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Control of overweight and obesity in childhood through education in meal time habits. The 'good manners for a healthy future' programme

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Summary

Objective: Our aim is to determine the effect of paced eating, exposure to an educational programme that promotes healthy eating habits and allowing the satiety reflex to limit food intake in controlling weight gain in healthy adolescents.

Methods: Fifty-four healthy individuals consisting of 18 adolescent girls and 36 boys aged 12 ± 2 years were given recommendations for reducing eating rate without changing diet or meal size according to the educational programme 'good manners for a healthy future'. Each participant was provided with a 30-s portable hourglass to pace time between bites. Individuals using and not using the hourglass were placed either into an 'adhering' or a 'non-adhering' group, respectively. Control data were obtained from a similar population.

Results: Initially, the adhering group had higher weight compared with the non-adhering group (64.1 ± 13.2 vs. 56.2 ± 11.7 kg). Control group weight was no different from the study group at baseline (56.3 ± 10.3 kg). Weight in the adhering group decreased after the first semester of participation by 2.0 ± 5.7% and after a year by 3.4 ± 4.8%, while the non-adhering group gained weight by 5.8 ± 4.5% and 12.6 ± 8.3%. The control group increased weight after a year by 8.2 ± 6.5%. In total, 18 non-adhering and 14 adhering adolescents completed the study.

Conclusions: This 1-year study shows a statistically significant association between rate of food intake and weight control in adherence to an educational programme directed at developing healthy eating habits. The proposed behavioural training may serve as an option for weight control in adolescents.

Keywords: Adolescents, obesity, satiety reflex, slow eating.

Introduction

Overweight and obesity in the Mexican school-age population (5 to 11 years old) affects 12 million children, an increase from 27.0% to 34.4% between 2009 and 2012 (1). This problem is driven by powerful social and economic forces not easily counteracted with the limited resources available (2,3). This conundrum suggests exploring whether a solution may be addressing eating behavioural patterns.

Most approaches to control/reduce weight focus on reducing food quantity, improving quality and promoting daily activity, yield short-term, modest results. In adults, weight lost from dietary interventions is commonly regained upon their termination (4).

Overweight and obese children and adolescents appear to respond similarly to adults, although with better maintenance of the weight loss over extended periods (4). This difference suggests that treating children and adolescents food overconsumption and changing their eating habits may be more effective and of longer impact than interventions in adults.

The 'glucostatic theory' for the control of hunger and regulation of body energy balance indicates that cessation of eating by the satiety feeling (reflex) is controlled by blood glucose levels (5). Laboratory animals and humans show that changes in blood glucose levels are a determinant for beginning food intake but do not correlate with its cessation (6) because they are determined by its absorption in the intestinal tract, a significantly longer process than the interval for onset of the satiety feeling. Consequently during rapid food consumption, the satiety reflex may occur when only a fraction of the total caloric intake has been absorbed, setting the stage for excess caloric consumption outside the control of the satiety reflex.

Food intake is ultimately limited by oropharyngeal area stimulation and stomach filling, which generate the conditioned stimuli for ending a meal, a mechanism present at the very beginning of childhood (7). In healthy individuals, the satiety signal develops ~15 min after start of eating, when the metabolic products and hormonal signals from the gastrointestinal tract are conveyed through the bloodstream to satiety areas in the brain, where they serve as the unconditioned stimuli (8). Therefore, extending the ingestion of a meal beyond this period should cause the satiety signal to appear prior to the termination of the same meal eaten more rapidly. This could limit the total food intake. The influence of eating rate on overconsumption of calories and body weight in children and adults has not yet been studied, but the effect of fast eating rates on hormonal regulators of satiety is confirmed (8–10). Faster eating rates and larger bites are commonly observed in obese individuals (11,12).

We propose the hypothesis that slower eating rates with normal or lower bite size, combined with emphasizing eating at a consistent, orderly daily schedule as provided by the family setting (13), at apposite places (i.e. sitting at the table), avoiding food intake between meals and starting meals with a glass of water (to quench thirst with minimal caloric intake at the beginning of a meal), may serve to control weight gain. These recommendations constitute our programme called 'good manners for a healthy future', which we tested in children and adolescents. The study's goal was to test the feasibility of reducing body weight by teaching how to eat at a controlled pace and stop eating at satiety. The approach allows weight control without imposing dietary or food quantity restrictions or food selection and can be implemented regardless of the socioeconomic status of the user.

Methods

All procedures complied with the Declaration of Helsinki, and the protocol was approved by the Ethics Committee of the General Hospital of Mexico (Mexico City, Mexico, approval no. HGMEL-017-2012). Fifty-four individuals aged 12 ± 2 years, 18 females and 36 males, and their parents were recruited in the study group. Thirty-six individuals aged 13 ± 2 years, 21 females and 15 males, were recruited for the control group. Written informed consent was obtained from the parents of the study and control groups. All subjects were healthy and were not taking medication.

The study began in November 2011, by open invitation to children and adolescents of 6–17 years of age (and their parents), studying at the Mac Donell School (Durango, Mexico). Those interested in participating were scheduled to return to a meeting with their parents or legal guardians and were explained the programme guidelines, its emphasis on education and promoting healthier eating habits, for preventing obesity and overweight and their associated complications, such as diabetes mellitus and hypertension. Informed consent clearly explained that the study was not intended to alter diet or meal size, only to follow a series of recommendations to reduce eating rate and to foster awareness of the onset of the satiety reflex. There was no exclusion/inclusion criteria based on weight.

Study protocol

After obtaining informed consent, the medical history of participants was completed, including overall health status, anthropometric measurements, physical activity and the time devoted to it. Medical advice from paediatric specialists was available throughout the study to address concerns from children, adolescents and parents. The control group and their parents was fully informed of the programme purpose and agreed to be measured according to the programme's schedule, at which time they received heath advice, recommended by the Ethics Committee.

All participants enrolled in the study received a 30-s-period portable hourglass used to pace the timing of bites during meal consumption. Participants were asked to record (yes/no) whether they had used the hourglass on a card provided by the experimenter. Participants using the hourglass for 4 or more days a week were considered adhering to the study. Weekly adherence to the use of the hourglass was tabulated every 6 months. Participants with more than 50% weekly adherence were considered part of the *adhering group*, whereas the rest were considered part of the *non-adhering group*. Participants were cited at school to complete the report card during school breaks.

Anthropometric and blood pressure measurements were completed at the start of the study (baseline) and every 6 months thereafter, with results reported to the participants and their parents. Monitoring was carried out for 1 year, from November 2011 to November 2012. Participants were also instructed on the use of the 30-s hourglass to pace bites during meals and received a guide with recommendations on how to follow the programme. Participants and parents were shown the appropriate weight by age, main causes of obesity or dyslipidaemia in children and adolescents, complications of obesity such as diabetes and which foods are recommended and not recommended for healthy growth. Instruction also promotes eating a home-cooked meal at the table (14). Additional recommendations given were as follows: eat slowly, using the hourglass as a guideline; drink water before starting to eat (possibly avoiding sugary drinks); do not talk and eat at the same time; no repeated portions; no overfilling; no eating or snacking between meals; and no eating off the table. The control group did not receive any instructions.

Anthropometric and blood pressure measurements

Every participant was asked to take a seat, rest for 10 min and then with the arm in a comfortable position, blood pressure was measured three times with 5-min intervals. Weight (kg) and height (m) measurements were taken according to de Onis *et al*. (15) and Frainer *et al*. (16) and used to calculate body mass index [BMI: weight {kg}/height^2 {m^2}] and body surface area (BSA, Mosteller formula (17)). Participants were classified according to BMI percentile as normal (BMI < 85%), overweight (85% ≤ BMI < 95%), or obese (BMI ≥ 95%) (16). Waist–hip ratio (WHR) was calculated using the measured hip (cm) and waist (cm). Weight gain change was calculated at each time point.

Statistical analysis

Controls were analysed using the paired non-parametric (Wilcoxon rank matched-pairs) test. Non-parametric paired analysis of variance (ANOVA, Friedman test) with Dunn's multiple comparisons test was used to determine statistical significance between time points within each group, the association between weight and BMI, BSA and WHR at 6 and 12 months and compare study groups. Two-way ANOVA was used at each time point to determine statistical significance between groups, except at 6 months where a non-parametric *t*-test was used. Results of anthropometric measurements and other continuous outcome variables were adjusted for baseline and first semester vs. second semester participation in the study when appropriate. The Pearson product–moment correlation was used to compare series collected data. The correlation coefficient was calculated between independent parameters. Analysis was performed using Prism 4.01 (GraphPad, San Diego, CA, USA) by a statistician independent of clinical evaluations. Results were considered statistically significant if $P < 0.05$.

Results

Anthropometric measurements

Age, gender, anthropometric measurements, clinical characteristics and blood pressure for the study and the control groups are shown in Table 1. Weight for each participant in the study and the control groups are shown in Fig. 1. Baseline mean weight of the adhering group was significantly higher than the non-adhering group. Adhering and non-adhering groups were not different from the control group at baseline. Weight of the adhering group decreased after the first and second semesters, respectively. The weight of non-adhering group increased after the first and second semesters, respectively. The control group also increased weight over the year.

Baseline heights of the adhering and non-adhering groups were no different at the start and end of the study. The adhering group had a significantly greater waist circumference at baseline than the non-adhering and control groups. Waist of the adhering group after first semester and second semester did not increase, whereas it increased significantly in the non-adhering and control groups. Hip circumference followed the same pattern.

Clinical characteristics

Absolute values for BMI are presented in Table 1. BMI for each participant in the study and the control groups are shown in Fig. 2. At baseline, the average BMI of the adhering group was significantly greater than the BMI of the non-adhering group. BMI was

Table 1 Age, gender, anthropometric measurements, clinical characteristics and blood pressure for study and the control groups

	Baseline			6 months		12 months		
	Adhering	Non-adhering	Control	Adhering	Non-adhering	Adhering	Non-adhering	Control
n	16	26	36	16	26	14	20	36
Age (years)	13 (12; 15)	13 (12; 15)	13 (12; 14)	14 (9; 16)	13 (9; 15)	14 (9; 16)	14 (9; 16)	14 (13; 15)
Sex								
Male	10	15	15	10	15	9	15	15
Female	6	9	21	6	9	5	3	21
Weight (kg)	66.0 (57.1; 83.2)§	52.5 (51.2 61.2)	54.5 (48.5; 66.5)	63.2 (44.3; 81.3)†	54.0 (51.0; 73.4)†	63.0 (43.9; 78.5)	59.5 (53.8; 76.5)†‡	60.4 (69.2; 84.0)†
Height (cm)	161 (150; 174)	164 (159; 166)	160 (154; 165)	164 (151; 177)†	163 (159; 172)†	167 (161; 170)†‡	166 (163; 170)	161 (157; 167)†
Waist (cm)	80 (69; 93)$^{\S\#}$	72 (62; 89)	72 (67; 82)	80 (69; 102)	76 (63; 96)†	78 (68; 92)	77 (66; 94)	76 (69; 85)†
Hip (cm)	92 (79; 106)	83 (69; 100)	89 (84; 96)	89 (79; 102)	84 (72; 102)	88 (77; 101)	87 (77; 100)	91 (86; 98.7)
BMI (kg m^2)	23.7 (22.5; 26.6)§	20.5 (19.5; 23.4)	21.5 (21.0; 23.7)	22.9 (21.1; 25.2)†	20.6 (20.2; 24.1)	22.6 (20.5; 23.8)†‡	21.3 (20.9; 24.9)†	20.3 (22.1; 25.0)
zBMI (or z-score BMI)	1.31 (1.02; 1.67)§	0.62 (0.37; 1.06)	0.89 (0.56; 1.13)	1.25 (0.64; 1.46)†	0.62 (0.37; 1.06)	1.12 (0.50; 1.22)†‡	0.84 (0.54; 1.34)†	1.19 (0.83; 1.36)
BSA (m^2)	1.73 (1.57; 1.82)	1.57 (1.50; 1.69)	1.58 (1.54; 1.65)	1.71 (1.52; 1.81)	1.59 (1.56; 1.75)	1.70 (1.53; 1.80)†	1.69 (1.64; 1.82)†	1.64 (1.61; 1.74)†
WHR	0.91 (0.85; 0.91)	0.86 (0.85; 0.88)	0.82 (0.81; 0.85)	0.91 (0.88; 0.93)	0.88 (0.85; 0.91)†	0.89 (0.86; 0.91)	0.92 (0.88; 0.96)†	0.84 (0.82; 0.85)
Blood pressure (mmHg)								
Dyastolic	69 (56; 84)	64 (54; 84)	65 (59; 71)	63 (54; 76)	65 (53; 79)	68 (61; 74)	69 (62; 85)	63 (60; 70)
Systolic	116 (104; 129)	109 (91; 126)	99 (91; 110)	112 (99; 123)	112 (97; 139)	111 (101; 116)	113 (101; 129)	101 (95; 110)
MAP	85 (74; 97)	79 (69; 102)	77 (70; 83)	80 (70; 91)	81 (68; 97)	81 (77; 88)	85 (75; 98)	76 (73; 82)

†, $P < 0.05$ compared to baseline within the same group; $^{\ddagger}P < 0.05$ compared to 6 months within the same group; § $P < 0.05$ compared to non-adhering at a time point; and $^{\#}$, $P <$ compared to control at a time point. Program dropout was due to change of school, graduation, travel and loss of interest.

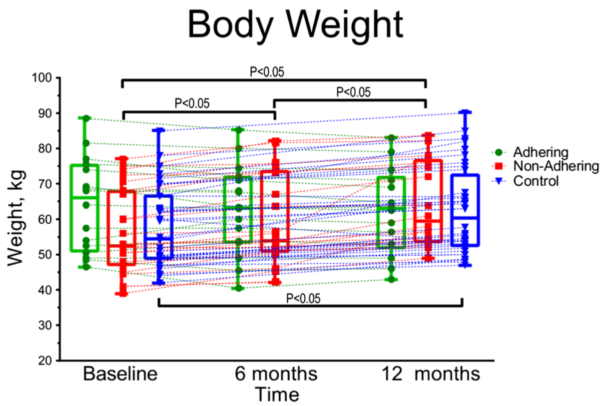

Figure 1 Body weight for the adhering, non-adhering and control groups at baseline, first semester and second semester. Individual trends are shown for each participant in the study. Dotted line indicates participants younger than 10 years old. Participants using the hourglass for 4 or more days a week were placed in the adhering group; others in the non-adhering group (see section on Study protocol). The box charts (black lines) present median, 95% confidence levels and maximum and minimum values.

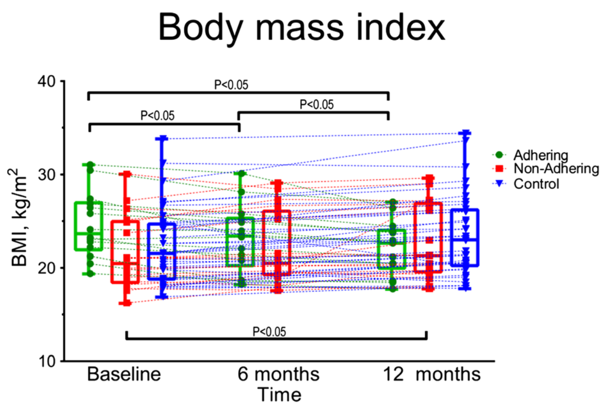

Figure 2 Body mass index (BMI) for the adhering, non-adhering and control groups at baseline, first semester and second semester. Notation is the same as in Fig. 1.

not different between the study groups and the control group at baseline. The BMI in the adhering group significantly decreased after the first semester and second semester, whereas the BMI in the non-adhering and the control groups significantly increased after the 1-year period. The same pattern was found analysing the data using *Z*-scores (Table 1).

At baseline, there was no difference in average BSA between the adhering, non-adhering and control groups. There was no significant change in BSA for the adhering group after the first semester and second semester of participation. The non-adhering and control groups increased BSA during the 1-year period.

There was no initial difference in WHR between adhering and non-adhering groups. The WHR did not change for the adhering and control groups, while the non-Adhering groups showed an increase after the second semester.

Blood pressure

There was no difference in systolic pressure, diastolic pressure or mean arterial pressure (MAP) between the adhering and non-adhering groups at baseline and after first semester and second semester of participation. MAP had a highest coefficient of variation (>18%). No significant correlations were found between MAP and BMI, BSA or WHR at any time point or study group.

Discussion

The principal finding of this study is that deliberate pacing between bites during meal consumption and the associated slower eating pattern combined with behavioural counselling specific to the eating process reduced the rate of weight gain of children and adolescents in the adhering population. The slower eating pattern suggested by our educational programme emerges as the strong determinant of the reduction of BMI in this study. Therefore, simple changes in eating pattern, including proper mastication, reduced bite frequency, eating cessation at point satiety, reducing eating in between meals and limiting eating to the table appear to prevent over intake of food in children and adolescents between 6 and 17 years of age. It should be noted that the results of this study do not establish a specific cause–effect or mechanisms but rather a statistically significant correlation between adherence to our programme and the results obtained.

Paired analysis was used because of the difficulty of standardizing percentiles according to age groupings. Therefore, in this study, we used data relating to a complete year, e.g., without age grouping. Dietary recollections are known to be subject to reporting bias, and the extent of bias may increase with age and obesity. In addition, on any given day, a participant may eat less (e.g. because of sickness) or more (e.g. because of a special occasion) than normal. Therefore, this study aimed to standardize the time between morsels rather than reduce the size or caloric content of meals and snacks.

The present study corroborates perceptions of the importance of healthy eating habits during childhood and adolescence. The percentage of overweight and obese participants adhering to the study decreased from 35.4% and 7.7%, respectively, to 29.0% and

0.4% in 6 months and to 13.3% and 0% in 12 months. The retention rate of overweight and obese participants adhering to the study guidelines and using the hourglass to pace between bites after the 12 months of the study was 86%. Among the non-adhering, the 16.6% percentage of participants with overweight increased to 25.0% overweight after 6 months and to 33.5% overweight after 12 months. The retention rate of overweight participants classified as non-adhering was 80%, suggesting that our programme attracted individuals motivated by the weight loss and reduction in BMI due to adhering to the study guidelines.

Our results suggest that extending the time to consume a meal may decrease the amount of food consumed during meals, thus decreasing energy intake. In contrast, previous studies show that children and adolescents do not respond to decreased meal portion sizes, which tends to be compensated by consumption of more frequent meals and snacks (18). Presumably, regardless of the amount of food available, participants adhering to the use of the 30-s hourglass to pace time between bites reach the satiety reflex, thus limiting the food intake after satiety.

There was no specific correlation with age, weight, height and change in BMI detected in both groups or between boys and girls. Our results do not identify particular characteristics of participants that make them either more or less susceptible to adhere to a healthy educational programme.

Most people, especially children and adolescents, are unaware of what constitutes an appropriate meal portion size (19). Our programme aims to facilitate identifying the appropriate portion size on the basis of a natural eating reflex. Because portion size is modifiable, it can be addressed in treating and preventing obesity. Contrary to educating people about appropriate portions, our approach is to allow establishing the appropriate portion until satiety is reached.

The enduring changes in diet and the compliance in the current study were most likely attributable to recurring contacts with the same study personnel and immediate feedback to the subjects. Therefore, we can neither exclude a significant contribution due to simple advice in the form of constructive talks and encouraging messages inherent to the implementation of our programme nor an effect related to self-monitoring (20,21). Moreover, healthy eating habits have beneficial impact in participant children, and the findings suggest that positive changes inspired by the programme can be maintained beyond its completion. Similarly, programmes to promote healthy exercise and nutrition in younger population have shown to protect against later obesity (22).

The strengths of the present study are further demonstrated by the anthropometric measurements made by the same researchers throughout the study. The adjustment for height and weight is important for interpretation of a healthy growing population. Waist and hip circumference measurements were taken to evaluate central adiposity and to show correlations with metabolic risk factors; however, more sophisticated analytical methods to measure central obesity are needed, as waist and hip circumference measurement have high variability and no correlation with BMI or BSA.

Summary and conclusions

In conclusion, we demonstrate the feasibility of 1-year BMI gain control in children and adolescents by means of education directed at developing healthy eating habits and the correlation between weight control and adherence to the educational programme. Our approach based on behavioural considerations and guidance and not dependent on dietary restrictions is based on the ‘good manners for a healthy future’ educational programme that promotes healthy eating patterns and exploits the physiological time course of the satiety signal, which regulates food intake and is unrelated to food type, flavour and meal size. The programme focuses on appropriate eating habits by means of an inexpensive, portable hourglass that directs attention and interest to the eating process *per se*, rather than outcome, i.e., weight loss. Our results suggest that the combination of behavioural training and focused eating monitoring may constitute a weight control method that can be promoted for children and adolescents, at moderate costs and with lasting effects.

Statement of authorship

Authors’ responsibilities were as follows: B. Y. S. V., P. C., R. P. T. and G. W. S. S. did the study and data collection design. B. Y. S. V. and M. A. S. V. collected the data. P. C., R. P. T., M. I., F. V.-O., J. C. M. and G. W. S. S. analysed the data and made the first draft of the paper. P. C. did the statistical analysis. All authors contributed to writing and revising the manuscript and approved the final draft.

Conflict of Interest Statement

No conflict of interest was declared.

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