European Journal of Pediatrics (2018) 177:1121–1130
https://doi.org/10.1007/s00431-018-3158-2

ORIGINAL ARTICLE

Anthropometric outcomes of a motivational interviewing school-based randomized trial involving adolescents with overweight

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Received: 19 October 2017 / Revised: 15 April 2018 / Accepted: 20 April 2018 / Published online: 15 May 2018

Abstract

Motivational interviewing (MI) is an effective method to promote weight loss that can be delivered by non-mental health providers. The aim of this study was to evaluate whether MI was superior to conventional counseling to improve the anthropometric outcomes of adolescents with obesity/overweight. It was a controlled cluster randomized trial with parallel design in a school setting. The study included two groups: Motivational Interviewing Group (MIG) and control group (Conventional Intervention Group, CIG). Students participated in three face-to-face 30-min interviews, 3 months apart. Outcomes were BMI z-score, abdominal circumference, percentages of fat mass and muscle mass, and blood pressure. Sessions were coded with the Motivational Interviewing Treatment Integrity (MITI) manual. Mixed repeated-measures ANOVAs were used to assess the group versus time interaction. Effect sizes were calculated for each ANOVA with eta-squared measures (η^2). Eighty-three adolescents finished the protocol. While MIG participants showed a significant improvement in all anthropometric scores at 6 months, CIG participants showed an unfavorable change in those variables.

Conclusion: Our results provide additional evidence of the short-term usefulness of a school-based MI intervention on anthropometric outcomes of adolescents with obesity/overweight, demonstrating that pediatricians can play an important role in the prevention and management of pediatric obesity.

Trial registration: The study is called IMAGINE and is registered in Clinicaltrials.gov with the number NCT02745795.

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What is Known:
• *Although MI has been recognized as an effective counseling style for behavioral change in weight loss, there are few reports about the anthropometric outcomes of interventions with adolescents being treated for obesity/overweight.*
• *Our study showed significant positive changes in anthropometric variables (BMI z-score, abdominal circumference, percentage of fat mass, percentage of muscular mass, systolic and diastolic blood pressure) after only three face-to-face sessions over 6 months.*

What is New:
• *MI delivered by non-mental health providers in a school setting seems to have short-term usefulness in a program aiming the treatment of obese/overweight adolescents.*

Keywords Pediatric obesity · School health services · Motivational interviewing · Body mass index · Body composition · Blood pressure

Abbreviations

BMI	Body mass index
CIG	Conventional Intervention Group
MI	Motivational interviewing
MIG	Motivational Interviewing Group
MITI	Motivational Interviewing Treatment Integrity
PE	Physical education
SD	Standard deviation
WHO	World Health Organization

Introduction

Pediatric obesity is a public health concern worldwide. It is crucial to find the right strategies to manage pediatric patients with obesity [9]. Obese/overweight children and adolescents have an increased risk of becoming obese adults; are likely to develop a wide range of comorbidities, such as type-2 diabetes *mellitus*, hypertension, and coronary heart disease; and are at a higher risk of premature death [32]. In the last decades, there was an increase in the abdominal obesity, with the tendency to a greater increase of central obesity than the overall one, implying a more pronounced impact on metabolic complications [37]. It is estimated that this generation will probably be the first in the history of mankind to live shorter than their parents [21].

The American Academy of Pediatrics recommends motivational interviewing (MI) as an effective method to promote behavior changes related to weight loss that can be delivered by non-mental health providers [7].

Previous research has suggested that MI can be integrated into daily school practice along with other counseling strategies [12]. MI offers the advantage of personalizing school interventions. Instead of treating all the students as a homogeneous group, MI supports behavior change by a person-centered approach based on the individual's current behavior and perceptions related to it, including personal motivation to change [24].

Nevertheless, few of the studies which have examined the use of MI in the management of adolescent obesity reported anthropometric outcomes. Although there are some studies which show a positive effect of MI on weight loss [4, 16, 19], in others, MI has not resulted in body mass index (BMI) decrease compared to control group interventions [20, 41].

The school setting may be worth while exploring to address obesity in adolescents, because it provides increased access to a population traditionally difficult to reach, and also because the potential benefit from the peer group interaction [12].

The objective of this study was to evaluate the effect of a MI intervention compared to conventional counseling over the anthropometric outcomes of adolescents with obesity/overweight. We hypothesized that MI was superior to conventional counseling on the improvement of those outcomes.

Materials and methods

Sampling

This study was a randomized controlled trial with cluster blocked randomization. Assuming an effect size of d =.78 [18], a power of 80% and an alpha level of .05, a minimum sample size of 22 participants per condition was calculated. Expecting a response rate of 25% and an attrition rate of 75%, in the range of values observed in other similar studies [35], 800 participants were randomly selected. The study took place in eight high schools randomly selected in the area of Great Lisbon (Portugal) and randomly allocated to one of the arms of the study (intervention or control) with a 1:1 ratio. The allocation sequences were generated by a computerized number generator. The sample was chosen using a cluster blocked randomization in which the cluster unit was the school. The block size was fixed, with 100 participants randomly selected and invited to participate at each school, allowing stratification of the sample by the schools. To select the sample, all the students of those schools were weighted and their height was measured. Measurements were made by the physical education (PE) teachers of the students. Before the measurements, the research team met with the PE teachers to uniformize the measurement methods, and a random sample of 80 out of the 800 students was evaluated for reliability. Measures of weight and height were highly reliable with 1-week test-retest (Cronbach's alpha > .98 for all measures). The research coordinator wrote one invitation letter to the participant and another one to his/her caregiver, explaining the intervention and the study's scope. Invitation letters were delivered to the students by their teachers. Allocation was blinded both from the participant's and data collectors side, but not from the interviewer, due to the nature of the study. Inclusion criteria were the presence of both of the following: (1) age between 14 and 19 years old and (2) overweight according to WHO BMI SDs criteria [29]. Exclusion criteria were the presence of one or more of the following: (1) recent weight loss of 10% or more of body weight, (2) pregnancy, (3) breastfeeding, (4) endocrine disease, (5) current therapy with antidepressant or hypoglycaemic drugs, (6) current treatment for eating disorders or depression, and (7) cognitive impairment (either the student's or the tutor's). At each school, 100 students among those who met the inclusion criteria were randomly chosen and invited to participate. Those who accepted were assigned into two groups: (1) a MI intervention (Motivational Interviewing Group, MIG) and (2) a conventional intervention (Conventional Intervention Group, CIG), according to the school to which they belonged.

Measurements

The primary outcome was body mass index z-score. Secondary outcomes were abdominal circumference, percentage of fat mass, percentage of muscle mass, systolic blood pressure, and diastolic blood pressure.

Weight, percent fat mass, and percent muscular mass were obtained by the mean of three evaluations in the Omron Body Composition Monitor with Scale BF 11® (Omron®, Kyoto, Japan) with the adolescent in light clothing and without shoes. The adolescents were asked to stand on the center of the scale, without support and with their weight distributed evenly on both feet. Weight was measured in kilograms (kg) to the nearest 0.1 kg. Percentages of fat mass and muscular mass were measured with an accuracy of 3.5% for both measurements. Adolescents were asked to avoid vigorous exercise or taking a bath immediately before the measurements, or taking alcohol or a large amount of water in the two previous hours because the estimates of total body water depend on the hydration of fat-free mass, which varies according to the pediatric age [15]. Height was obtained by the mean of three measurements in the staturometer Seca® 213 Portable Stadiometer Height-Rod® (Seca@, Hamburg, Germany). Height was measured in meters (m), with approximation to the nearest centesimal, with the adolescent standing upright in the Frankfurt plan, with bare feet, back in contact with the stadiometer. The BMI was computed by the Quetelet formula [BMI (kg/m^2) = weight (kg)/height^2 (m^2)]. Overweight and obesity were diagnosed when BMI was equal or over + 1SD and + 2SD, respectively, according to WHO guidelines [29]. Abdominal circumference was measured with an inextensible and undeformable tape 1 cm wide Seca 203 Circumference Measuring Tape® (Seca@, Hamburg, Germany). The measurements were made directly over the skin, with the adolescents standing up, with their feet together and the upper limbs relaxed and lying freely. The tape was put in a perpendicular plane to the vertical axis of the body and parallel to the floor, around the abdomen, at the level of the superior iliac crests, at the end of a normal expiration. Blood pressure was measured with an aneroid sphygmomanometer (Riester®, Jungingen, Germany) three times after a 30-min rest, in the right arm according international guidelines [22]. Measures were done at baseline (immediately before the start of the intervention), 3 and 6 months. The anthropometric measures used for purposes of eligibility were not used as baseline measures.

Socioeconomic status was evaluated according to the Graffar Classification [17].

Intervention

The study had a parallel design, with only the counseling style changing between the two groups. Both groups received three 30′ individual and confidential face-to-face lifestyle counseling sessions, 3 months apart. All the sessions were audiotaped and coded according to the Motivational Interviewing Treatment Integrity (MITI) manual [25] version 3.1.1. The MITI has two components: the global scores and the behavior counts. A global score requires the coder to assign a single number from a five-point scale to characterize the entire interaction. Five global dimensions are rated: Evocation, Collaboration, Autonomy/Support, Direction, and Empathy. A behavior count requires the coder to tally instances of particular interviewer behaviors. Both the global scores and behavior counts were assessed within a single review of the tape, using a random 20-min segment. The sessions occurred always in a place with privacy, mostly at the school health room. Interrater reliability for the MITI was assessed, using two independent coders. The interviewer of the MIG was a pediatrician who had formation in MI with two Motivational Interviewing Network of Trainers (MINT) members. MIG participants received a counseling intervention based on the MI principles described by Miller and Rollnick [24]. In MIG, the intervention was focused on three main components: collaboration, evocation, and autonomy. The interviewer employed four basic strategies to help the participant resolve ambivalence toward change. These included asking open-ended questions, reflective listening, affirming, and summarizing. The CIG intervention, delivered by a school nurse and a resident in pediatrics, included a conventional counseling style, characterized by being more directive, providing information, instruction, and advice without seeking for the agreement or collaboration of the participant. In both groups, specific and individualized dietetic counseling took place by registered dietitians with experience in adolescent care. The dietitians prescribed a diet targeting weight loss, adapted to the age and gender of the participant, according to the Dietary Guidelines for Americans 2015–2020 [10]. A physical exercise plan was also proposed by a PE teacher of the participant's school, including 60 daily minutes of moderate to vigorous activity according to the American Heart Association guidelines [30]. The plan was individualized according to the preferences of the participant, as personalization of the plan seems to be important to increase efficacy of the intervention [39]. The exercise sessions were supervised by the PE teachers, when exercise was done at school, or by monitors, when sessions occurred at the exercise infrastructures from the municipalities (e.g., pools or stadiums). The allocation was blinded to the participants and to the PE teachers who made the anthropometric measures and collected the questionnaires, but not to the interviewers, the dietitian, and the physical activity counselors, in order to provide dietetic and exercise counseling in the same framework as the individual sessions. The study took place between September 2015 and May 2016.

Statistical analysis

Sample characteristics were described using frequencies (percentages) for categorical variables and means and SDs for continuous variables. Differences in the distribution of sociodemographic characteristics between the groups (MIG versus CIG) were compared using the χ^2 test for categorical variables and the unpaired t test or Mann-Whitney U test for continuous variables. Normality of distributions and homogeneity of variances were evaluated with Kolmogorov-Smirnov test with Lilliefors correction and with Levene test, respectively. Once a possible confounding variable was identified, it entered into the analysis as a covariate. A mixed repeated-measures ANOVAs analysis was conducted to assess the group (MIG or CIG) versus time interaction (0, 3, and 6 months). Effect sizes were calculated for each ANOVA with eta-squared measures (η^2). For each significant interaction of treatment and time, individual variables were compared by a paired t test for normally distributed variables and a with Wilcoxon signed-rank test for non-normal variables. Bonferroni correction was used after the univariate tests. To compare pre- with post-intervention differences within groups, a paired samples t test was used while crude differences between groups were analyzed with an independent samples t test. Values of $p < .05$ were considered statistically significant. Data was analyzed using SPSS® software (version 20.0) (SPSS® Inc. Chicago, IL).

Results

The sample comprised 97 students [70 girls (72.2%), 27 boys (27.8%)], as shown in Fig. 1. Approximately 12.1% of the 800 invited students accepted to participate in the program. Respondents did not differ significantly from non-respondents regarding age, sex, and BMI z-score (see Table 1). Eighty-three participants completed the study protocol (corresponding to 82% of the girls and 93% of the boys). Dropouts were not significantly different from completers on any of the demographic or clinical variables at baseline. Moreover, baseline characteristics (age, sex, socioeconomic *status* average score) did not differ significantly between the two groups except for BMI z-score (MIG 1.54 ± .48; CIG 1.83 ± .28; p = .001) and abdominal circumference (MIG 92.65 ± 11.05; CIG 99.57 ± 11.45; p = .006), which were lower in the MIG (see Table 2). Therefore, these variables entered as covariates in the final analysis.

Intervention coding summary of proficiency ratings according to MITI (the average of coding scores of the three intervention sessions), were statistically different between the two groups: global rating (MIG 4.66 ± .31; CIG 3.22 ± .68; $p < .001$), percentage of MI adherent behaviors (MIG 97.0 ± 3.4; CIG 59.8 ± 16.3; $p < .001$), percentage of open questions (MIG 78.9 ± 9.6; CIG 34.2 ± 10.8; $p < .001$), and percentage of complex reflections (MIG 79.7 ± 6.9; CIG 42.7 ± 14.9; $p < .001$). Global rating was calculated by the formula (evoking + collaboration + autonomy)/3 [25].

The time versus group evolution of BMI z-score [$F(2,160) = 7.739$, $p = .001$, $\eta^2 = .09$], abdominal circumference [$F(2,160) = 29.716$, $p < .001$, $\eta^2 = .271$], percentage of fat mass [$F(2,162) = 22.041$, $p < .001$, $\eta^2 = .214$], percentage of muscle mass [$F(2,162) = 18.484$, $p < .001$, $\eta^2 = .186$], systolic blood pressure [$F(2,162) = 27.127$, $p < .001$, $\eta^2 = .251$], and diastolic blood pressure [$F(2,162) = 20.202$, $p < .001$, $\eta^2 = .200$] depended on the type of intervention.

MIG participants showed a significant decrease of the BMI z-score both at 3 and 6 months [MIG: $\chi^2_F(2) = 22.975$, $p < .001$, $n = 42$]. The BMI z-score in the CIG decreased non-significantly between baseline and 3 months and increased significantly between 3 and 6 months [CIG: $\chi^2_F(2) = 15.019$, $p = .001$, $n = 41$] [see Fig. 2a].

The intervention effect on abdominal circumference between baseline and 6 months was significant in both groups [CIG: $\chi^2_F(2) = 18.417$, $p <= .001$, $n = 41$; MIG: $\chi^2_F(2) = 37.819$, $p < .001$, $n = 42$]. As it is shown in Fig. 2b, CIG participants showed an increase in the abdominal circumference over time, and the increase was significant between 3 and 6 months. MIG participants showed a significant decrease of abdominal circumference in both revaluation moments (3 and 6 months).

Relative to percent of fat mass, the effect of the intervention between baseline and follow-up was significant in both groups [CIG: $\chi^2_F(2) = 17.494$, $p < .001$, $n = 41$; MIG: $\chi^2_F(2) = 37.928$, $p < .001$, $n = 42$]. CIG participants showed a significant increase between intermediate and final moments while MIG participants had a significant decrease in both revaluation moments [see Fig. 2c]. The effect of the intervention on percentage of muscle mass between baseline and 6 months was significant in both groups [CIG: $\chi^2_F(2) = 12.758$, $p = .002$, $n = 41$; MIG: $\chi^2_F(2) = 30.147$, $p < .001$, $n = 42$].

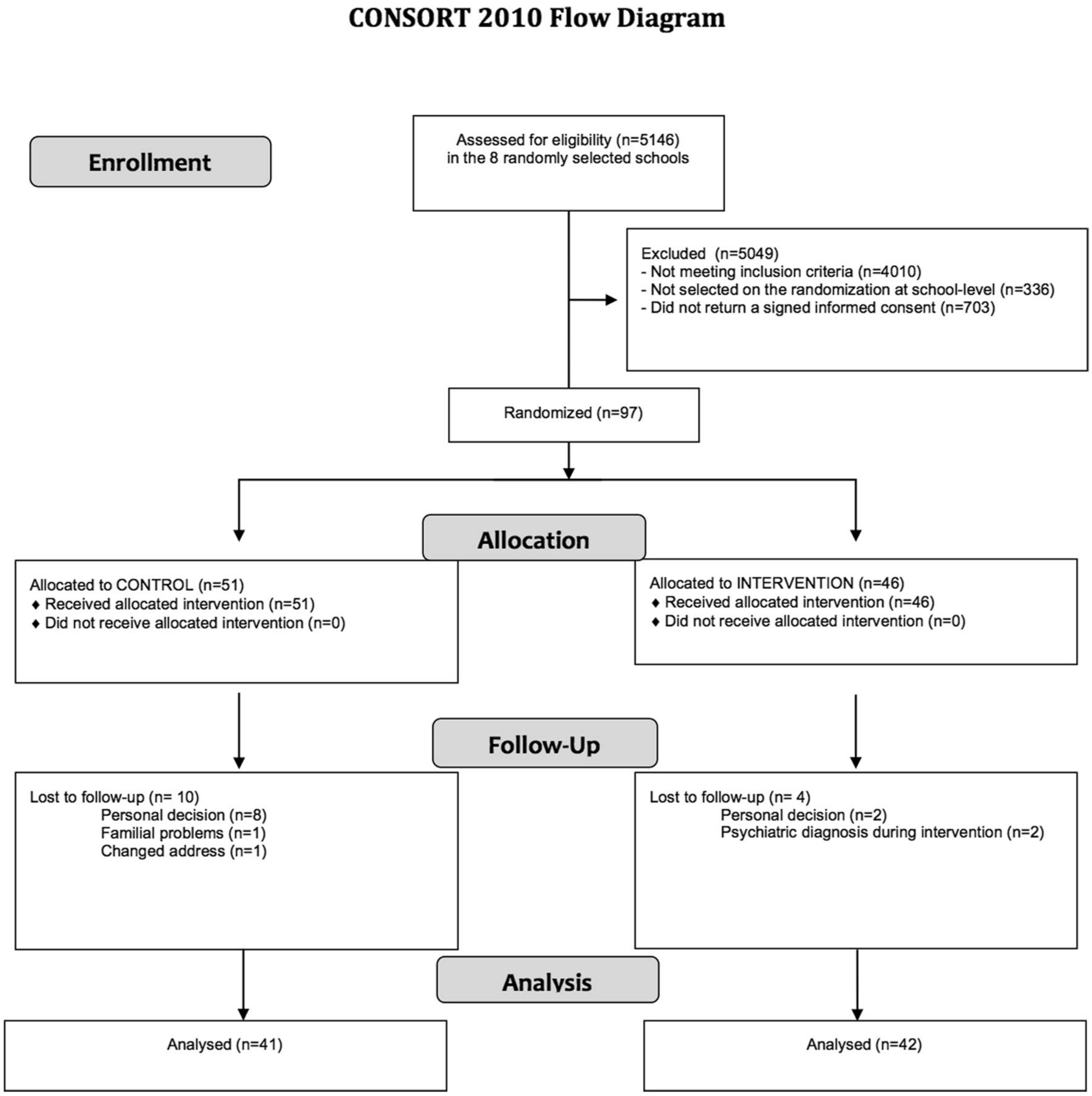

Fig. 1 Study flowchart

Figure 2d shows that while in CIG the percentage of muscle mass decreased significantly between 3 and 6 months, in MIG, there was a significant increase in both revaluation moments.

Systolic [CIG: $\chi^2_F(2) = 39.767$, $p < .001$, $n = 41$; MIG: $\chi^2_F(2) = 39.769$, $p < .001$, $n = 42$] and diastolic [CIG: $\chi^2_F(2) = 10.571$, $p = .005$, $n = 41$; MIG: $\chi^2_F(2) = 28.373$, $p < .001$, $n = 42$] blood pressures showed a significant effect of the intervention between baseline and 6 months in both groups. Figure 2e, f shows that CIG participants had a non-significant decrease in systolic and diastolic blood pressures between baseline and 3 months and a significant increase between 3 and 6 months, while MIG participants had a decrease in blood pressure in both revaluation moments and that decrease was significant between 3 and 6 months.

Table 1 Respondents and non-respondents age, sex and BMI z-score

	Respondents ($n = 97$)	Non-respondents ($n = 703$)	p value
Age in years (mean ± SD)	15.96 ± 1.30	15.58 ± 1.53	.089
Sex (% male)	30.1	28.2	.863
BMI z-score (mean ± SD)	1.65 ± .39	1.68 ± .42	.249

BMI body mass index

Table 2 Baseline characteristics of Motivational Interviewing Group and Conventional Intervention Group

	MIG ($n = 46$)	CIG ($n = 51$)	Test	p value
Age in years (mean ± SD)	16.15 ± 1.49	15.77 ± 1.04	$t(81) = -1.363$	.177
Sex (% male)	33.3	26.8	$\chi^2(1) = .634$	.343
BMI z-score (mean ± SD)	1.54 ± .48	1.83 ± .28	$t(81) = 3.457$	.001
Abdominal circumference in cm (mean ± SD)	92.65 ± 11.05	99.57 ± 11.45	$t(81) = 2.800$	.006
Percent body fat mass (mean ± SD)	37.95 ± 7.33	40.00 ± 7.39	$t(81) = 1.275$	.206
Percent body muscular mass (mean ± SD)	28.24 ± 5.22	28.23 ± 4.34	$t(81) = -.008$	.993
Systolic blood pressure in mm Hg (mean ± SD)	120.05 ± 9.20	122.93 ± 10.22	$t(81) = 1.350$	.181
Diastolic blood pressure in mm Hg (mean ± SD)	68.29 ± 9.38	67.39 ± 7.04	$t(81) = -.493$	.623

MI Motivational Interviewing Group, *CIG* Conventional Intervention Group, *BMI* body mass index

Discussion

These findings provide support for the use of MI at the school setting aiming to improve anthropometric outcomes of obese/overweight adolescents. The positive "time *versus* group" effect was significant in all study variables.

MI is a counseling style especially appropriate for counseling adolescents [27]. However, there are few randomized controlled trials (RCTs) which have evaluated the anthropometric outcomes of a MI weight loss program involving adolescents [14]. Furthermore, analysis of the efficacy of MI interventions addressing adolescent obesity is difficult to assess in large part due to the heterogeneity of the duration and type of interventions applied to the control group, ranging from a time/type-matched behavioral intervention to no intervention at all. Furthermore, most studies do not include any information regarding the training of interviewers and the fidelity of interviews. This study tried to overcome these limitations by providing two time- and type-matched interventions and only changing the counseling style between the two groups.

A study very similar to ours showed that MI delivered by a health educator had not improved BMI outcomes [20]. However, sports participation in the control group was higher compared to the intervention group, and therefore, authors concluded that sports participation was probably a confounding factor [20].

Walpole et al., in a study with 40 adolescents, aged 10 to 18 years, randomly assigned to a treatment group (MI) and a control group (social skills training), found that the specific benefits attributable to MI were limited [41]. Both groups received individual therapy (approximately 30 min per month) in addition to the usual care consisting of diet/exercise counseling. Although the follow-up timing was similar to ours (6 months), perhaps the smaller sample could have limited statistical significance. Moreover, the absence of a conventional care group made it impossible to determine whether participants would have shown improvements in BMI with the usual care alone (i.e., diet and exercise counseling). In our study, we isolated the effect of MI counseling, and thus, its effects were easier to evaluate.

Positive results in BMI percentile and waist circumference were found in the "Adolescents Committed to Improvement of Nutrition and Physical Activity" Study (ACTION), which took place at the school setting [19]. No differences were found between the two groups regarding blood pressure. However, while participants in the intervention group participated in eight visits using MI to improve eating and physical activity behavior, the control group participated in only one visit. The different number of visits may have rendered interpretation of results difficult.

Some studies reporting results of MI interventions with adolescents have included the family in the treatment [5, 23, 38]. Families are an essential component in pediatric obesity management of children/adolescents [36]. However, from the adolescent's point of view, the presence of the caregivers in the interviews may render them less comfortable to talk about intimate problems. This discomfort may have explained the high attrition rates of some studies [23, 38]. In adolescent samples, the presence of the family in the MI therapeutic intervention may not yield positive results, and thus, the benefit of involving parents in adolescent weight loss programs is controversial [11]. Adolescents may have greater need for autonomy and may become more motivated when they take charge of their own behaviors and lifestyle-related decisions [26]. Interviews in the presence of their parents may diminish the efficacy of MI due to a lack of privacy and an undermining of autonomy.

MI was also delivered by online [33] and telephone [31] programs providing tailored lifestyle counseling for adolescents without significant reductions of BMI. However, in the aforementioned studies, MI was used as an intervention without the relational and empathic benefits of a face-to-face interview, which could have hampered the full expression of MI benefits. Our better results may reflect the advantages of a more direct interaction.

MI permits a wide adaptation of treatment to the special ethnic and cultural circumstances of each patient. In a study

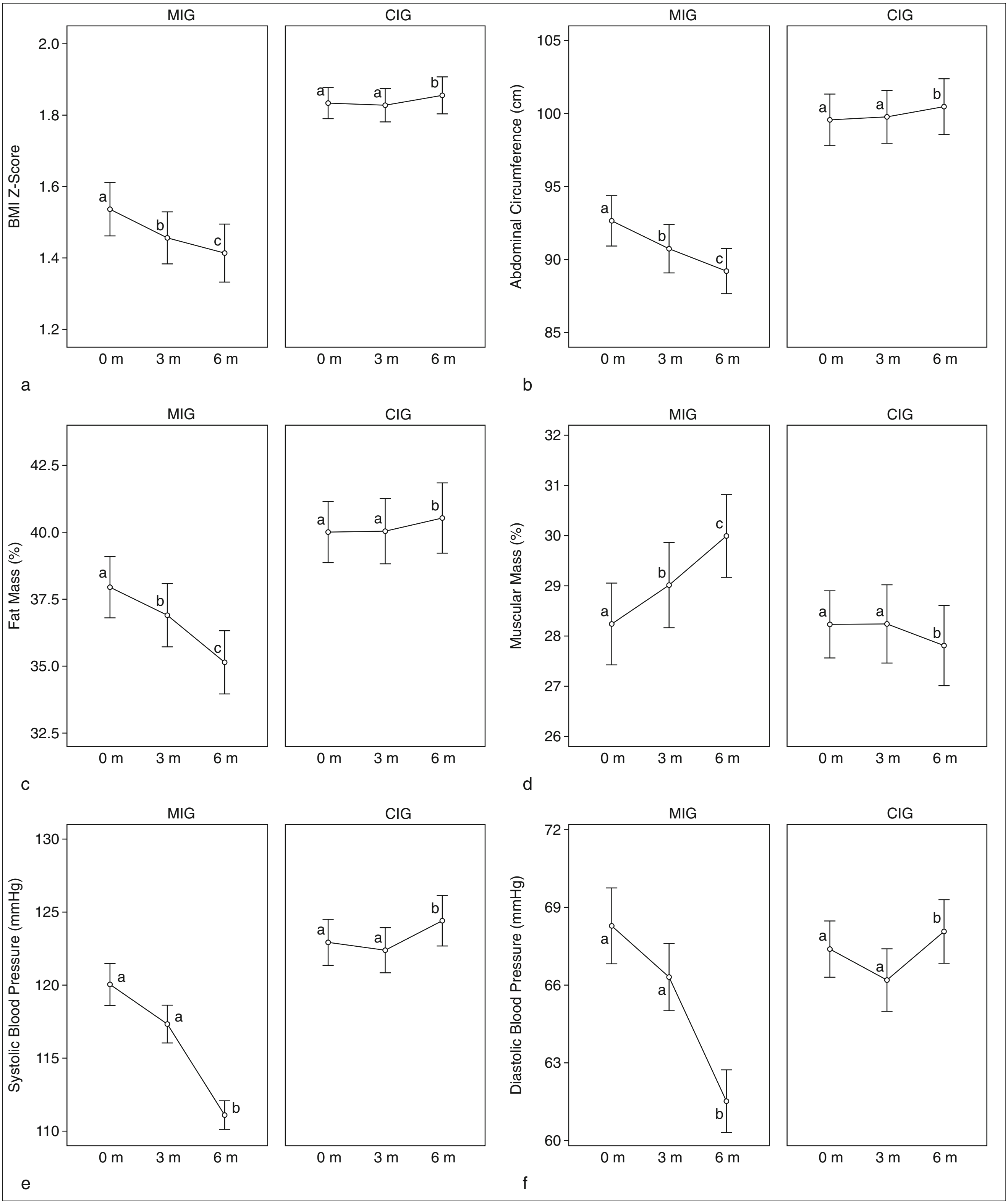

Fig. 2 Time versus group evolution of **a** body mass index z-score, **b** abdominal circumference, **c** percentage of fat mass, **d** percentage of muscle mass, **e** systolic blood pressure, and **f** diastolic blood pressure. Evaluation moments: *0 m* 0 months (baseline), *3 m* 3 months, *6 m* 6 months

with African-American adolescents, who participated in a culturally matched intervention [4], authors found positive results on the reduction of BMI and on the change of body composition. Acknowledging ethnic and cultural specificities as part of the therapeutic process probably facilitated the engagement of participants. In another study involving Latin adolescents with overweight, although there was a significant decrease in the participants' waist circumference, subcutaneous adipose tissue and visceral adipose tissue, no additional effect of MI on health outcomes was found comparatively with circuit training alone [8]. Nevertheless, the lack of positive effects of MI may have been due to the small sample (38 participants, of whom only 12 received MI intervention).

Adaptation of the counseling to the developmental stage of the participant seems to be important to increase adherence [40]. Like children show a greater adherence when the program involves a ludic and creative intervention, adolescents are receptive to interventions which approach the socio-psychologic aspects of their lifestyle and the lack of motivation.

Our study has several strengths. Among them is the fidelity of the intervention, which was monitored with audio analyses and MITI coding of the sessions. The engagement of the participants was high, which translated into high retention rates. Several studies have shown that MI does not have a positive effect on retention to obesity treatment programs [1, 5, 20, 34]. On the contrary, our results support research which found that MI enhances adherence to the obesity intervention [2, 41]. The intervention of our study was individualized, face-to-face, and took place at the school setting thus improving accessibility to the participants. These characteristics probably facilitated retention to the study schedule, as the setting of the interviews impacts on retention rates [28].

This study also has some limitations. The majority of participants were females, recruited from an urban community, which may limit the generalization of our findings. Another limitation is the absence of a long-term follow up. Future studies will need to determine whether the positive results observed can be sustained over a longer period. One possible limitation was the use of BMI z-scores instead of BMI. Although the effect estimates provided by the change in BMI z-scores are difficult to interpret and have been argued to be less powerful than the changes in the raw values of BMI in longitudinal studies [3, 6], a recent study has showed that the two measures show little difference in the tracking of adiposity change except in severe obese adolescents [13]. Besides, BMI z-scores are dimensionless quantities which can be used for comparisons across indicators and populations, especially when participants are adolescents with different ages and genders undergoing rapidly changing trajectories in their BMI evolution [42]. Also, no data was collected around adolescent physical activity levels and their actual compliance with the activity recommendations. Similarly, no data was collected around dietary intake behaviors.

In conclusion, previous research examining MI as a tool for the management of adolescent overweight and obesity has found inconsistent results regarding anthropometric outcomes, probably due to the heterogeneity of the populations, study designs and intensity of the interventions. Our results provide additional evidence of the positive effects of a school-based MI intervention on anthropometric outcomes of adolescents with overweight, suggesting that pediatricians can play an important role in the prevention and management of pediatric obesity, and that the school can be an important setting for running interventions aiming at weight loss. Moreover, our findings provide evidence that MI counseling is effective in improving several aspects of the health status of overweight adolescents. Future studies should focus on replicating these effects and on the maintenance of these effects over time.

Acknowledgements The authors thank the teachers of the schools involved in the study (Alfredo dos Reis Silveira High School, José Afonso High School, Manuel Cargaleiro High School, Amora High School, Terras de Larus Basic 2/3 School, Fernão Mendes Pinto High School, Emídio Navarro High School, Professor Ruy Luís Gomes High School), the Seixal and Almada Municipalities, the associations Independente Futebol Clube Torrense and Sociedade Recreativa União Pragalense, and the Holon Pharmacy Group®.

The study was not funded by any grant but the Portuguese Municipalities of Seixal and Almada, where the study took place, partially funded the physical activities for the participants. Dieticians from Holon Pharmacy Group® gave free dietetic counseling, which did not involve any selling of dietetic products in the pharmacies. Neither the municipalities nor the above mentioned pharmacy group had any role in the study protocol or in any decisions related to the study.

Authors' contributions Silvia Freira: (1) conception and design of the study, acquisition of data, and analysis and interpretation of data, (2) drafting the article, and (3) final approval of the version to be submitted

Marina Serra Lemos: (1) conception and design of the study and analysis and interpretation of data, (2) revising the article critically for important intellectual content, and (3) final approval of the version to be submitted

Helena Fonseca: (1) analysis and interpretation of data, (2) revising the article critically for important intellectual content, and (3) final approval of the version to be submitted

Geoffrey Williams: (1) analysis and interpretation of data, (2) revising the article critically for important intellectual content, and (3) final approval of the version to be submitted

Marta Ribeiro: (1) conception and design of the study and acquisition of data, (2) revising the article critically for important intellectual content, and (3) final approval of the version to be submitted

Fernanda Pena: (1) conception and design of the study and acquisition of data, (2) revising the article critically for important intellectual content, and (3) final approval of the version to be submitted

Maria do Céu Machado: (1) conception and design of the study and analysis and interpretation of data, (2) revising the article critically for important intellectual content, and (3) final approval of the version to be submitted

Funding This study was not funded by any grant, but the municipalities where the study took place (Seixal and Almada, Portugal) partially funded the physical activities for the participants. Additionally, pharmacies from Group Holon® gave free dietetic counseling, without selling any dietetic products. Neither the municipalities nor the pharmacies had any influence on the study protocol or on the analysis of results. Authors do not have any financial relationship with the organizations that sponsored the research.

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Study registry The Study is called IMAGINE and is registered at Clinicaltrials.gov database with the number NCT02745795.

Ethical approval Approval to conduct the study was granted by the local research ethics committees (equivalent to a Human Subjects Review Boards). The study is called IMAGINE and is registered in Clinicaltrials.gov with the number NCT02745795. The full trial protocol can be accessed at the *repositorium* of the University which supervised the study (University of Lisbon). The students who agreed to participate provided written assent and their parents/guardians were asked to sign an informed consent, which was obtained from all individual participants included in the study. All procedures performed in this study involving human participants were in accordance with the institutional and/or national research committee and with the Code of Ethics of the World Medical Association (1964 Helsinki Declaration) and its later amendments or comparable ethical standards for experiments involving humans and with uniform requirements for manuscripts Submitted to Biomedical Journals.

Informed consent Informed consent was obtained from all individual participants included in the study.

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