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Effects on Physical Health of a Multicomponent Programme for Overweight and Obesity for Adults with Intellectual Disabilities

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Background Overweight and obesity are major health risk factors in people with intellectual disabilities. The aim of this study was to test the effectiveness of a multicomponent programme (physical activity, diet and motivation) for overweight and obesity in adults with intellectual disabilities.

Material and Methods A quasi-experimental design with repeated-measures and non-equivalent control group ($n = 33$, $n = 31$) was used. The programme was conducted over 17 weeks, with follow-up at 6 months in a sample of Spanish adults with a mild and moderate intellectual disability from a community occupational day centre, aged from 23 to 50, 40.6% of which were women.

Results A significant reduction in weight and diastolic blood pressure was obtained over time, and this reduction was maintained in the follow-up for weight. Reduction in heart rate was only marginally significant.

Conclusions The treatment was effective in reducing overweight and obesity, improving cardiovascular capacity and therefore the physical health of the participants.

Keywords: adults, intellectual disability, obesity reduction, physical health

Introduction

Obesity is currently a major health problem in developed societies: its prevalence is increasing worldwide and it is a high risk factor for non-communicable diseases (WHO 2012, 2014). These diseases include cardiovascular problems – mainly heart disease and stroke (Reddy & Katan 2004; Haslam & James 2005) – type 2 diabetes (Steyn *et al.* 2004; NICE 2012), hypertension (Clavijo 2009), musculoskeletal disorders, especially osteoarthritis (Gabay *et al.* 2009), and numerous cancers (Key *et al.* 2004; Pischon *et al.* 2008).

The WHO (1998) defines overweight and obesity as based on the body mass index (BMI). A person is overweight when their BMI is higher than 25 and less than 30 and obese when BMI is higher than or equal to 30, with varying degrees of obesity (I, II and III) according to the five-point increases in BMI. This index is not subject to the variables of age and gender in the adult population.

In people with intellectual disabilities and/or with developmental disabilities, the same problems related to health and obesity increase, constituting an evident health inequality (Emerson & Hatton 2014; Taggart & Cousins 2014). While certain syndromes involved in intellectual disabilities include obesity as a pathogenic feature (Prasher 1995; Allison *et al.* 1998; Myers *et al.* 2000; Rimmer *et al.* 2004; Melville *et al.* 2008), the acquisition and implementation of health promoting behaviours are hindered because the cognitive, social and behavioural practices that shape adapted behaviour such as self-control, goal setting, skills related to home health care, risk perception and executive planning are by definition (AAIDD 2010) significantly limited in people with intellectual disabilities. The use of some antipsychotic medications, lack of physical activity (PA) and lack of programmes and promotional and

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educational materials about healthy eating, or education and promotion aimed specifically at people with intellectual disabilities contribute to the high prevalence of obesity and overweight in this group (Van Schrojenstein Lantman-de-Valk 2005). However, other behaviours which are a risk to health such as consumption of tobacco and alcohol are lower than in the general population (McGuire *et al.* 2007). As adults with intellectual disabilities living in community settings age, behaviours such as the consumption of high fat foods and an inadequate intake of fruit and vegetables are likely to play a role in the development of obesity and high cardiovascular disease risk factors such as hypertension and diabetes, as well as the risks of cancer (Braunschweig *et al.* 2004; Draheim *et al.* 2007). Also, low income among the majority of the population with intellectual disabilities (Yamaki & Fujiura 2002) may limit access to healthier food options. Finally, some environmental barriers related to transport, financial constraints and lack of PA programmes in services that attend people with intellectual disabilities have a negative impact on PA time (Bodde & Seo 2009; systematic review) and thus sedentary behaviours increase (Foley & McCubbin 2009).

A review of recent literature about research conducted over the last few years in relation to overweight and obesity in people with intellectual disabilities reveals the following results. Overweight and obesity in people with intellectual disabilities are usually higher than in the general population and higher among women (Moore *et al.* 2004; Yamaki 2005; Rimmer & Yamaki 2006; Melville *et al.* 2008; De Winter *et al.* 2012b; Hsu *et al.* 2012; Beeken *et al.* 2013). Globally, about 30% of people with intellectual disabilities have overweight or obesity, with significant differences between regions (Emerson 2005; Moran *et al.* 2005; Rimmer & Wang 2005; Yamaki 2005; Rimmer & Yamaki 2006), among young people and women (Moore *et al.* 2004; Melville *et al.* 2008; Bégarie *et al.* 2013; Jankowicz-Szymanska *et al.* 2013; Mikulovic *et al.* 2014), and a significant deviation of weight and lack of exercise are risk health behaviours (Emerson 2005; Rimmer & Yamaki 2006; Melville *et al.* 2008; Wallace & Schluter 2008). There are also substantial differences between the results of the prevalence of obesity obtained by objective measurements – higher prevalence – and self-reported data – lower prevalence (Hill & Roberts 1998; Rimmer & Wang 2005). Moreover, people with intellectual disabilities with a high risk of cardiovascular disease (diabetes, hypertension, hyperlipidemia and metabolic syndrome) are women, elderly, obese, people living independently and those able to prepare meals independently (Hove 2004; Bhaumik *et al.* 2008; Richard & Stolzle 2011; De Winter *et al.* 2012a), and prevalence is already high among adolescents and increases with age (Stewart *et al.* 2009; Maïano 2011; Philips & Holland 2011). Even athletes with intellectual disabilities participating in Special Olympics exhibit high rates of overweight and obesity (Temple *et al.* 2014). In the search for the causes of overweight and obesity, the key seems to be the imbalance between energy intake and expenditure (Stroebe 2008).

An important concept regarding overweight and obesity in people with intellectual disabilities is the need for social support to change their lifestyles and improve their health (Scheepers *et al.* 2005). It is doubtful whether people with intellectual disabilities themselves can apply the components of behavioural interventions and develop effective PA to improve their health without the help of friends, family and carers (Mitchell *et al.* 2013). Even when these different people are involved in the treatment, positive changes are not always achieved (Bergström *et al.* 2013) or the changes achieved do not improve without social support (Pett *et al.* 2013). For this reason, some studies focus their attention on the barriers and difficulties that people who provide support come up against in promoting healthy lifestyles and their training needs (Melville *et al.* 2009; Spanos *et al.* 2013b). In this sense, parents and/or carers should be educated in areas such as nutrition, weight control exercise, postures, sleeping habits and stress management techniques (Rimmer 1999). On the other hand, a study of family involvement as part of the treatment shows that better results are obtained when there is family engagement, indicating the need to emphasize community support (Fox *et al.* 1985). Recently, some studies have shown positive results in adherence to PA and personal barriers are reduced when social support is provided by peers in community settings (Temple & Stanish 2011; Stanish & Temple 2012a,b).

Different types of treatment have been tested to reduce overweight or obesity in people with intellectual disabilities (Hamilton *et al.* 2007; Heller & Sorensen 2013; Spanos *et al.* 2013a; systematic review). Since the 1970s and 1980s, some of the most used treatments have been behavioural self-control strategies (e.g. self-monitoring of daily weight and food intake, increase of awareness, and positive reinforcement) to produce changes in eating and PA patterns (Fox 1972; Gumaer & Simon 1979; Rotatori *et al.* 1981, 1986). However, these strategies have often had only a limited effectiveness on weight reduction in children and adults with intellectual disabilities (Hamilton *et al.* 2007; McDermott *et al.* 2012; Spanos *et al.* 2013b). Nevertheless, it is important to mention a slight reduction in weight (2.3 kg) obtained by Mann *et al.* (2006) in 26% of the participants in a behavioural programme, where the key variable was increasing knowledge about diet and exercise, although in this study there was no follow-up after the intervention. The three main strategies used in the intervention for overweight and obesity are as follows: PA, nutrition and diet, and motivation or behaviour change (Spanos *et al.* 2013b).

Programmes to reduce overweight and obesity which include exercise interventions differ greatly in the PA to be implemented (resistance or strength training), the intensity and duration of effort, the characteristics of the diet, nutritional knowledge, family involvement, social support, etc. Weight reduction is not always significant (Bergström *et al.* 2013), although there are other physical improvements. Significant weight loss occurs when the programmes include aerobic PA several times a week (Rimmer & Kelly 1991; Pommering *et al.* 1994; Stanish 2004; Frey & Chow 2006; Calders *et al.* 2011; Stanish & Temple 2012b; Ordonez *et al.* 2013). Significant PA programmes (at least three times per week) produced an increase in cardiorespiratory fitness (Moss 2009). There is a positive relationship between functional balance, muscle strength, wellness and physical training (Carmeli *et al.* 2004), which supports the importance of physical training to improve locomotion results and perception of welfare in adults with intellectual disabilities. Lin *et al.* (2010) conclude that to maximize the positive effects of PA, it is necessary to use motivational techniques for participation in exercise programmes.

Nevertheless, there is little research regarding the long-term effects of programmes; scores demonstrate a return to baseline (Rotatori *et al.* 1986; Norvell & Ahern 1987), and the effects of weight loss usually disappear earlier in women (Yen *et al.* 2012).

A balanced diet is an essential element for the achievement and maintenance of normal weight (NAASO 2000; NICE 2006; SIGN 2010). However, several studies show that many adults with intellectual disabilities do not follow the criteria of a balanced diet (Robertson *et al.* 2000; Bertoli *et al.* 2006). Moreover, it has also been found that it is possible to achieve positive nutritional changes in adults with intellectual disabilities living in community homes and long-stay hospitals because they are controlled environments, and opportunities to choose what and when to eat are limited (Bertoli *et al.* 2006; De Winter *et al.* 2012b). Thus, the prevalence of obesity is affected by the type of housing, and in residential centres, prevalence of overweight and obesity is lower than in people who live in their own homes (Humphries *et al.* 2004; Emerson 2005; Stancliffe *et al.* 2011). However, some studies show the possibility of combining a suitable menu with the personal preferences of people with disabilities living in community homes (Humphries *et al.* 2009).

Given the moderate effects of some of the above programmes, an integrated programme of treatment could improve the results (Spanos *et al.* 2013b; Oviedo *et al.* 2014). A treatment programme, based on the principles for action contained in the global strategy of diet, PA and health (WHO 2004), was designed for that purpose. As PA and nutritional health have been shown as the main interventions to achieve weight reduction (Heller *et al.* 2011), the initiation or increase in PA and decreased caloric intake made up the bases of the intervention components. However, fearing that such components could make the treatment programme aversive (Allison *et al.* 1998) for many of the participants, motivation was included as a third component to encourage participation and retention in the programme. This component was implemented using a token economy system.

Objectives and hypotheses

This research aims mainly to assess the effects of a multicomponent intervention programme to reduce overweight and obesity in a group of adults with intellectual disabilities by improving participants' energy balance. In addition, a specific objective based on the motivational component was to achieve a dropout rate of less than 10%.

The following hypotheses were made:

H1) Adults with intellectual disabilities participating in the programme will achieve significant reductions in weight compared to the baseline measurements and to control measures, which after withdrawal of support will not be maintained at 6 months after completion of treatment.

H2) After the intervention programme, there will also be a significant decrease in resting heart rate and blood pressure, which after the withdrawal of support will not be maintained at 6 months after completion of treatment.

As can be seen, the theoretical framework reviewed and used in this study is the cognitive–behavioural paradigm.

Material and Methods

Design and procedure

The study was carried out using a quasi-experimental design with repeated-measures and a non-equivalent control group. A total of six specially trained instructors (a psychologist, a pedagogue and two special needs workshop teachers) plus the help of two PA technicians were responsible for implementing the programme. They were professional carers working in the centre and were known previously by the clients.

Participants and settings

Participants were clients from a community, occupational therapy day centre for people with intellectual disabilities, from a Mediterranean city in the south-east of Spain, belonging to a middle socio-economic status (SES). They were all adults with physical autonomy (i.e. with ability to move around and change position) to carry out basic day-to-day activities, related to movement and displacement. The centre is a public social service which is half-board, so the only intake clients are provided with is lunch, and it attends a total of 81 people with mild and moderate intellectual disabilities through occupational therapy, and cognitive–behavioural therapy. Recruitment was based on BMI and interest in participating in the study.

Inclusion criteria in the treatment programme were overweight or obese status according to WHO and willingness to participate. Exclusion criteria included: not having physical autonomy, that is, not having the ability to move, people with uncontrolled epilepsy and people with cerebral palsy without autonomy. From a potential sample of 81 people, 10 were excluded due to their having reduced mobility, and another five people were excluded because they did not want to participate. The group was therefore made up of 66 participants, 35 of them in the experimental group and the rest in the control group. After the second week of the intervention phase, the centre's technical team (consisting of a psychologist, a pedagogue and an occupational therapist) decided to exclude two people from the experimental group due to their lack of interest in doing PA (they did not wear appropriate clothes and annoyed the other participants while doing PA), and in practice were considered dropouts. Thus, the final group was made up of 64 participants.

Ethics

Either the participants (if they had legal capacity) or their carers signed an informed consent to participate in the programme. Staff explained the programme to participants, and later to their families. After receiving this information, they were given a week to decide whether they would participate or not. They were also allowed to leave the programme at any time. The study was approved by the centre's technical team, who is responsible for ethical issues.

Variables and instruments

Predictors considered for inclusion in the experimental/control group and level of PA, consisting of three levels: no exercise (people whose exercise is limited due to a medical prescription), light exercise (people capable of walking and moving around autonomously but not able to run more than 1 min) and intense exercise (people capable of running to intense running for at least 1 min).

The criterion variables used to assess the effects were as follows: for anthropometric measurement, weight (kg) and for physiological measures, heart rate (HR) (beats per minute at rest), systolic blood pressure (SBP) and diastolic blood pressure (DBP) (mmHg) measured with an OMRON RX-I device (OMRON Healthcare 2014). Weight was chosen instead of BMI due to its greater visibility when observing treatment results. Four time measures were taken: two pre-test measures (4 months before the beginning of treatment, looking for a similar period as the treatment length, and just before the beginning), post-test (at the end of treatment) and follow-up at 6 months.

Descriptive data for IQ were obtained by WAIS-III (Wechsler 1999) (the centre's psychologist administered the tests), and comorbidity was diagnosed by DSM-IV-TR (APA 2000).

Data analysis

Data were analysed by SPSS v.21 (IBM 2012), and the level of significance was set at 0.05. Three values were found to be missing, which were estimated using the Missing Data Analysis procedure of SPSS (IBM 2012).

Firstly, the dependent variables, taken from the four measurements over time, were transformed into change variables. That is, they became three values which reflected the change from a given value to the next timed measurement for: weight, beats per minute, systolic and diastolic blood pressure. For a better interpretation, positive values reflected a decrease in value of the variable, and negative values reflected increases in the values of these variables. The first value (pre-test) reflected the difference between pre-test two and pre-test one, the second value (post-test) reflected the difference between post-test and pre-test two, and the third value (follow-up) showed the difference between follow-up and post-test. These differences were not cumulative, so each value referred to the one that preceded it. Then, we used an observational comparative design with the group as a between factor (experimental and control) and measurements as a within repeated factor (pre-test, post-test and follow-up).

To compare the groups and the effect of treatment over time, two different data analysis approaches were used: the general linear model (GLM) and the new mixed linear model (MLM).

For the GLM analysis, a univariate GLM ANOVA with repeated measures was used. Sphericity was tested in all cases by means of Mauchly's *W*. If sphericity was violated, the Huynh–Feldt criterion was used to verify the significance of the tests. The Levene test for equality of error variances was used to show the equality of the variance–covariance matrices; results were not significant in all cases. Furthermore, effect size was evaluated using partial eta-squared coefficient (acceptable range between 0.10 and 0.25) and statistical power (acceptable values greater than 0.75) (Grissom & Kim 2012). The evolution of the variables and trends was examined by conducting multiple comparisons.

The MLM is a generalization of the GLM which permits fixed and random effects to be estimated independently, and homogeneity of variances and independence of observations permit different covariance structures to be dealt with (Heck *et al.* 2010). Therefore, this method models not only the means, but also the variances and covariances. Restricted maximum likelihood (REML) was used as the estimation method. Several possible covariance structures for random effects were analysed, and in each case, the most parsimonious structure was chosen. BIC (Schwarz 1978) and AIC (Akaike 1974) were used as fit indices for helping to select the best covariance structure, choosing the model with the lowest values from all the adjusted models. Also, pairwise comparisons were carried out by controlling the error rate by means of the Bonferroni likelihood adjustment method. Furthermore, marginal means were compared over time by the same adjustment process. Finally, models with the most parsimonious covariance structure were selected and the fixed effects of each resulting model were interpreted in the usual way.

The general linear model (GLM) approach involved repeated-measures ANOVA for the respective dependent variables (weight, HR, SBP and DBP changes).

Programme Development Phases

A flow chart diagram to describe programme phases is shown in Figure 1.

Preliminary phase (baseline)

This phase lasted 4 months (between autumn and winter), during which weight, blood pressure and HR

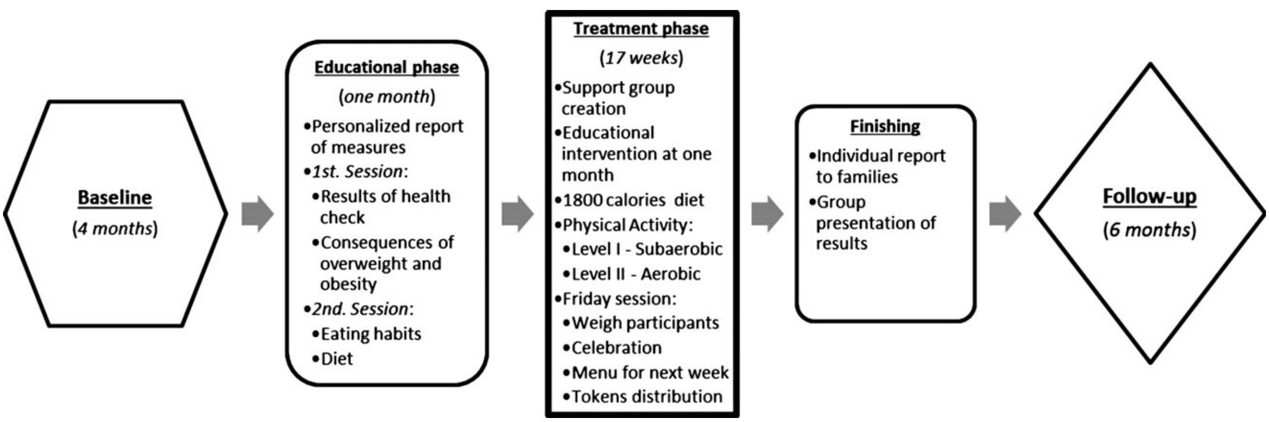

Figure 1 Programme development phases.

data were collected monthly from all participants. One month between measures was selected because that was the normal period for collecting measures from the clients to inform families routinely.

Intervention phase

This phase began in winter and finished in spring, with a month long educational phase which aimed to make families and clients aware of the importance of health and control care (the measurement of weight, HR and blood pressure), while obtaining the commitment of all the potential participants. So, after the last preliminary measurement, a personalized report was given to each family by the centre's technical team containing the series of data obtained and a recommendation, if any, to go to their family doctor and/or to join the treatment programme (e.g. obesity status according to WHO and risks associated). Participants in the experimental group and their families were seen twice before starting treatment. Both clients and families were present at meetings. In the first session, they were given the results of health checks and explained the consequences of obesity, overweight and morbidity. They were also told about the programme, given details about its development, duration and the commitment required from each party (occupational therapy centre, family and client), highlighting the motivational role of the family, especially in the preparation of the diet to be followed at home (breakfast, lunch and dinner). They also signed a contingency contract, to improve adherence to treatment. From the very first stages, the family was fully involved, because reports about health status of clients were routinely delivered throughout, and commitment to health programmes was high. The second session was devoted primarily to eating habits and the diet to be followed for the duration of the intervention (4 months). A nutritionist gave a talk on 'Guidelines for healthy eating' and they were given the diet for the first week along with the compliance record and any queries they had were answered. Once the intervention began, after a month, a third session was arranged to encourage them to comply with the diet and to make a provisional assessment of the first results of the programme.

The intervention phase was developed over a 17-week implementation period through the simultaneous execution of the three components that make up the programme:

a) *PA*: This component consisted of five sessions per week (Monday to Friday) for one continuous hour (in the morning and at a fixed time), making a total of 5 h a week, and supervised by the instructors at all times. Each working session consisted of warm-up, subaerobic or aerobic activity, strength and power training without auxiliary equipment and recovery. The PA was done at the centre's sport facilities and gym, and the activities were supervised in small groups with a 1 : 8 factor.

Participants were divided into two levels. Level I was made up of people who had difficulty in coordinating movements and making intense efforts and needed constant monitoring and encouragement from staff. They did a subaerobic activity, mainly *continuous movement* combined with other strength or power exercises. Level II included participants who had a high level of autonomy and good comprehension. They could do aerobic exercises, mainly running, with a higher intensity than Level I and required less supervision, which mainly consisted of showing them how to do the exercises and controlling the timing of each one.

The exercises and their intensity were reviewed every week to prevent participants from getting bored. This was especially the case for those in Level II, who improved their aerobic capacity quickly and so physical exertion was adapted correspondingly: they began with 5 min of continuous running and ended up running between 30 and 50 min per session, managing to participate in the races held in the local community. Although having fun was not an essential prerequisite, activities were designed to be recreational, as long as the participants were in constant motion and able to reach aerobic or subaerobic level. In the first sessions, HR was monitored with a HR monitor or pulse monitor and calculated using a stopwatch to detect possible cardiac complications and avoid working above aerobic levels.

b) *Food and calorie restriction (diet)*: This part of the programme was a very delicate matter because, unlike PA, it could not be controlled directly by the programme's technical team as the centre only provided lunch and, consequently, breakfast, afternoon snack and dinner would be provided for by the family at home. A nutritionist drew up a daily 1800 calorie diet (five intakes, balanced, low salt menu), based on the centre's baseline menu, which was maintained for the clients that did not participate in the programme. A weekly menu was given to families for breakfast, lunch, afternoon snack and dinner with several choices for each meal of the day.

c) *Motivation*. It was predicted that continuance in the programme would increase if external motivation was added to personal and family motivation (intrinsic). For this purpose, a token economy system was designed and a support group was set up. Through the token economy system, the intention was to reward weight loss and PA performance. The system was established as follows:

Green token. Participants obtained a green token every time they successfully completed the PA session, which was decided by the sports instructor responsible for each participant. The tokens were given out by another member of the team who also kept the tokens in a safe place. Each participant had an envelope where they could personally put the tokens they had won. In general, all participants received a token because they all did PA; when, in exceptional cases, they did not do it, they were not given a token. The green tokens were given out daily and immediately after the exercise session. It was usual for participants to receive five green tokens per week. When a participant had 10 green tokens, they had the right to exchange them for a prize which was chosen from among the various items exhibited and on sale in the centre. These are attractive, good quality products made in the centre's workshops and are usually a tempting gift. The exchange of green tokens for a reward was made once a month during the Friday session, when each participant would say which gift they wanted.

Blue token. During the Friday session, the blue token was given out to clients, whenever there was any weight loss or weight maintenance after a week of loss, but not when there were two consecutive weeks of weight maintenance. When participants had four blue tokens, they were rewarded with a special outing which they decided on among themselves during the same Friday session. Examples of these outings were as follows: having a PA session on the beach, a tour of the local football stadium and a talk on sports by professional athletes at our own centre. During the last month of the programme, several participants had reached normal weight and were also rewarded for maintaining weight as long as it was normal weight.

A support group was created which worked in the same way as self-help groups and took place during the Friday session. During these sessions, which lasted approximately 75 min, several tasks were carried out, and the whole experimental group participated. The first task was to weigh all participants, always barefoot and without heavy clothing, using the same scales in the same place and under the same conditions. Whenever someone was weighed, they were immediately handed a blue token if there was weight loss (or weight was maintained after a week of weight loss). Weight was announced openly to the group and applause was always given (or there was a celebration) when participants were successful. If they were not successful, they were encouraged to continue working to achieve their goals and were then given a card where they could note down their weekly weight, so they could check their results and/or show them at home. No crises or intense emotional reactions were registered by those clients who did not get the correspondent token. During this Friday session, participants were also informed about the changes that were going to be introduced into the programme, and the menu for the following week was given out. The number of tokens each participant had received was also announced and they exchanged the green tokens for gifts from the centre's exhibition, and the participants who had four blue tokens decided which reward (special outings) they would prefer. The group interacted as it if was a real support group. These day sessions were attended by all the staff involved in the programme; further support was given by cheering on and encouraging participants to achieve permanence in the programme and also to share in the satisfaction of achieving the objectives.

Finishing. When the programme finished and/or normal weight was achieved, an individual report was submitted to the families with the results and recommendations to follow. A group presentation of the results was also held, in order to encourage families and clients to continue with the programme on their own. Once clients reached their normal weight, they continued following the diet and doing PA in the centre, but were free to either follow or not follow the diet at home.

Results

Sample description

The experimental group was made up of 33 participants. Mean age of participants was 34 (SD = 5.71). Mean height was 1.59 m (SD = 0.12 m). The mean BMI of this group was 31.76 (obesity situation I). 15 participants were women (45.5%). Eight people had comorbidity with other mental disorders, mainly schizophrenia. The mean IQ was 53.21 with a SD of 10.61. The mean pre-test weight before the start of treatment was 79.28 kg (SD = 14.80), mean HR 72.70 (SD = 11.91), mean SBP 116.30 (SD = 13.30) and mean DBP 74 (SD = 13.80). All participants in the experimental group followed a diet, although three of them did not do physical exercise, 17 did light exercise, and 13 did intense exercise.

The control group was made up of people from the centre who had normal weight, were not interested in the programme, had serious mental or behavioural disorders or who would have suffered side effects from taking part in the programme. The control group was made up of 31 participants. Their mean age was 34.71 years with a SD of 5.84. Mean height was 1.60 m (SD = 0.12) and mean IQ was 56.94, with a SD of 9.42. Eight people had comorbidity with other mental disorders, mainly schizophrenia. Eleven participants were women (35.5%). The mean pre-test weight before the start of treatment was 64.71 kg (SD = 17.52), the mean HR was 75.30 (SD = 10.43), mean SBP was 118.90 (SD = 15.30), and mean DBP was 73.50 (SD = 10.80).

Therefore, 64 people made up the total sample, after subtracting the two participants who dropped out of the treatment programme (6.66% of the experimental group). Ages ranged from 23 to 50, 40.6% were women, and intellectual disabilities oscillated from 50 to 80 in service marks in the ICAP test (Bruininks *et al.* 1986; adapted by Montero 1996). Unlike previous studies, the total sample did not show any differences in BMI according to sex ($t(62) = -0.583$, $P = 0.562$, non-significant Levene's test).

Table 1 shows the descriptives for the changes between pairs in the dependent variables over time for the experimental group: positive values represent decreases in the values of the variable; negative values represent increases. In Table 2, the results of the GLM analysis are given. Figure 2 shows the changes for each of the dependent variables over time.

By comparing the three change values calculated, the results show that the treatment had a significant overall effect on weight over time. Post-test pairwise comparisons show that higher positive changes took place than in the pre-test (i.e. weight loss), and in the post-test, there were more changes than in the follow-up, where change (weight gain) was minimal. There were also significant differences in favour of the experimental group. The type of exercise was not significant, but interaction with other measures over time was significant (not ordinal), although marginally so, in which case we can point out that the differences that exist at different points in time are not the same for all types of exercise (see Figure 3); with a greater weight loss for those who performed intense exercise. A significant interaction was also found between time measures and the experimental/control group (not ordinal). The data therefore followed a quadratic trend. With respect to the BMI mean values of the experimental group, they went from a situation of type I obesity ($\bar{x} = 31.76$) to overweight ($\bar{x} = 28.54$), which was maintained at follow-up ($\bar{x} = 28.53$).

Only marginally significant overall differences were found for the HR change variable in relation to time, whether or not from the control group, and for the interaction between time and the experimental/control group (not ordinal). Type of exercise does not appear as an intervener. Data appear to follow a quadratic trend, which results in a positive change (decrease in HR) in the post-test and a negative change (increased HR) at follow-up. SBP changes show overall significant results during treatment. There are also differences which favour the experimental group. Data appear to follow a linear trend, and therefore, the SBP increases progressively over time, in contrast to what was expected.

DBP changes display only marginally significant overall results. In the experimental group, there are more changes in DBP than in the control group (marginally significant differences). A significant interaction between the effect of time and the experimental/control group (not ordinal) is also apparent. Data follow a quadratic trend, showing a positive change (lower DBP) in the post-test and a negative change (increase in DBP) at follow-up.

In all cases, interaction effects were also found, highlighting the impact of the therapy. The effect size and statistical power of the tests meet the established criteria for repeated measurements in weight changes and to all intents and purposes in SBP. In the other cases, these criteria would not be met.

Table 1 Descriptive statistics, mean and standard deviation [M (SD)] for the three scheduled measures of the dependent variables analysed for the experimental group

Variable (decrements)	*Pre-test*	*Post-test*	*Six-month follow-up*
Weight changes (kg)	−1.26 (1.56)	8.16 (4.23)	−0.11 (6.60)
HR changes (bpm)	3.30 (9.91)	4.36 (9.44)	−4.21 (9.46)
SBP changes (mmHg)	7.84 (10.42)	5.90 (17.96)	−11.27 (16.45)
DBP changes (mmHg)	3.75 (12.55)	5.42 (14.81)	−6.33 (12.24)

Table 2 Results obtained for the four dependent variables of the MLG study, including pairwise comparisons

Outcome variable (decreases)	*Variables*	*W*	*P*	*F*	*df*	*P*	η^2	*1-B*	*Post hoc*
Weight changes	Time	0.685	0.000	22.906	1.630, 97.796	0.000	0.276	1.000	2>1 2>3
	EG/CG			4.081	1, 60	0.048	0.064	0.511	1>2
	Type of exercise					n.s.			
	Time*EG/CG			5.074	1, 60	0.028	0.078	0.601	
	Time*Type of exercise			2.843	2, 60	0.066[1]	0.087	0.538	
HR changes	Time	0.969	0.380	2.966	2, 124	0.055[1]	0.046	0.568	
	EG/CG					0.093[1]	0.045	0.389	1>2
	Time*EG/CG					0.064[1]	0.043	0.543	
SBP changes	Time	0.914	0.065	7.358	2, 124	0.001	0.106	0.934	1>3 2>3[1]
	EG/CG			8.405	1, 62	0.005	0.119	0.814	1>2
	Time*EG/CG			3.348	2, 124	0.038	0.106	0.761	
DBP changes	Time	0.922	0.083	3.058	2, 124	0.051[1]	0.047	0.582	1>3
	EG/CG			3.369	1, 62	0.071[1]	0.052	0.439	1>2
	Time*EG/CG			5.264	2, 124	0.006	0.078	0.826	

W = Mauchly's *W*, *df* = degrees of freedom, η^2 = size effect, *1-B* = statistical power, post hoc = significance between post hoc mean differences, time: 1-pre-test, 2-post-test, 3-follow-up, EG/CG: 1-experimental group, 2-control group, type of exercise: 1-without exercise, 2-light, 3-intense.
[1]Marginally significant, n.s. = non-significant.

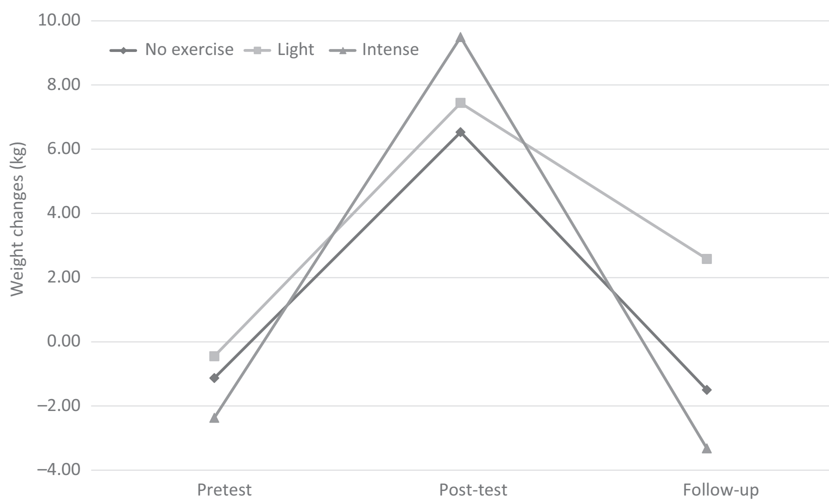

Figure 2 Weight changes, HR, SBP and DBP in the experimental group versus time. *Note*: The SBP and DBP values were divided by 10 to fit them into the figure.

Changes observed in the analysis of repeated measures: mixed linear model (MLM)

The results (see Table 3) do not contradict the previous results, but on seeing the structure of the data in detail provide more complete information.

Different covariance structures were tested for the weight change variable, and a diagonal covariance structure was finally selected. The estimated marginal means for the effect of time makes it possible to detect that greater positive changes occurred in the post-test than in the pre-test, and in the post-test, there were more positive changes than in the follow-up. There are also differences in favour of the experimental group, as well as interactions between the experimental/control group and time (not ordinal).

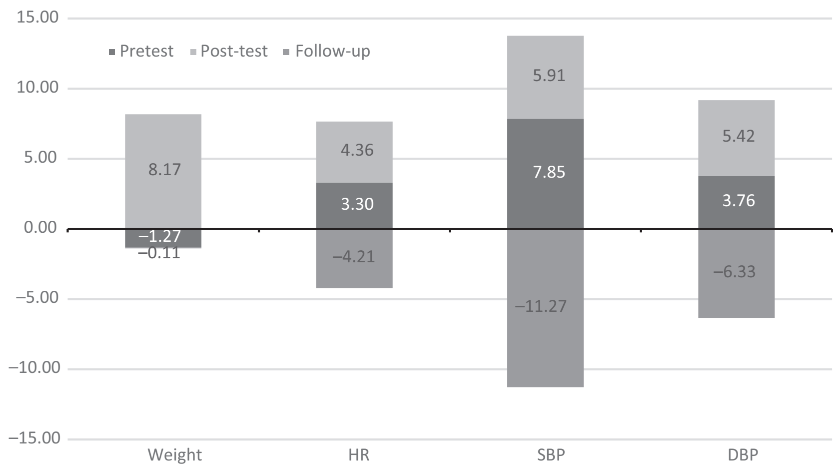

Figure 3 Interaction between the different measures over time and type of exercise in relation to the weight change variable.

Table 3 Results obtained for the four dependent variables of MLM study, including pairwise comparisons

Outcome variable (decrements)	*Fixed effects*	*Selected covariance structure*	*df*	*F*	*P*	*Post hoc*
Weight changes	Time	Diagonal	2, 116.844	40.640	0.000	2>1 2>3
	EG/CG		1, 158.004	12.776	0.000	1>2
	Time*EG/CG		1, 116.844	26.942	0.000	
HR changes	Time	Heterogeneous first-order autoregressive -ARH(1)-			n.s.	
	EG/CG		1, 82.859	7.663	0.007	1>2
SBP changes	Time	Compound symmetry	2, 124	7,358	0.001	1>3 2>3
	EG/CG		1, 62	8.405	0.005	1>2
	Time*EG/CG		2, 124	3.348	0.038	
DBP changes	Time	Autoregressive-moving-average	2, 121.836	3.793	0.025	1>3
	EG/CG		1, 60.396	3.245	0.077[1]	1>2
	Time*EG/CG		2, 121.836	4.916	0.009	

df = degrees of freedom; Post hoc = significant mean differences; time: 1-pre-test, 2-post-test, 3-follow-up; EG/CG: 1-experimental group, 2-control group.
[1]Marginally significant; n.s. = non-significant.

Global effects were not significant for the HR change variable (heterogeneous first-order autoregressive covariance structure – ARH (1) -). However, differences favouring the experimental group do appear. The effects of interaction were not significant, so the model was simplified to improve its interpretation, eliminating this effect of the analysis.

For the SBP change variable, results are exactly same as for the GLM, as the adjusted matrix (compound symmetry) is the same as the default that follows the GLM.

The DBP change variable followed an autoregressive-moving-average covariance structure. Significant global effects occur over time, highlighting differences between the pre-test and the follow-up in pairwise comparison. The experimental group shows marginally significant differences in their favour. The interaction between temporal measures and the experimental/control is also significant (not ordinal).

On comparing both analyses, some differences in the results can be seen. For the dependent weight change variable, GLM manages to include the interaction between time and type of exercise, but with only marginal significance. Nevertheless, the rest of the analysis parameters are better for the MLM. For HR changes, the GLM results are only marginal, while with the MLM significance in the predictor is obtained. As it is a compound symmetry matrix, the results for SBP changes are the same. For DBP change, changes are more obvious in the MLM, and predictors of both methods show marginal significance. Pairwise comparisons provide practically the same results. In general, we can conclude that the results are better in the MLM because it is able to find a covariance matrix that fits the data and increase statistical power.

Discussion

Overweight and obesity are major health problems for people with intellectual disabilities because of the health risks involved. The aim of this study was to evaluate the effectiveness of a multicomponent programme for overweight and obesity in people with intellectual disabilities in order to achieve weight loss and improve cardiovascular capacity and in turn reduce the risks which especially affect these people. The results have been satisfactory: all participants lost significant weight, and 6 months later, the weight loss was still maintained, although there was an increase in the HR, SBP and DBP levels achieved after treatment.

The data justify the claim that the programme design and the conditions it is carried out in are effective. Previous studies (Carmeli *et al.* 2004; Stanish 2004; Mann *et al.* 2006; Ordonez & Rosety 2006) focused on the same goals but used only some of the components. In contrast, the multicomponent programme has proved to be valid from the point of view of weight reduction, which is probably due to the combination of PA, diet and motivation. Furthermore, the secondary objective has also been achieved, as the dropout rate (6.66%) was lower than the expected 10%, which indicates that the motivational component of the programme, which achieved excellent adhesion, has therefore worked well (i.e. having fun in PA was important for continuing in the activity, and not dropping out). Other studies have reflected higher dropout rates especially in those with a lack of social support (see Spanos *et al.* 2013b).

In the light of the overall results, hypothesis one (significant weight reduction due to treatment) has been confirmed. The programme achieved the expected result: participants achieved a substantial reduction in weight, and the generalization of results was maintained at 6 months of treatment, which was unexpected because a regression to baseline values due to the withdrawal of support in that period was found in most studies (Moran *et al.* 2005). This may be related to the commitment and collaboration of families and their natural support (Scheepers *et al.* 2005; Melville *et al.* 2009; Stanish and Temple 2012a,b; Mitchell *et al.* 2013; Spanos *et al.* 2013b) obtained throughout the programme and, specifically, in the completion phase when there was a group announcement of results, and clients and their families were encouraged to continue with the programme (diet and exercise) alone. Also, during the follow-up period, they were informally encouraged by the staff to continue with diet and exercise. This probably meant that motivation to stay in the programme once it finished was casually/implicitly maintained (Lin *et al.* 2010).

Moreover, participants who did intense exercise lost more weight. This result, however, is not conclusive, given that during follow-up, they also regained more weight than the group that did light activity. This phenomenon could have a twofold explanation: firstly, it could be because the group which did intense PA/aerobic did not continue doing PA with the same intensity during the follow-up period and, consequently, decreased energy expenditure; or secondly, it could be related to lower dietary compliance, as high-functioning people with intellectual disabilities – as in the case of this group of people who did intense PA – are better able to manage and determine their own lives. This usually coincides with greater social participation and the possibility of choosing what they want to eat and preparing their own food, which leads to a higher energy intake (De Winter *et al.* 2012a,b). In contrast, people who performed light PA, as they have greater limitations, are less self-determined and more dependent on their carers and families to follow health requirements and compliance with the diet.

Hypothesis two (significant reduction in HR, SBP and DBP) was largely confirmed, although the results are less conclusive for HR changes, which probably decreased due to the combination of improved cardiopulmonary capacity and reduced weight. There were also important variations in systolic and diastolic blood pressure. In the case of systolic blood pressure, however, it was contrary to what was expected, probably due to the large variation this measure experiences daily and seasonally (Armario & Hernández-del-Rey 2002) and which affects different measurement times. The results are interpretable because diets which are low in fat and salt, as well as weight loss and exercise, produce a fall in blood pressure levels, which are reflected in the study. These side effects of the programme which are so beneficial to health are particularly noteworthy.

Finally, it can be concluded that the use of the MLM benefits the interpretation of results, because it gives a much more accurate fit to the data, whereas the GLM results are more diffuse (Ato & Vallejo 2007).

Limitations of the study

This programme is the sum and interaction of various components or subprograms (PA, caloric restriction and motivation). Future studies could be designed to evaluate the individual effect of each component in the final result through a breakdown of the treatment's active components. The study therefore has not been able to determine which component (PA or diet) is the first to be abandoned with the withdrawal of support that occurs at the end of the intervention phase and how the motivational component interacts with the other two in relation to this supposed abandonment. Moreover, in future studies, given the high circadian variability of blood pressure, during data collection, several series of measurements should be carried out to minimize this variability and improve comparisons. Another limitation is that because of the present design of the study, it is not possible for it to be implemented only at home.

Future prospects

In the future, these results should also be monitored beyond the 6-month follow-up, namely the permanence of weight loss over time. Considering that this is a major challenge for any individual, for people with intellectual disabilities, it is even harder because they need more natural and institutional support to function better, to compensate for their limitations in activities and to counteract their restrictions when participating. As soon as these supports are removed – and as a planned institutional support, it is necessary to consider this programme to reduce obesity and overweight – there is likely to be a return towards the baseline. It would be ideal if the services and institutions that serve people with intellectual disabilities included health promotion, disease prevention and general behavioural education in their programmes, which would promote healthy lifestyles. Changing the environment people with intellectual disabilities live in and providing them with the opportunity to do PA are ways to encourage clients to be active during the day. As Temple *et al.* (2006) point out, future research in this field should aim at increasing the inclusion of representative samples, which include controls for comparison groups, validate PA questionnaires and determine the accuracy of the data provided by the respondents, including the tutors. The paradox of the right to self-determination of people with intellectual disabilities who live independently, which usually brings with it a decrease in health outcomes (Rimmer *et al.* 1992; Frey & Rimmer 1995; Draheim 2006; Rimmer & Yamaki 2006), should also be taken into account when assessing and balancing these two rights (self-determination and health).

Conclusions

The results support the idea that the multicomponent programme used for the reduction of obesity, based on PA, diet and motivation has been effective in reducing overweight and obesity, and in improving the cardiopulmonary capacity of a group of people with intellectual disabilities from a non-residential institution.

This study, compared to the other studies mentioned that include either only diet or exercise, or both components, presents more visible results. However, it is important to mention that a non-equivalent control group is used to compare these results.

Conflict of interest

No conflict of interests to declare.

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