to all crucial areas of weight management. These changes must be simple and acceptable by individuals to be sustainable. This structured multicomponent weight maintenance intervention provides first evidence on weight maintenance in adults with intellectual disability. Revisions to the physical activity component of the TAKE 5 weight management programme are required. Controlled studies re-examining the effectiveness of weight management programmes including weight loss and weight maintenance phases should be considered.

Acknowledgments

The present authors would like to thank the study participants and family and paid carers. The present authors would also like to thank the Glasgow and Clyde Weight Management Service. The research was funded by the Equally Well Programme, Adult Care and Support Division, Scottish Government.

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