AMEA kids

REPORT

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1. BACKGROUND

Portugal is one of the countries within the WHO European Region with higher prevalence of overweight and obesity among children but not all are affected equally by the burden of obesity and poor health[1]. Children that do not have adequate resources are more likely to be obese and face a greater burden of ill health than the ones who grow up in environments that are better off[2]. In Portugal, latest data have shown that 9% of the Portuguese population is unemployed and 18,3% is at risk of poverty[3]. This contributes largely to poor nutrition and unhealthy behaviors among children, which leads to poor health, particularly to obesity.

Portugal has consistently been one of the countries with higher prevalence of childhood obesity[4] affecting children from the most disadvantage groups as nutritional inequalities continues to be a major problem[1]. According to COSI Portugal, data from the last decade has shown a prevalence of overweight above 30%, in children from 6 to 8 years old (y.), including 11.7% of obesity in 2016[5].

Tackling this important public health issue is, therefore, urgent. Action should be taken at both micro and macro levels and in different setting such as home and families, communities and schools. Increasing evidence shows that the most successful interventions are multi-component, adapted to the local context, using the existing local structures of a community, and involving the participants in the planning and implementation stages[6]. Using this sort of approach and involving multiple partners contributes to community empowerment and affords the opportunity to reach a large number of people. The aim of this study was to implement, a multi-component community intervention towards primary school children, at municipality level, targeting particularly low socio-economic environments.

Based on the rationale that local governments exert an important and decisive role in counteracting malnutrition in children, this program sought to engage the community

and all stakeholders at local level on helping kids of 6-10 years old through a set of individual and community activities at different levels.

The project was locally established through a multidisciplinary team who implemented it on site. Some of the actions included, family, school and community activities promoting sports and games, healthy cooking workshops, nutritional status evaluation, coaching, and health literacy.

2. AMEA KIDS PROGRAM

The AMEA kids program - Promotion of Healthy Lifestyles in Children - coordinated by CEIDSS (Center for Studies and Research in Social Dynamics and Health), was developed at regional and local level, within a period of 24 months (2016-2017), which had, as main goal, the prevention and tackling of overweight and obesity in primary school children from five Health Regions of Portugal.

As partnerships were established at the Regional, Municipal and School level, it eased the process of families' selection and invitation.

The project was implemented in two different levels of intervention, Individual and Community.

3. OBJECTIVES

3.1. General

The general objective was to promote healthy lifestyles in children through a multidisciplinary and multi-stakeholder approach, at local level in 5 regions in Portugal.

3.2. Specific

1. To empower children to be an active participated member in community action, to promote health within their environment (particularly at school level) and with their peers;
2. To involve all the actors at community level, school staff, teachers, municipality staff and other associations from neighborhood, sport centers (particularly the ones where children usually participate);
3. To improve and strengthened partnerships between local stakeholders (Health centers; Sports centers; Research centers and others);
4. To provide a convenient environment with competent and trained staff, that will also gain skills in this project;
5. To educate kids in acquiring knowledge in Nutrition and healthy diet and Food labeling (smart choices at supermarket);
6. To improve their daily routines increasing physical activity patterns (at least 15 more min/day);
7. To improve dietary patterns (increasing the consumption of food and vegetables; decreasing consumption of foods high in fat, salt and sugar);
8. To improve their nutritional status.

4. METHODS

The project was developed within a period of 24 months (2016-2017) through a randomized controlled trial to evaluate the effectiveness. Preceded by a screening process, the goal was to target low-income families where the probability of finding overweight children is higher and then implement a set of activities in order to reverse the trend.

4.1. The Initial Screening

The project previewed a national call of Municipalities in order to select the expected 600 participants. The response was very low, thus the project chose to approach the Regional Health Directorates in order to support the study.

After consulting the 7 Health regions directorates, 5 agreed to participate on AMEA Kids namely Lisbon and Tagus Valley (LVT), Alentejo, Algarve, Madeira and Azores. A common study protocol was developed and agreed among the Regions. Formal and official letters were signed by the Regional Directors of Health, in each region.

Regional Coordinators established local teams, where other stakeholders and municipality technicians were encouraged to participate. AMEA kids also benefit from the pre-established network of stakeholders and influence of the Regional Health Directorates which have an easy access and partnership with municipalities and schools.

The Nutritional status AMEA Kids survey was implemented during the 1st semester of 2016 through the National Childhood Obesity Surveillance Initiative, which measures routinely children from 6-8 years old, in Portugal, except for LVT, which used data from the Eat Mediterranean study. The studies had the approval of the National Ethical Committee and followed a strict methodological protocol using specific scales and anthropometric measurements, performed by trained health professionals. Children´s weight was measured once to the nearest 0.1 kg with an electronic scale (Seca® 840)

and height was measured twice to the nearest 0.1 cm with a stadiometer (Seca® 214), following the World Health Organization[7] and Portuguese[8] guidelines.

Table 1 shows the initial screening. Data from all large schools of the 5 Regions was selected for AMEA kids. AMEA kids was implemented in 22 of the 27 invited municipalities. 56 primary schools were then selected corresponding to 125 classes of 1st and 2nd graders, plus 3rd and 4th graders in LVT.

Azores (1-5)

Madeira (6-8)

LVT (9-10)

Alentejo (11-18)

Algarve (19-22)

List of Municipalities:

Azores
1. Angra do Heroísmo
2. Lagoa
3. Madalena
4. Ponta Delgada
5. Ribeira Grande
Madeira
6. Funchal
7. Câmara de Lobos
8. Santa Cruz
LVT
9. Alpiarça
10. Santarém
Alentejo
11. Borba
12. Campo Maior
13. Elvas
14. Évora
15. Portalegre
16. Serpa
17. Vidigueira
18. Vila Viçosa
Algarve
19. Faro
20. Loulé
21. Portimão
22. Vila Real de Stº António

Figure 1: AMEA kids Regions and Municipalities distribution.

A total of 2238 children were measured. For nutritional status classification, the 2007 WHO Growth Reference was used[9], which defines:

Thinness: Body Mass Index (BMI)-for-age <-2 standard deviation (SD),

Overweight: $>+1$ SD (equivalent to a BMI of 25 kg m-2 at 19 years)

Obesity: $>+2$ SD (equivalent to a BMI of 30 kg m-2 at 19 years).

An overall prevalence of 31,9% of overweight children (20,3% of pre-obesity and 11,6% of obesity) was found, thus 672 children were eligible for the study.

The highest prevalence of overweight was found in Santarém and Alpiarça (two munici-palities of LVT Region (36,8%) and the lowest in the 4 municipalities (Faro, Loulé, Vila

	Primary Schools (n)	Cities (n)	Classes (n)	Nutritional Status Survey (2016) (n)	Obesity Prevalence (%)	Obesity (n)	Overweight (OW) Prevalence (%)	Screening of OW children (n)
Alentejo	9	8	18	320	13,8%	44	28,4%	91
Algarve	11	4	22	387	8,3%	32	21,7%	84
Madeira	9	3	18	337	12,5%	42	35,0%	118
Azores	9	5	18	264	18,6%	49	29,9%	79
LVT	18	2	56	930	10,0%	93	36,8%	342
Total	**56**	**22**	**132**	**2238**	**11,6%**	**260**	**31,9%**	**714**

Real de Santo António and Portimão) of Algarve (21,7%).

Table 1: Study's sample description.

4.2. The Intervention (6-7 months)

AMEA Kids intervention was implemented on the 2nd year of the project (2017) and was built as an integrated, multi-component healthy lifestyle program based on the princi-ples of nutrition and physical activity, from psychology, learning, and social cognitive theories and the study of therapeutic processes.

This project was one of the first in Portugal to put forward an approach to treat obesity in children, national wise, with a common and very specific methodology with the in-volvement of community players.

In order to give visibility, for better communication and establishment of partnerships, a WEBSITE (http://ameaprogram.com/amea-kids/) was created as well as its social media networks (facebook page: https://www.facebook.com/ameaprogram/).

WEBSITE: www.ameaprogram.com

The Regional Coordinators were responsible to implement and co-organize the activities in every site and establish local teams.

To implement the project, 35 nutritionists were appointed as local focal points and examiners, by the Regional Coordinators. In order to have homogeneous guidance of the project, the national team developed several training sessions towards the nutritionists and other local team members. A specific methodological AMEA kids protocol with common documents, forms and guidance on nutritional evaluation and counseling and the school based program/intervention, was given and followed by the examiners/local team. The training was given by the same national coordinator, in each region, and only the nutritionists/local members certified in this session were able to collaborate in the project.

4.2. Randomized Control Trial procedures

We undertook a randomized controlled trial according to the initial eligible number of children (714). These children, identified as overweight (pre-obesity or obesity), were randomized into 3 groups of 238 each.

Group 1: Control Group (no intervention);

Group 2: Individual Intervention Group;

Group 3: School-based Intervention Group.
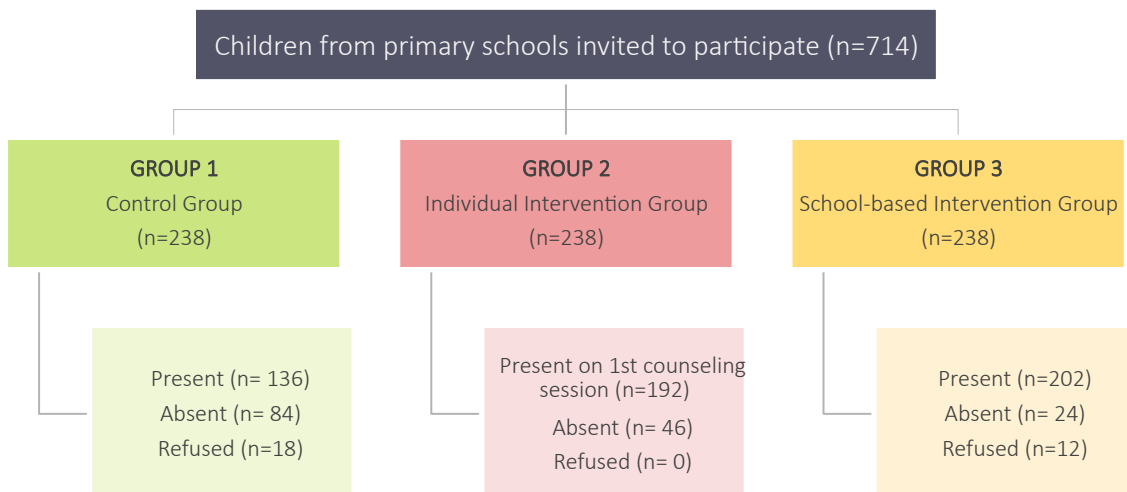
Figure 2: AMEA kids participation flow chart.

4.2.1. CONTROL GROUP (GROUP 1)

The control group did not receive any kind of intervention. This group of children were invited to be measured at the end of the study, using the same methodology used at baseline (2016).

Again, prior to the new measurements, parents were advised of the day of the activity by a letter containing the specific procedures. A Passive informed consent approach was used.

These children were measured at the end of the study in the same period that the children in the individual or group intervention were.

4.2.2. INTERVENTION GROUPS

The intervention consisted of two different levels of approach:

4.2.2.1 INDIVIDUAL INTERVENTION GROUP (GROUP 2)

At **individual level**, a Nutrition education and motivation program was implemented targeting the students whose nutritional status was impaired (pre-obesity and obesity). The intervention involved 4 individual sessions with the student and their respective families.

Individual counseling sessions

Nutritionists of each municipality offered 4 individual counseling sessions to children. On site each individual counseling consisted on nutrition education with healthy eating advice customized for their specific nutritional status. This approach was focus on Mediterranean Diet, because of this importance on a well-balanced life style and similarity to Portuguese diet pattern. On a whole approach to the home setting, it included healthy eating tips in the form of achievable weekly and monthly targets.

The nutritionists had to follow a script and check-list of tasks for each counseling session. On the 1st and last session, a family questionnaire was applied to collect data on socio-economic status, children´s eating habits and other personal information (Appendix 1).

The food and nutritional guidance included a diet/food plan according to the methodology based on the Traffic Light Diet approach adapted to the Mediterranean Diet which followed the Epstein *et al.*[10] principles and previously discussed by Carvalho *et al.*[11] A

specific and revised version was produced by the Coordinated Team and followed by the nutritionists (Appendix 2).

Traffic Light Food plan approach

The main goal of this food plan was to provide children a balanced diet by reducing their energy intake. Foods are categorized as red, yellow or green based on their energy and nutritional value. Thus, green foods (eg fruits and vegetables), have a low energy value so they are of free consumption. Yellow foods (eg milk, yogurt and cereals), have a higher energy value than green foods, although they contain the nutrients essential for a balanced diet, should be consumed moderately (1-2 times a week). Finally, red foods (eg sweets and fried foods), because of their high energy density and low nutritional density, should be limited.

This type of session was built to improve children empowerment about food choices so they could make better decisions about their meals throughout the intervention period. The end point was that on the last counseling session their 24 hours recall (Appendix 3) should be plenty of green choices.

A "non-dieting" philosophy was advocated throughout the intervention; therefore children were discouraged from weighing themselves and encouraged to make small lifestyle changes to improve health rather than achieve rapid weight loss or gain. Behavioral approach focused on teaching parents and children to apply different techniques such as: stimulus control, goal setting, reinforcement, and response prevention to es

tablish a health promoting home environment. All children were encouraged to under-take at least 1h of physical activity per day. All children were in constant contact with the nutritionists, to share their ideas, feelings and results.

SMART Choices at the supermarket

Throughout the individual intervention period, children were invited to come to the supermarket, with a pre-established and planned buying list according to their needs and also according to family income. Reading Food labels was an important issue to be tackle in theses supermarkets (Appendix 4).

Children doing smart choices at the supermarket

Moreover a questionnaire about student´s knowledge and their habits regarding the Mediterranean Diet principles was also applied (Appendix 5).

4.2.2.2 SCHOOL-BASED INTERVENTION GROUP (GROUP 3)

Classroom Activities

At **group-level intervention**, 4 Nutritional educational sessions were delivered with a Mediterranean life-style approach, inside the classroom for all the participant children

in this Group. This level of intervention was developed towards teachers as well, during class time.

In these sessions nutritionists had a specific Guide to follow which included in each session the following themes: "the importance of breakfast in a Mediterranean country"; "Getting an higher Fruit and Vegetable Soup intake", "Healthy packed lunches and snacks" and "A day of Mediterranean diet".

This level of intervention was developed towards children with correspondence to their families, but also towards teachers, during class time. Other activities included Food and Nutrition education through fun activities such as a "Mediterranean Diet story", Games like the "Mediterranean Food Wheel".

The "Mediterranean Food Wheel" game was produced by the National Coordinating team, by an adaption of "Mediterranean Food Wheel" content, developed by the Faculty of Nutrition and Food Sciences – University of Oporto. The Mediterranean Wheel was adapted into a carpet and numbers were added to the original format of the wheel. The students were divided into 4 teams, each team had one pawn who was responsible to throw the dice and depending on the number the team had to answer a question concerning the Mediterranean Diet. In some cases if the answer was correct, the pawn could move forward 2 or more positions. In other cases, if the answer was wrong, the pawn had to move backwards 2 or more positions. The answers were given after a deliberation in order to encourage the group discussion about the Mediterranean Diet theme (Appendix 6).

The Mediterranean Food Wheel Game

Again, in this study group, the same questionnaire about student´s knowledge and their habits regarding the Mediterranean Diet principles was also applied (Appendix 5).

Healthy cooking workshops

Children were invited to participate in Healthy Cooking Workshops, under the guidance of a nutritionist where nutrition education focused not only on the provision of nutrition information, but also on the development of skills and behaviours related to areas such as food preparation, food preservation and storage; social and cultural aspects of food and eating and other consumer aspects. Main goal was to learn how to prepare low budget healthy meals and how to prepare these recipes at home, with a strong focus on vegetables.

Healthy Cooking workshops

Sport School activities

Another important setting for health promotion in children, in intervention involving the school community is promoting physical activity. Throughout the intervention period children were actively encouraged to engage in sports offered by the school, to use playgrounds and to be actively registered in sports centers.

Facebook challenge

Considering that social networks are proven to be an important social marketing mechanism with a strong diffusion among young people, children were invited to participate in *Facebook/Instagram* challenge. Despite the efforts and dissemination of the *Facebook* challenge, the adherence to activity was not significant, since children under 10 years old do not have free access to social media, such as *Facebook* or *Instagram*, and therefore needed to use their parents' social networks. Thus, this activity was not executed.

5. RESULTS

5.1. Family characteristics

At the beginning of the AMEA kids study, data regarding socioeconomic characteristics of all study groups, such as mother's educational level and their occupation, was collected in order to have a deeper understanding of the family environment in which the child lived.

Tables 2 to 7 show that the study groups were homogenous as most of the mothers of these families with overweight children, had mandatory education (until 12th grade) or less.

Control Group Family characteristics

		Age at Baseline (years)							
		6-6,99		7-7,99		>=8		All	
		n	%	n	%	n	%	n	%
	Primary school	0	0,0	3	5,2	4	14,3	7	5,8
	Secondary school	16	45,7	31	53,4	12	42,9	59	48,8
Mother's educational level	Vocational school	2	5,7	5	8,6	0	0,0	7	5,8
	Undegraduate/Bachelor degree	13	37,1	17	29,3	10	35,7	40	33,1
	Masters degree or higher	4	11,4	2	3,4	2	7,1	8	6,6
	Total	**35**	**28,9**	**58**	**47,9**	**28**	**23,1**	**121**	**100,0**

Table 2: Mother's educational level at the baseline, by the children's age group – Control Group.

		Age at Baseline (years)							
		6-6,99		7-7,99		>=8		All	
		n	%	n	%	n	%	n	%
	Government employed	8	22,9	15	25,9	10	37,0	33	27,5
	Non-government employed	23	65,7	31	53,4	11	40,7	65	54,2
	Self-employed	2	5,7	4	6,0	3	11,1	9	7,5
	Student	0	0,0	0	0,0	1	3,7	1	0,8
Mother's occupation	Homemaker	1	2,9	2	3,4	1	3,7	4	3,3
	Unemplyed, able to work	1	2,9	5	8,6	1	3,7	7	5,8
	Unemployed, unable to work	0	0,0	1	1,7	0	0,0	1	0,8
	Retired	0	0,0	0	0,0	0	0,0	0	0,0
	Total	**35**	**29,1**	**58**	**48,3**	**27**	**22,5**	**120**	**100,0**

Table 3: Mother's occupation at the baseline, by the children's age group – Control Grou

Individual Intervention Group Family characteristics

		Age at Baseline (years)							
		6-6,99		7-7,99		>=8		All	
		n	%	n	%	n	%	n	%
Mother's educational level	Primary school	0	0,0	1	1,3	2	4,8	3	1,9
	Secondary school	9	22,0	23	29,5	16	38,1	48	29,8
	Vocational school (Grade 12)	9	22,0	20	25,6	8	19,0	37	23,0
	Undegraduate/Bachelor degree	17	41,5	26	33,3	9	21,4	52	32,3
	Masters degree or higher	6	14,6	8	10,3	7	16,7	21	13,0
	Total	41	25,5	78	48,4	41	26,1	161	100,0

Table 4: Mother's educational level at the baseline, by the children's age group – Individual Intervention Group.

		Age at Baseline (years)							
		6-6,99		7-7,99		>=8		All	
		n	%	n	%	n	%	n	%
Mother's occupation	Government employed	7	17,1	12	15,8	9	23,1	28	17,9
	Non-government employed	24	58,5	41	53,9	21	53,8	86	55,1
	Self-employed	7	17,1	9	11,8	2	5,1	18	11,5
	Student	0	0,0	0	0,0	2	5,1	2	1,3
	Homemaker	0	0,0	4	5,3	3	7,7	7	4,5
	Unemplyed, able to work	2	4,9	10	13,2	2	5,1	14	9,0
	Unemployed, unable to work	1	2,4	0	0,0	0	0,0	1	0,6
	Retired	0	0,0	0	0,0	0	0,0	0	0,0
	Total	41	26,3	76	48,7	39	25,0	156	100,0

Table 5: Mother's occupation at the baseline, by the children's age group – Individual Intervention Group.

School-based Intervention Group Family characteristics

| | | Age at Baseline **(years)** | | | | | | | |
| | | 6-6,99 | | 7-7,99 | | >=8 | | All | |
		n	%	n	%	n	%	n	%
Mother's educational level	Primary school	1	5,0	1	2,8	1	1,3	3	2,2
	Secondary school	11	55,0	20	55,6	42	53,8	73	54,5
	Vocational school	0	0,0	0	0,0	0	0,0	0	0,0
	Undegraduate/Bachelor degree	6	30,0	13	36,1	31	39,7	50	37,3
	Masters degree or higher	2	10,0	2	5,6	4	5,1	8	6,0
	Total	**20**	**14,9**	**36**	**26,9**	**78**	**58,2**	**134**	**100,0**

Table 6: Mother's educational level at the baseline, by the children's age group – School-based Intervention Group.

| | | Age at Baseline **(years)** | | | | | | | |
| | | 6-6,99 | | 7-7,99 | | >=8 | | All | |
		n	%	n	%	n	%	n	%
Mother's occupation	Non-government employed	14	70,0	29	76,3	60	75,9	103	75,2
	Self-employed	1	5,0	5	13,2	7	8,9	13	9,5
	Student	0	0,0	0	0,0	1	1,3	1	0,7
	Homemaker	0	0,0	4	10,5	1	1,3	5	3,6
	Unemplyed, able to work	4	20,0	0	0,0	8	10,1	12	8,8
	Unemployed, unable to work	1	5,0	0	0,0	2	2,5	3	2,2
	Retired	0	0,0	0	0,0	0	0,0	0	0,0
	Total	**20**	**14,6**	**38**	**27,7**	**79**	**57,7**	**137**	**100,0**

Table 7: Mother's occupation at the baseline, by the children's age group – School-based Intervention Group.

5.2. Nutritional Status

5.2.1. CONTROL GROUP (GROUP 1)

Table 2 presents children's participation in the **Control Group** by age and gender. Gender distribution was similar (slightly higher in girls: 54,5%) and the majority of the children were 7 years old (mean age 6,99 years old), at the beginning of the study (2016).

Age at Baseline (years)	n	%	Male		Female	
			n	%	n	%
6-6,99	40	29,4	17	27,4	23	31,1
7-7,99	60	44,1	26	41,9	34	45,9
≥8	36	26,5	19	30,6	17	23,0
Total	**136**	**100,0**	**62**	**45,6**	**74**	**54,4**

Table 2: Control Group's children participation, by age and gender.

Anthropometric characteristics (weight, height and body mass index) of the Control Group are displayed on table 3. As expected, children aged ≥8 years are the ones who present the highest mean values of weight and height.

	Age at Baseline (years)	Baseline (2016)		Post Intervention (2017)	
		n	Mean ± SD	n	Mean ± SD
Weight (kg)	6-6,99	40	32,5 ± 5,6	40	37,1 ± 5,7
	7-7,99	60	31,5 ± 5,1	60	40,6 ± 7,6
	≥8	36	35,5 ± 6,3	36	45,8 ± 8,5
	Total	136	32,9 ± 5,8	136	40,9 ± 8,0
Height (cm)	6-6,99	40	127,5 ± 5,9	40	133,6 ± 4,3
	7-7,99	60	127,9 ± 6,8	60	136,7 ± 6,4
	≥8	36	130,5 ± 6,6	36	142,2 ± 6,6
	Total	136	128,5 ± 6,6	136	137,3 ± 6,8
BMI (kg/m2)	6-6,99	40	20,7 ± 2,6	40	22,4 ± 3,1
	7-7,99	60	19,2 ± 1,8	60	21, 0 ± 2,8
	≥8	36	19,8 ± 2,5	36	21,7 ± 2,9

Table 3: Distribution of children weigh, height and BMI by age, at the beginning (baseline) and ending of the project (post intervention) of the Control Group.

The changes on the BMI for age z-scores (BAZ) among the different age groups are presented on Table 4. In all age groups the mean BAZ values at the end was higher than the ones observed at the beginning of the AMEA kids study, with an overall increase of (+0,10). The overall increase in mean BAZ values was statistically significant between the two moments of the study (p<0,001)

	Age at Baseline (years)	Baseline		Post Intervention		
		n	Mean ± SD	n	Mean ± SD	p value
BAZ	6-6,99	40	1,90 ± 0,77	40	2,01 ± 0,71	0,051
	7-7,99	60	1,95 ± 0,84	60	2,02 ± 1,00	0,040
	≥8	36	1,98 ± 0,78	36	2,09 ± 0,73	0,070
	Total	136	1,94 ± 0,80	136	2,04 ±0,85	0,001

Table 4: Changes on the BMI for age z-scores (BAZ) of the Control Group, from baseline to post intervention, by age group.

5.2.2. INDIVIDUAL INTERVENTION GROUP (GROUP 2)

The Individual Intervention Group had a slightly higher percentage of girls (56,3%). Most of the children of this group were aged 7 years old (46,4%) at the baseline of the program (mean age 7,04 years old) (Table 5).

Age at Baseline (years)	n	%	Male		Female	
			n	%	n	%
6-6,99	56	29,2	27	32,1	29	26,9
7-7,99	89	46,4	33	39,3	56	51,9
≥8	47	24,5	24	28,6	23	21,3
Total	192	100,0	84	43,8	108	56,3

Table 5: Individual Intervention Group's children participation, by age and gender.

Table 6 describes the children participation rate per counselling session during the intervention period. Between the 1st and the 4th counselling session there was a drop out of the program of 44,8% (86 children). The higher rate of drop out was between the 1st and the 2nd (-20,4 %) decreasing in time (2nd to 3rd: -15,6% and 3rd to 4th -8,8%).

Age at Baseline (years)	1st counseling session	2nd counseling session	3rd counseling session	4th counseling session
	n (%)	n (%)	n (%)	n (%)
6-6,99	56 (29,2)	45 (29,4)	36 (29,3)	31 (29,2)
7-7,99	89 (46,4)	69 (45,1)	52 (42,3)	47 (44,3)
≥8	47 (24,5)	39 (25,5)	35 (28,5)	28 (26,4)
Total	192 (100,0)	153 (79,7)	123 (64,1)	106 (55,2)

Table 6: Children's participation per individual counseling session.

Anthropometric characteristics (weight, height and BMI) of the Individual Intervention Group are displayed on Table 7. Again mean weight and height was higher for the age group of 8 years or older.

	Age at Baseline (years)	Baseline		1st counseling session		2nd counseling session		3rd counseling session		4th counseling Session (Post Intervention)	
		n	Mean ± SD	n	Mean ± SD	n	Mean ± SD	n	Mean ± SD	n	Mean ± SD
Weight (kg)	6-6,99	56	29,0 ± 4,5	56	33,9±5,8	45	34,3±5,7	36	33,9±6,4	31	35,0±6,0
	7-7,99	89	33,2 ± 5,4	89	38,3±6,9	69	38,9±7,2	53	40,7±15,9	47	38,6±6,8
	≥8	47	37,2 ± 6,5	47	42,8±7,6	39	43,5±7,7	35	44,9±8,0	28	45,3±8,0
	Total	192	32,9 ± 6,2	192	38,1±7,5	153	38,7±7,7	124	39,9±12,5	106	39,3±7,9
Height (cm)	6-6,99	56	122,4±6,0	56	128,4±6,5	45	129,3±7,0	36	129,1±7,3	31	129,6±7,8
	7-7,99	89	128,0±5,6	89	134,4±6,7	69	134,4±6,4	52	134,4±6,7	47	134,6±7,0
	≥8	47	133,3±6,3	47	139,3±6,9	35	140,2±6,9	35	141,5±7,3	28	142,2±7,5
	Total	192	127,7±7,1	192	133,9±7,8	153	134,4±7,8	123	134,9±8,5	106	135,2±8,7
BMI (kg/m2)	6-6,99	56	19,2±2,0	56	20,5±2,5	45	20,4±2,3	36	20,3±3,0	31	20,7±2,5
	7-7,99	89	20,2±2,2	89	21,1±2,5	69	21,4±2,6	52	21,3±2,5	47	21,2±2,3
	≥8	47	20,8±2,2	47	21,9±2,5	35	22,0±2,7	35	22,3±2,6	28	22,3±2,5
	Total	192	20,1±2,2	192	21,1±2,6	153	21,3±2,2	123	21,3±2,8	106	21,3±2,6

Table 7: Anthropometric characteristics (weight, height and BMI) of the Individual Intervention Group, by age and counselling session.

The Intervention Individual Group participants' BAZ evolution is displayed on Table 8. It is possible to notice an **overall decrease** of the BAZ mean value from the 1st counselling session compared to the one shown in the last counselling session (-0,04).   This decrease was statistically significant for the overall population as for the children age 8 or more years (p<0,05).

	Age at Baseline (years)	1st counseling session		2nd counseling session		3rd counseling session		4th counseling session		p value (1st vs 4th counseling session)
		n	Mean ± SD	n	Mean ± SD	n	Mean ± SD	n	Mean ± SD	
BAZ	6-6,99	31	2,18±0,75	31	2,17±0,70	31	1,99±1,27	31	2,16±0,75	0,754
	7-7,99	47	2,04±0,71	47	2,01±0,70	47	2,03±0,69	47	2,02±0,66	0,334
	≥8	28	2,15±0,65	28	2,09±0,65	28	2,08±0,65	28	2,03±0,62	0,004
	Total	106	2,11±0,70	106	2,08±0,68	106	2,03±0,88	106	2,07±0,67	0,030

Table 8: Changes on the BMI for age z-scores (BAZ) of the Individual Intervention Group, from baseline to post intervention, by age group.

5.2.3. SCHOOL-BASED INTERVENTION GROUP (GROUP 3)

Table 9 presents children's participation of the **School-based (SB) Intervention Group** by age and gender. Gender distribution was the same and, the majority of the children were 8 or more years old, at the beginning of the study (2016) (mean age 8,10 years old).

Age at Baseline (years)			Male		Female	
	n	%	n	%	n	%
6-6,99	34	16,8	19	18,8	15	14,9
7-7,99	57	28,2	28	27,7	29	28,7
≥8	111	55,0	54	53,5	57	56,4
Total	202	100,0	101	50,0	101	50,0

Table 9: School-based Intervention Group participation by age and gender.

Anthropometric characteristics (weight, height and BMI) of the SB Intervention Group, by age are displayed on Table 10. Similar to what was previously described, children of the age group ≥8 were the ones who presented higher weight, height and BMI mean values.

	Age at Baseline (years)	Baseline		Post Intervention	
		n	Mean ± SD	n	Mean ± SD
Weight (kg)	6-6,99	34	28,4 ± 4,3	34	32,9 ± 6,7
	7-7,99	57	32,0 ± 6,0	57	36,4 ± 7,6
	≥8	111	39,3 ± 7,7	111	44,7 ± 9,1
	Total	202	35,4 ± 8,1	202	40,4 ± 9,6
Height (cm)	6-6,99	34	122,4 ± 4,5	34	130,3 ± 5,6
	7-7,99	57	126,1 ± 6,8	57	133,4 ± 7,0
	≥8	111	135,3 ± 6,3	111	142,4 ± 6,7
	Total	202	130,5 ± 8,2	202	137,8 ± 8,4
BMI (kg/m2)	6-6,99	34	18,9 ± 2,3	34	19,3 ± 3,2
	7-7,99	57	20,0 ± 2,5	57	20,3 ± 3,0
	≥8	111	21,3 ± 2,9	111	21,9 ± 3,3
	Total	202	20,5 ± 2,8	202	21,0 ± 3,3

Table 10: Anthropometric characteristics (weight, height and BMI) of the School-based Intervention Group, by age.

The differences on the BAZ among the different age groups in the beginning and at the end of AMEA Kids are presented on Table 11. In all age groups the mean BAZ values, at the end of the study, are lower than the ones observed at the beginning of the AMEA kids study, with an overall decrease of (-0,23). Except for younger children (6-6,99) the decrease was statistically significant for all age groups (p<0,001).

	Age at Baseline (years)	Baseline		Post intervention		p value
		n	Mean ± SD	n	Mean ± SD	
BAZ	6-6,99	34	1,84 ± 0,82	34	1,60 ± 1,17	0,068
	7-7,99	57	1,99 ± 0,82	57	1,73 ± 0,93	0,001
	≥8	111	2,04 ± 0,83	111	1,83 ± 0,83	0,0001
	Total	202	1,99 ± 0,83	202	1,76 ± 0,92	0,0001

Table 11: Changes on the BMI for age z-scores (BAZ) of the School Based Intervention Group, from baseline to post intervention, by age group.

Changes on BMI/age per intervention group

Figure 3 illustrates the comparison between the 3 study groups, regarding the changes in BAZ mean values, per age group, during the intervention period.
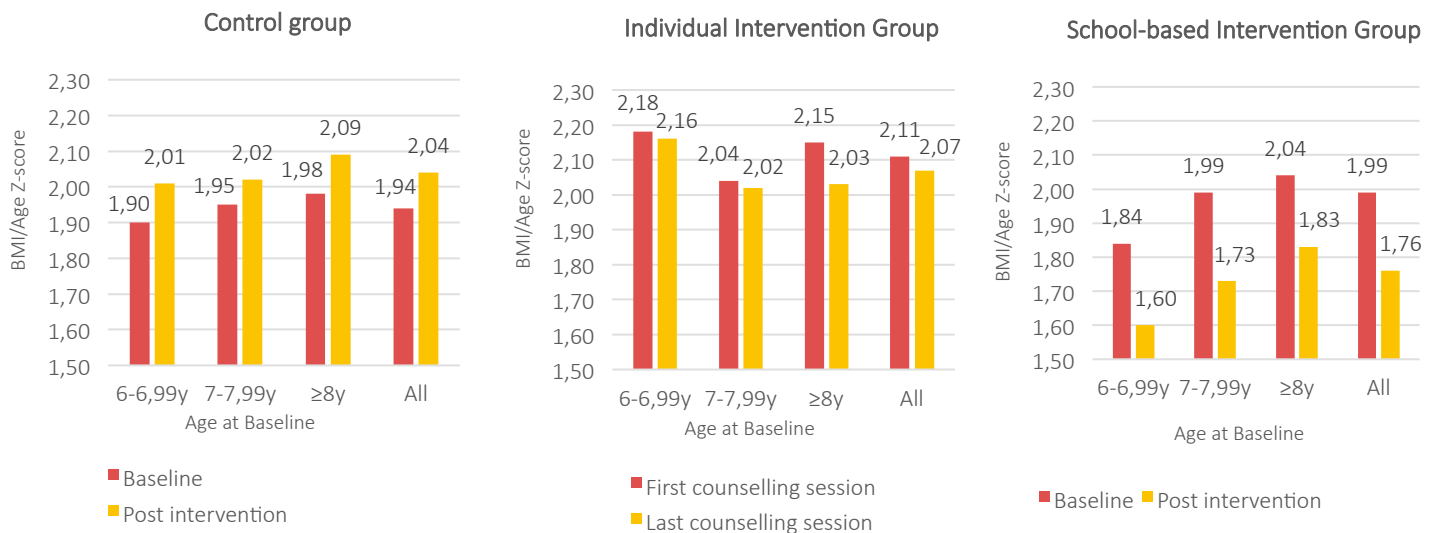
Figure 3: Changes in BMI /age z scores, from baseline to post intervention, by age in the 3 Study Group.

As reported, there was an overall BAZ mean value decrease in the intervened groups compared with the control group which, in opposite to these two, had an overall and statistically significant increase of (+0,10 mean BAZ).

Between the two intervention groups, a higher effect was seen in the school based intervention group (-0,23 mean BAZ)(p<0,001) compared with the Individual counseling Intervention group (-0,04 mean BAZ)(p<0,05) .

As for SB Group, the effect of the intervention on BAZ mean values, was similar between age groups (age 6y: -0,24; 7y: -0,26; ≥8y: -0,21) although its decrease was only statistically significant for children of 7 years and aged 8 or more years (p<0,001).

This age group were the ones with a greater decrease of the BAZ mean values (-0,12) in the Individual Intervention Group, compared with the other two age groups (age 6-7y: -0,02; 7-8y: -0,02), and also the only age group with a statistically significant decrease on their BAZ mean values (p<0,05)

Moreover, when we analyze by the number of children that change their initial nutritional status for an healthier category, we see that that there <u>was a decrease in the number of overweight children in all study groups</u> showing a bigger effect on the School Based Intervention Group (-18,3%) when compared with the Individual Intervention Group (-2,8%) and the Control Group (-7,4%) (Table 12).

Control Group		Indivual Intervention Group		School Based Intervention Group	
Baseline	Post Intervention	Baseline	Post Intervention	Baseline	Post Intervention
n	n	n	n	n	n
136	126 (-7,4%)	106	103 (-2,8%)	202	165 (-18,3%)

Table 12: Changes in overweight status among participant children of the 3 study groups.

	Individual Intervention Group					
	Baseline			Post Intervention		
	Pre-obesity n	Obesity n	OVERWEIGHT	Pre-obesity n	Obesity n	OVERWEIGHT (variation)
LVT	25	31	56 (52,8%)	22	32	54 (-3,7%)
Alentejo	8	5	13 (12,3%)	8	5	13 (0%)
Algarve	7	2	9 (8,5%)	7	2	9 (0%)
Madeira	8	8	16 (15,1%)	9	6	15 (-6,3%)
Açores	7	5	12 (11,3%)	5	7	12 (0%))
Total	55	51	106 (100%)	51	52	103 (-2,8%)

Table 13: Changes in overweight status among participant children of the Individual Intervention.

Comparing the intervention on individual basis, among all municipalities, the ones from Madeira Island (Funchal, Câmara de Lobos and Santa Cruz) were the one with a higher effect in Children´s nutritional status, (Table 13)

5.1.4. EATING AND PHYSICAL ACTIVITY HABITS

To assess the children's eating habits, a questionnaire was applied to the child's parents/educators of the Intervention Groups, at the beginning (2016) and at the end of AMEA Kids (2017) study. The results regarding the Individual Intervention Group are displayed on Table 14 and the ones regarding the School-based intervention Group are displayed on Table 15.

Food Frequency	Baseline							Post intervention						
	Fruit (n=52)	Vegetables (n=52)	Soft drinks (n=51)	Diet soft drinks (n=50)	Candies (n=52)	Savoury Snacks (n=52)	Cakes (n=51)	Fruit (n=52)	Vegetables (n=52)	Soft drinks (n=51)	Diet soft drinks (n=50)	Candies (n=52)	Savoury Snacks (n=52)	Cakes (n=51)
Never	0 (0,0%)	0 (0,0%)	19 (37,3%)	43 (86,0%)	8 (15,4%)	15 (28,8%)	9 (17,6%)	2 (3,8%)	3 (5,8%)	23 (45,1%)	48 (96,0%)	15 (28,8%)	23 (44,2%)	10 (19,6%)
Less than once a week	0 (0,0%)	1 (1,9%)	8 (15,7%)	1 (2,0%)	14 (26,9%)	15 (28,8%)	9 (17,6%)	1 (1,9%)	0 (0,0%)	7 (13,7%)	0 (0,0%)	15 (28,8%)	14 (26,9%)	13 (25,5%)
1-3 times a week	8 (15,4%)	12 (23,1%)	19 (37,3%)	6 (12,0%)	25 (48,1%)	22 (42,3%)	27 (52,9%)	4 (7,7%)	14 (26,9%)	11 (21,6%)	1 (2,0%)	18 (34,6%)	12 (23,1%)	20 (39,2%)
4-6 times a week	7 (13,5%)	19 (36,5%)	5 (9,8%)	0 (0,0%)	3 (5,8%)	0 (0,0%)	5 (9,8%)	11 (21,2%)	15 (28,8%)	5 (9,8%)	1 (2,0%)	1 (1,9%)	3 (5,8%)	7 (13,7%)
Every day	37 (71,2%)	20 (38,5%)	0 (0,0%)	0 (0,0%)	2 (3,8%)	0 (0,0%)	1 (2,0%)	34 (65,4%)	20 (38,5%)	5 (9,8%)	0 (0,0%)	3 (5,8%)	0 (0,0%)	1 (2,0%)

Table 14: Children's eating habits at the beginning and at the end of AMEA kids – Individual Group.
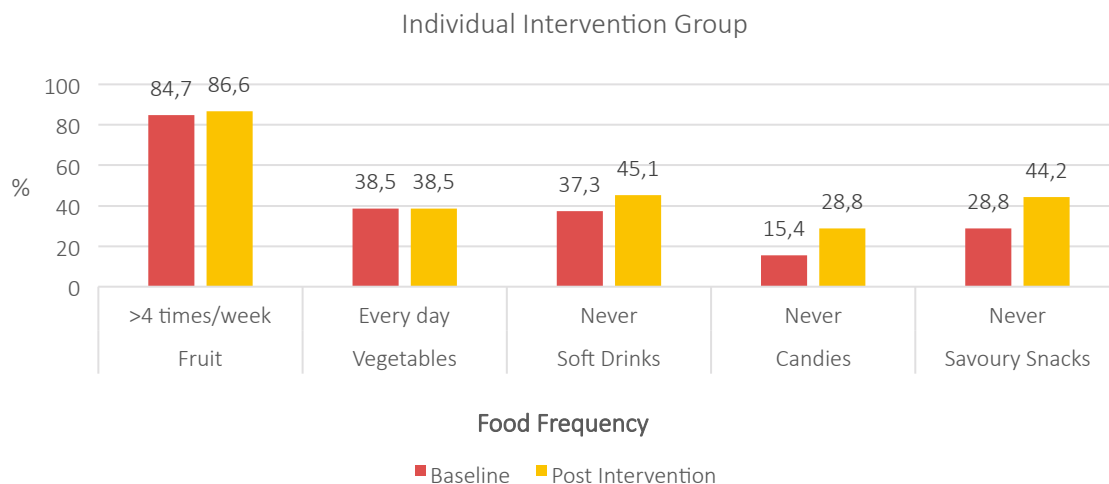
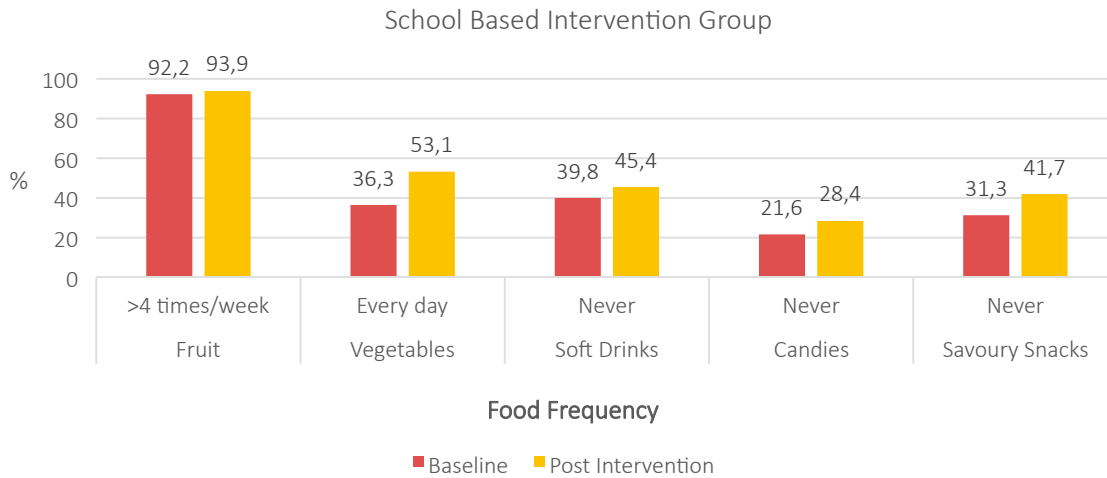|	Baseline							Post intervention						
	Fruit (n=115)	Vegetables (n=113)	Soft drinks (n=108)	Diet soft drinks (n=104)	Candies (n=116)	Savoury Snacks (n=115)	Cakes (n=114)	Fruit (n=115)	Vegetables (n=113)	Soft drinks (n=108)	Diet soft drinks (n=104)	Candies (n=116)	Savoury Snacks (n=115)	Cakes (n=114)
Never	0 (0,0%)	3 (2,7%)	43 (39,8%)	87 (83,7%)	25 (21,6%)	36 (31,3%)	15 (13,2%)	1 (0,9%)	5 (4,4%)	49 (45,4%)	86 (82,7%)	33 (28,4%)	48 (41,7%)	34 (29,8%)
1-3 times a week	9 (7,8%)	25 (22,1%)	43 (39,8%)	13 (12,5%)	76 (65,5%)	76 (66,1%)	68 (59,6%)	6 (5,2%)	12 (10,6%)	50 (46,3%)	18 (17,3%)	74 (63,8%)	66 (57,4%)	67 (58,8%)
4-6 times a week	23 (20,0%)	44 (38,9%)	11 (10,2%)	2 (1,9%)	13 (11,2%)	3 (2,6%)	22 (19,3%)	15 (13,0%)	36 (31,9%)	8 (7,4%)	0 (0,0%)	9 (7,8%)	1 (0,9%)	9 (7,9%)
Every day	83 (72,2%)	41 (36,3%)	11 (10,2%)	2 (1,9%)	2 (1,7%)	0 (0,0%)	9 (7,9%)	93 (80,9%)	60 (53,1%)	1 (0,9%)	0 (0,0%)	0 (0,0%)	0 (0,0%)	4 (3,5%)

Table 15: Children's eating habits at the beginning and at the end of AMEA kids – School-based intervention Group

Fig.4 and 5 shows some of the positive changes between the two moments of the study at baseline (M1) and at post-intervention (M2). Fruit frequency (>4 times/week) increased in both study groups, being slightly higher in the Individual Intervention group (+1,9%) than the SB Intervention Group (+1,7%). Regarding Vegetables frequency (every day) an higher effect of the intervention was seen on the school based intervention group (M1: 36,3%, M2: 53,1%) compared with the Individual Intervention group, as no effect was seen her (M1 and M2: 38,5%).

Whereas regarding non healthy food items (soft drinks, candies and savoury snacks) the Individual Intervention showed and higher effect than the SB Intervention. Particularly for savoury snacks, at M1 71,2% of the children of the Individual Intervention group, reported some sort of intake which corresponded to only of 28,8% of children reporting a null intake. This frequency was increase for almost double (44,2%) at M2, reducing in 15,4% of children that had some sort of intake per week (55,8%) of these foods (Fig.3). Similar results were seen in the SB Intervention group, although the latter frequency decrease was lower (-10,4%) (Fig 4).

Figure 4: Children´s food frequency of the Individual Intervention Group, at baseline and post intervention.

School Based Intervention Group

Figure 5: Children´s food frequency of the School-based Intervention Group, at baseline and at post interventio

Regarding children´s physical activity habits, the same questionnaire applied to the children's parents/educators, addressed this issue, namely about the intense physical activity daily frequency. These results are presented in tables 16 and 17.

Daily frequency of intense Physical Activity (n=54)	Baseline		Post intervention	
	n	%	n	%
Never	4	7,4	2	3,7
Less than 1 hour/day	17	31,5	16	29,6
About 1 hour/day	23	42,6	24	44,4
About 2 hours/day	6	11,1	10	18,5
3 or more hours/day	4	7,4	2	3,7

Table 16: Children's physical activity habits at the beginning and at the end of AMEA kids – Individual Group.

Daily frequency of intense Physical Activity (n=90)	Baseline		Post intervention	
	n	%	n	%
Never	5	5,6	1	1,1
Less than 1 hour/day	23	25,6	18	20,0
About 1 hour/day	54	60,0	53	58,9
About 2 hours/day	7	7,8	11	12,2
3 or more hours/day	1	1,1	7	7,8

Table 17: Children's physical activity habits at the beginning and at the end of AMEA kids – School-based intervention Group

In both study groups an icreased level of physical activity was achieved. The number of sedentary children (no exercise or less than 1h/day) decreased from 38,9% to 33,3% (-5,6%) in the Indivual Intervention Group and from 31,2% to 21,1% (-10,1%) in the SB Intervention group, whereas for exercing 1-2h/day (reccomended) intervention achieved an icrease from 53,7% to 62,6% (+8,9%) in the Individual Int. Group and 67,8% to 71,1% (+3,3%) in the SB Interv. Group.

5.2. Knowledge Assessment

At the end of the program, in order to assess the improvement of children's knowledge about Mediterranean Diet (MD) and its principals a session was given to the study groups. At the start of the session children were asked to answer a quiz about MD principles. A session on MD principles including a story and a game was then performed by a nutritionist and afterwards the groups were assessed again.

As described in figures 6 to 10, this session proved to be successful by increasing the participant's knowledge on this matter of both intervention groups.
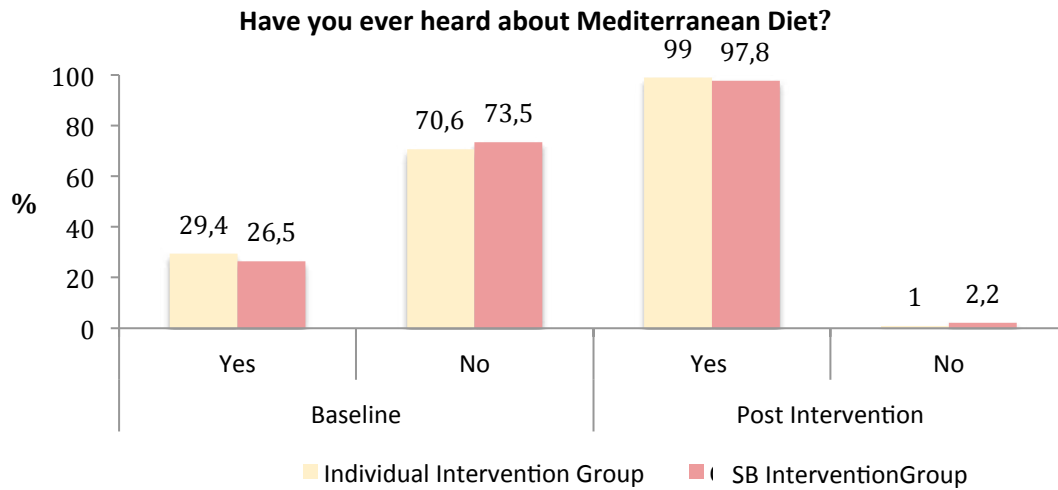
Have you ever heard about Mediterranean Diet?

Figure 6 – Children's knowledge about MD concept
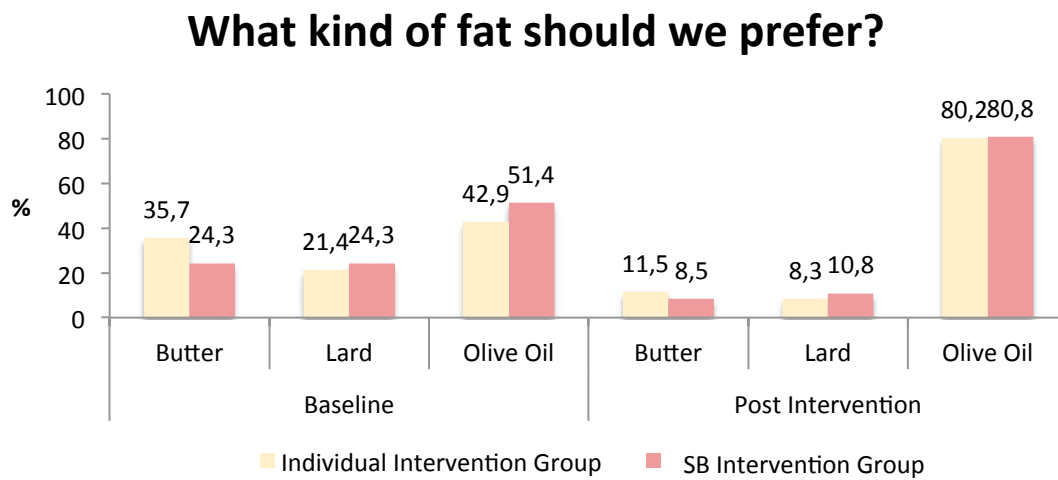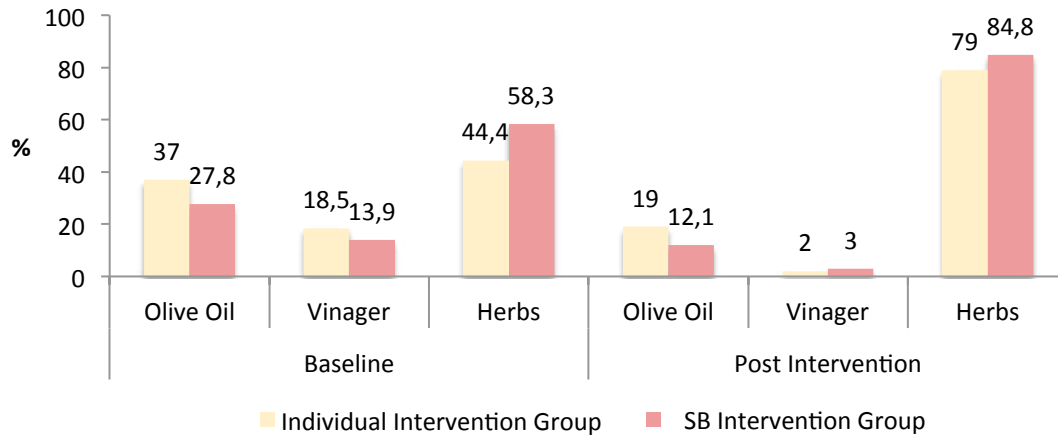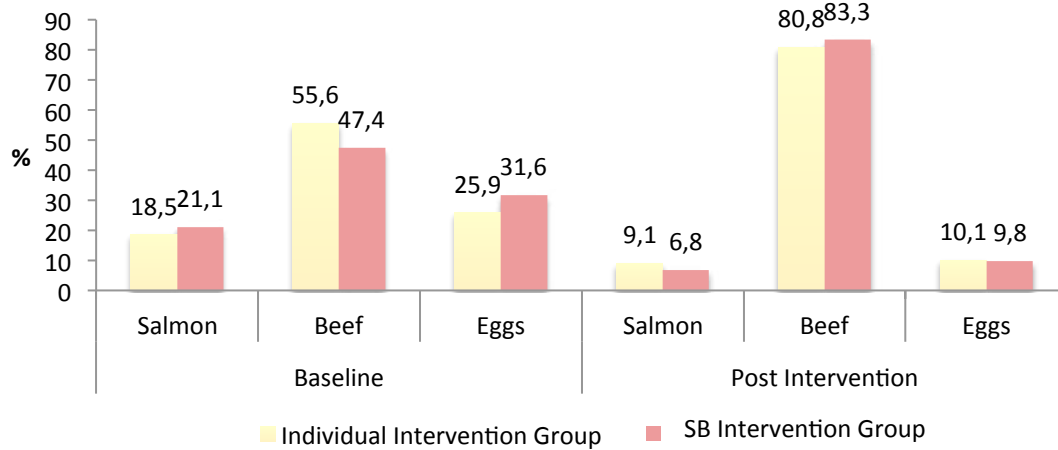
What kind of fat should we prefer?

Figure 7 – Children's knowledge about one of the MD principles, related with fat consumption
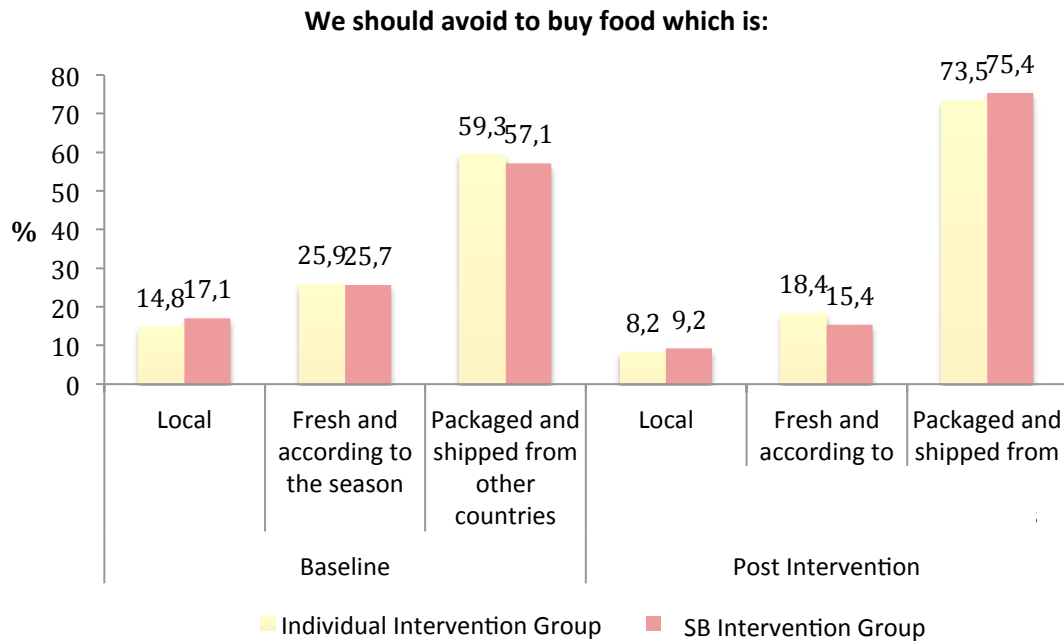
What ingredient sould we use to season our food?

Figure 8 - Children's knowledge about one of the MD principles, related with salt consumption

Which one of this foods should we eat less times a week?

Figure 9 - Children's knowledge about one of the MD principles, related with red meat consumption

We should avoid to buy food which is:

Figure 10 - Children's knowledge about one of the MD principles, related with purchase of local and seasonal products

6. Conclusion

AMEA kids proved to be a successful program among overweight children in Portugal. Applying a randomized control trial allowed to learn that independently of the type of intervention, school based or family based programs seem to have an effect on chidlren´s nutritional status.

In fact, in this study the control group showed a statistically significant increase on the mean Body Mass Index Z scores values, between the two moments of the study (p<0,001), whereas for the Individual and School Based (SB) Intervention Groups a statistically significant decrease was seen in both groups, with a higher effect on the SB intervention group and in older children (>8 years old).

The improvement of the nutritional status in the intervention groups was also followed by acquiring knowledge in Nutrition, the improvement on dietary patterns (increasing the consumption of food and vegetables; decreasing consumption of foods high in fat, salt and sugar) and on their daily routines, with an increase on physical activity patterns (1-2h/day). Overall, the Individual Intervention group achieved an higher effect than the School Based Intervention group, which can be partially explained by the individualized and specific recommendations for physical activity according to each child´s level and the

food dietary plan that focused in specific food groups assisting in a more in-depth way these chidlren´s and families to opt for healthier choices.

Although successful, this study also allowed the learning in a deeper level of some features of each type of intervention.

The individual intervention had better results on improving healthy lifestyles in the overweight children, with an improvement on their nutritional status, but proved to be more difficult to apply when compared with the other intervention group. One reason might be the specificity of the counseling sessions which had to be followed by the nutritionists. Despite having a very detailed and precise guide to assist them, the effect of the intervention also depended on the level of individual professional approach and on the level of enthusiasm, self motivation and participation of children and families in these sessions. This was showed by the rate of drop out between the 1st and the 4th counselling session of the program which consisted almost in half: 44,8% (86 children), being higher between the 1st and the 2nd (-20,4 %), which might lead us to believe that families are still not motivated, or are not aware of the importance on tackling overweight in children, or even because they still believe that with one session this problem can be solved. In fact the overall maternal education of the intervention groups were just what is considered in Portugal basic and mandatory (until 12th grade) which is a general feature, seen before in the literature[1], when it comes to characterize families with overweight children.

The School Based Intervention program, in AMEA kids, was a very well designed and established intervention set of activities, which followed the lessons learned from other studies. It proved to be very successful in decreasing the number of overweight children, thus improving their overall nutritional status. One must note that this program was done for all the children in that school despite their initial nutritional status. It was a very comprehensive program that empowered children to be an active participated member in community action, and also promote health within their environment with their peers. This approach seemed to be a more valued one when the objective is to deal with obesity and overweight in transversal to all community layers and as a multi stakeholder and multi level tackling of the problem.

Nevertheless this type of intervention showed to be more expensive, time consuming regarding the organization and preparation of the activities, and needed a very well organized coordinating team in order to successfully articulate with all agents who intervened. Specific family characterization was also more demanding with regard of time, as this had to go via school channels

On a final note, one can highlight that AMEA kids program accomplished its objectives and was an important program for the mobilization of all the actors at community level, parents, health professionals, school staff, teachers, municipality staff and other associations from neighborhood. This improved and strengthened the partnerships between local agents and institutions, provindig a better understanding of their community and also providing a better environment and better health among their children.

7. References

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