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Differences in meal patterns and timing with regard to central obesity in the ANIBES Study

With the participation of:

Spanish Nutrition and Food Sciences Academy (AEN)

Spanish Nutrition Society (SEN)

Spanish Society of Community Nutrition (SENC)

Spanish Foundation for Nutritional Research (FIN)

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Improvement of Health by Fitness, Nutrition and Exercise Research Group

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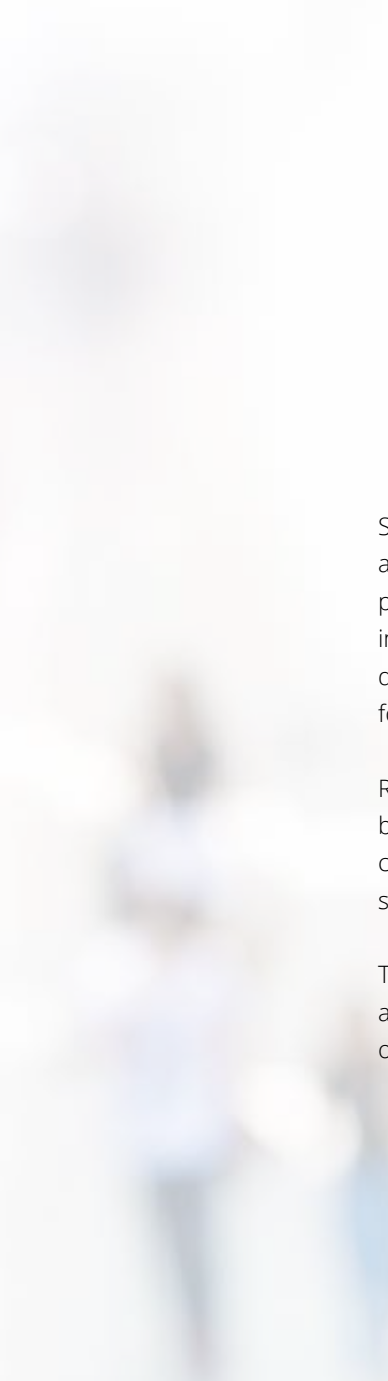
Introduction

The prevalence of obesity is increasing worldwide and the role of individual dietary components in this trend has been the main focus of considerable research.

Without a shadow of a doubt, changes in dietary habits and physical activity are essential in the strategies to reduce excess weight. However, it has been observed that not all of these are equally effective, it has even been proposed that some types of diets may increase risk factors associated with obesity. It should be taken into account that each diet to lose weight has limitations, ranging from high dropout rates to maintenance difficulties. Therefore, one can say that most of them have the ability to attenuate some, but not all, of the components involved in this complicated multifactorial condition that is obesity.

Overall, the adoption of a dietary pattern characterized by high intakes of red and processed meats, refined grains, sweets and desserts (Western pattern) is associated with larger weight gain, whereas a dietary pattern characterized by high intakes of fruits, vegetables, whole grains, fish and poultry (healthy pattern) may facilitate weight maintenance and have fewer metabolic consequences.



Several authors have considered that while some types of diet may be effective in the fight against obesity (low-calorie or high protein diets), they all have limitations, such as high dropout rates due to continuous difficulties or the mitigation of only some, but not all, factors involved in this condition. Therefore, it is currently unknown which is the most adequate dietary intervention. One current consideration is to pay attention at the time of the day foods are consumed.

Recent studies suggest that some characteristics of dietary behaviour such as skipping breakfast, eating more of the day's total energy intake during the evening, higher frequency of meals eaten away from home and a lower number of meals eaten per day, but also snacking between meals, are associated with a higher risk of being overweight or obese.

The aim of this research was to study the association of different meals frequency, as well as time spent on them and of nutrient intake and meal patterns, with abdominal obesity in order to identify the best dietary strategies that can help reduce the prevalence of obesity.

Materials and Methods

The design, protocol and methodology of the ANIBES Study have been already described in detail in Ruiz E. et al. 2015 and Varela-Moreiras G. et al. 2015.

Likewise, details of anthropometric parameters used in the ANIBES Study have been described in López-Sobaler AM. et al. 2016, and physical activity patterns have been analyzed in Mielgo-Ayuso J. et al. 2016. On the other hand, the association between suffering from general and abdominal obesity and the physical activity level has been studied in López-Sobaler AM. et al. 2016.

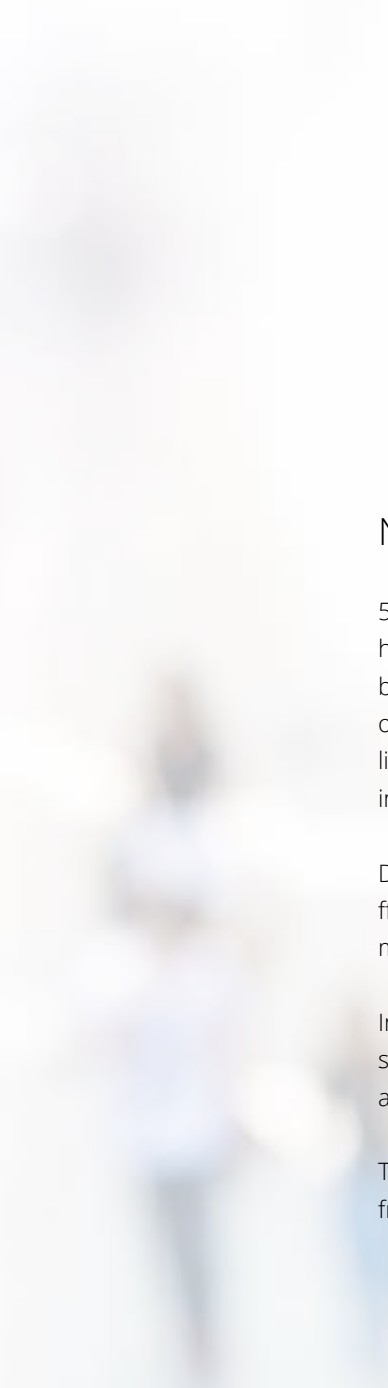
Concerning the sample, this work from the ANIBES Study was focused on the analysis of the adult group aged 18-64 years (n = 1,655; 798 men and 857 women).

Waist-to-height ratio was calculated in order to determine the existence of abdominal obesity. Height and waist circumference were measured using standardized procedures and their ratio was calculated, thus dividing subjects of the study into two groups: those without abdominal obesity (waist-to-height ratio < 0.5) and those with abdominal obesity (waist-to-height ratio ≥ 0.5).

Difference in habits according to sex

The results show that women followed more adequate dietary habits than men, eating a greater number of meals daily, skipping fewer meals, taking more time on the total of intakes, breakfast and mid-afternoon snack than men and eating more energy in the morning than in the evening. On the other hand, men consumed more energy after 14.00 hours and from dinner than women.

Finally, the variety of meat and eggs was higher in men than women, but the variety of fish, fruits, wholegrain cereals and dairy products was higher in women.



Number of meals daily

54.4 % of the adult female population ate more than 4 meals daily, a figure significantly higher than that observed in adult men (38.8 %). The percentage of men who skipped breakfast, mid-morning snack and mid-afternoon snack was higher than in women. In spite of this, the results found that eating four or more meals daily was associated with reduced likelihood of suffering from abdominal obesity in men, after adjusting for age and energy intake.

Dividing the population according to the presence of abdominal obesity, there were no differences in the total number of meals eaten per day, but the percentage of people eating more than four meals daily was higher in the group without abdominal obesity.

Individuals with abdominal obesity more frequently skipped the mid-afternoon snack and spent less time on the mid-morning snack and more time on lunch than those without abdominal obesity.

Thus, these findings suggest that there may be a favourable impact of increasing eating frequency with regard to preventing abdominal obesity.

Distribution of energy throughout the day

In women, those with abdominal obesity ate more calories at breakfast and lunch and less energy at mid-afternoon snack than those without abdominal obesity. Specifically, breakfasts containing more than 25 % of total daily energy were associated with increased likelihood of suffering from abdominal obesity. Nevertheless, women with abdominal obesity ate more energy after 14.00 hours than women without abdominal obesity.

As for the total population, breakfasts and lunches containing more than 25 % and 35 % of total energy intake respectively were associated with increased likelihood of suffering from abdominal obesity.

On the contrary, mid-morning snacks and mid-afternoon snacks, leading to an intake over 15 % of total energy, were associated with decreased likelihood of abdominal obesity. Furthermore, skipping the mid-afternoon snack was associated with increased likelihood of suffering from abdominal obesity.

As shown in these results, the importance of mid-morning and mid-afternoon snacks having adequate energy content (> 15 % of total daily intake) is remarkable because:

- The foods consumed during these meals could promote a healthier diet, because of their relationship with the consumption of milk and dairy products, fruits and vegetables and because it seems that a right mid-morning and mid-afternoon snack may contribute significantly to an adequate daily intake of nutrients.

- These meals might affect the subsequent intake, and thus lead to lower consumption of foods and energy in lunch and dinner. This situation may be beneficial to fight against the risk of suffering from obesity and other adverse metabolic consequences.

Diet characteristics of the studied population according to sex

	TOTAL (N = 1,655) MEAN ± SD / %	MEN (N = 798) MEAN ± SD / %	WOMEN (N = 857) MEAN ± SD / %
No. of eating occasions per 24 h	4.11 ± 0.85	3.95 ± 0.84***	4.26 ± 0.83***
No. of meals daily (%)			
0-3	15.6	20.4*	11.1*
3-4	37.5	40.7*	34.5*
>4	46.9	38.8*	54.4*
No. of meals away from home	1.08 ± 0.92	1.05 ± 0.93	1.11 ± 0.92
Percentage of individuals who skip meals			
Breakfast	1.99	3.01*	1.05*
Mid-morning snack	34.9	38.70*	31.40*
Lunch	0.6	0.00	0.12
Mid-afternoon snack	29.8	36.10*	23.90*
Dinner	0.3	0.25	0.35
Time spent on each meal of the day (min/d)			
Breakfast	12.5 ± 8.9	11.9 ± 9.4***	13.0 ± 8.3***
Mid-morning snack	4.9 ± 7.8	4.8 ± 7.6	5.1 ± 8
Lunch	19.6 ± 10.4	19.3 ± 10	19.9 ± 10.7
Mid-afternoon snack	6.1 ± 9.9	5.1 ± 9.3***	7.0 ± 10.4***
Dinner	18.7 ± 10.7	18.7 ± 10.9	18.8 ± 10.5
Total time	64.1 ± 29.8	62.3 ± 29.8**	65.8 ± 29.6**
Total energy (kJ/d)	7,598 ± 2,142	8,226 ± 2,272***	7,008 ± 1,828***
Total energy (kcal/d)	1,816 ± 512	1,966 ± 543***	1,675 ± 437***
Percentage of energy consumed at each meal (%)			
Breakfast	16.4 ± 8.5	15.5 ± 8.7***	17.2 ± 8.3***
Mid-morning snack	4.6 ± 6.2	4.8 ± 6.8	4.4 ± 5.5
Lunch	39.8 ± 9.9	39.8 ± 5.7	39.5 ± 9.9
Mid-afternoon snack	5.5 ± 6.4	4.8 ± 6.4***	6.1 ± 6.4***
Dinner	30.5 ± 9.9	31.7 ± 9.9***	29.4 ± 29.8***
Evening/morning energy intake ratio (cut point at 14.00 hours)	4.5 ± 19.7	4.65 ± 10.31*	4.35 ± 29.49*
Time spent sleeping (h)	7.46 ± 1.13	7.46 ± 1.11	7.46 ± 1.12

SD: Standard deviation

*p <0.05; **p <0.01; ***p <0.001 (significantly different between men and women). The Student t test (or the Mann–Whitney U test if the distribution of results was not homogeneous) was used to compare variables between men and women. The z test was used to compare proportions.

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Diet characteristics of the studied population according to abdominal obesity classification

	TOTAL		MEN		WOMEN	
	WHtR < 0.5 (n = 689) Mean ± SD / %	**WHtR ≥ 0.5 (n = 966) Mean ± SD / %**	**WHtR < 0.5 (n = 282) Mean ± SD / %**	**WHtR ≥ 0.5 (n = 516) Mean ± SD / %**	**WHtR < 0.5 (n = 407) Mean ± SD / %**	**WHtR ≥ 0.5 (n = 450) Mean ± SD / %**
No. of eating occasions per 24 h	4.14 ± 0.85	4.09 ± 0.85	3.98 ± 0.86	3.94 ± 0.83	4.24 ± 0.83	4.27 ± 0.84
No. of meals daily (%)						
0-3	15.5	15.6	21.3	20.0	11.5	10.7
3-4	34.5*	39.6*	35.8	43.4	33.7	35.3
>4	49.9*	44.7*	42.9	36.6	54.8	54.0
No. of meals away from home	1.21 ± 0.93***	0.99 ± 0.90***	1.12 ± 0.93	1.02 ± 0.92	1.28 ± 0.94***	0.96 ± 0.87***
Percentage of individuals who skip meals (%)						
Breakfast	2.61	1.55	3.55	2.71	1.97	0.22
Mid-morning snack	32.8	36.44	34.75	40.89	31.45	31.33
Lunch	0.15	0.00	0.00	0.00	0.25	0.00
Mid-afternoon snack	26.56*	32.09*	32.98	37.79	22.11	25.56
Dinner	0.44	0.21	0.35	0.19	0.49	0.22
Time spent on each meal of the day (min/d)						
Breakfast	12.1 ± 8.7	12.7 ± 9.0	11.7 ± 9.8	12.0 ± 9.2	12.4 ± 8.0	13.5 ± 8.6
Mid-morning snack	5.10 ± 7.6*	4.8 ± 7.9*	4.9 ± 7.0	4.7 ± 7.9	5.3 ± 8.1	4.9 ± 8.0
Lunch	19.1 ± 10.6**	20.0 ± 10.2**	18.9 ± 10.9	19.5 ± 9.6	19.2 ± 10.5*	20.0 ± 10.9*
Mid-afternoon snack	6.0 ± 8.9	6.2 ± 10.5	5.4 ± 9.0	5.0 ± 9.5	6.4 ± 8.9	7.6 ± 11.5
Dinner	19.1 ± 11.1	18.5 ± 10.4	18.7 ± 10.7	18.7 ± 11.0	19.3 ± 11.4	18.3 ± 9.7
Total time	63.7 ± 29.7	64.4 ± 29.8	60.8 ± 30.7**	63.1 ± 29.2**	65.7 ± 28.8	66.0 ± 30.4
Total energy (kJ/d)	7,891 ± 2,272***	7,385 ± 2,017***	8,795 ± 2,431***	7,916 ± 2,121***	7,263 ± 1,924***	6,778 ± 1,703***
Total energy (kcal/d)	1,886 ± 543***	1,765 ± 482***	2,102 ± 581***	1,892 ± 507***	1,736 ± 460***	1,620 ± 407***
Percentage of energy consumed at each meal (%)						
Breakfast	16.1 ± 8.3	16.6 ± 8.7	15.6 ± 8.3	15.4 ± 8.8	16.5 ± 8.21*	17.9 ± 8.4*
Mid-morning snack	5.2 ± 6.6***	4.1 ± 5.9***	5.8 ± 7.3**	4.2 ± 6.5**	4.8 ± 6.0	4.0 ± 5.1
Lunch	38.0 ± 9.6***	41.1 ± 9.8***	37.6 ± 9.3***	41.6 ± 9.8***	38.3 ± 9.9***	40.5 ± 9.7***
Mid-afternoon snack	6.3 ± 6.9***	4.9 ± 6.1***	6.0 ± 7.2***	4.2 ± 5.8***	6.5 ± 6.6*	5.8 ± 6.2*
Dinner	30.6 ± 10.2	30.4 ± 9.7	31.8 ± 10.0	31.7 ± 9.9	29.8 ± 10.3	29.0 ± 9.2
Evening/morning energy intake ratio (cut point at 14.00 hours)	3.5 ± 3.0	5.21 ± 25.66	3.56 ± 2.97	5.25 ± 12.61	3.45 ± 3.02*	5.16 ± 35.06*
Time spent sleeping (h)	7.62 ± 1.08***	7.34 ± 1.15***	7.64 ± 0.99***	7.35 ± 1.14***	7.60 ± 1.14***	7.33 ± 1.17***

SD: Standard deviation WHtR: Waist-to-Height Ratio

*p <0.05; **p <0.01; ***p <0.001 (significantly different between WHtR < 0.5 and WHtR ≥ 0.5). The Student t test (or the Mann–Whitney U test if the distribution of results was not homogeneous) was used to compare variables between WHtR < 0.5 and WHtR ≥ 0.5. The z test was used to compare proportions.

Without abdominal obesity, WHtR < 0.5; with abdominal obesity, WHtR ≥ 0.5.

Dietary variety

Dietary variety was higher in the total population and men without abdominal obesity. Specifically, the variety of cereals, wholegrain cereals and dairy products was higher in those individuals without abdominal obesity and of dairy products in women without abdominal obesity.

Time spent on different meals

According to the results of this work, individuals with abdominal obesity spent less time on the mid-morning snack than those without abdominal obesity. Furthermore, they consumed fewer meals away from home, slept for shorter, and ate more energy at lunch and less energy at the mid-morning and mid-afternoon snacks than those without abdominal obesity. Likewise, men with abdominal obesity spent more time eating all meals than those without abdominal obesity. On the other hand, women suffering from abdominal obesity spent more time eating lunch only, than those without abdominal obesity, which could be because this longer time allows a higher intake of food compared with those who spend less time.

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Diet variety of the studied population according to sex

	TOTAL Mean ± SD	MEN Mean ± SD	WOMEN Mean ± SD
Total variety	26.9 ± 6.70	27.00 ± 70.00	26.8 ± 6.40
Meat variety	2.96 ± 1.75	3.18 ± 1.86***	2.76 ± 1.62***
Fish variety	1.28 ± 1.42	1.22 ± 1.44**	1.34 ± 1.39**
Eggs variety	0.65 ± 0.51	0.68 ± 0.51*	0.63 ± 0.51*
Vegetables variety	5.02 ± 2.47	4.88 ± 2.48	5.14 ± 2.46
Fruits variety	1.73 ± 1.75	1.58 ± 1.68***	1.88 ± 1.81***
Fruits and vegetables variety	6.75 ± 3.40	6.46 ± 3.39	7.02 ± 3.39
Cereals variety	4.05 ± 1.84	3.97 ± 1.76	4.13 ± 1.91
Whole cereals variety	0.26 ± 0.55	0.20 ± 0.48***	0.32 ± 0.60***
Pulses variety	0.50 ± 0.67	0.53 ± 0.69	0.48 ± 0.64
Dairy products variety	2.78 ± 1.61	2.70 ± 1.60*	2.85 ± 1.62*

SD: Standard deviation

*p < 0.05; **p < 0.01; ***p < 0.001 (significantly different between men and women). The Student t test (or the Mann–Whitney U test if the distribution of results was not homogeneous) was used to compare variables between men and women.

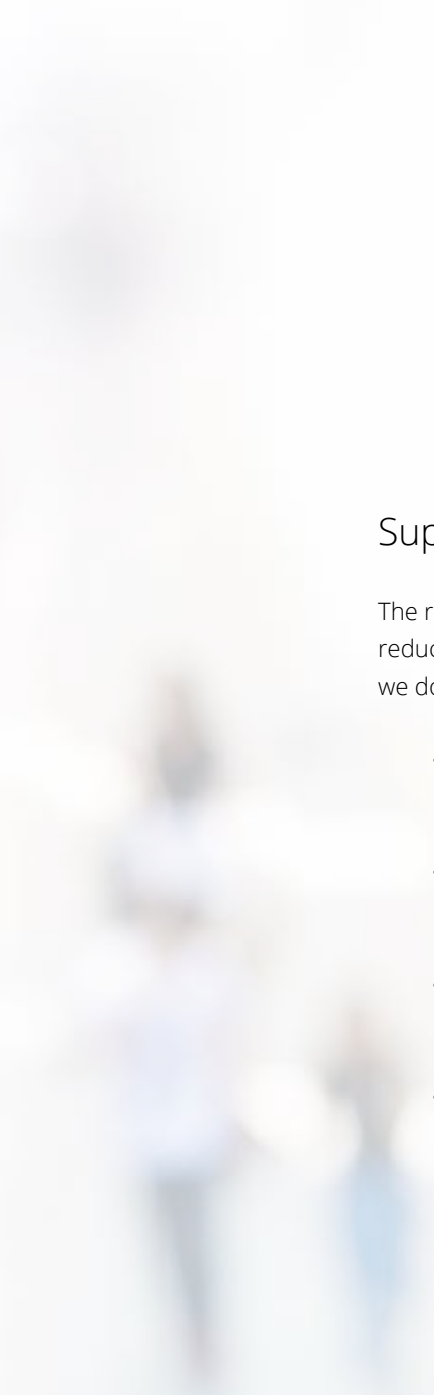
Diet variety of the studied population according to abdominal obesity

	TOTAL		MEN		WOMEN	
	WHtR < 0.5 Mean ± SD	WHtR ≥ 0.5 Mean ± SD	WHtR < 0.5 Mean ± SD	WHtR ≥ 0.5 Mean ± SD	ICT < 0,5 Media ± DE	WHtR ≥ 0.5 Mean ± SD
Total variety	27.6 ± 6.8***	26.4 ± 6.5***	28.0 ± 7.1***	26.3 ± 6.8***	27.2 ± 6.5	26.4 ± 6.1
Meat variety	2.97 ± 1.71	2.95 ± 1.78	3.24 ± 1.84	3.14 ± 1.87	2.78 ± 1.59	2.74 ± 1.65
Fish variety	1.28 ± 1.45	1.28 ± 1.39	1.20 ± 1.44	1.23 ± 1.45	1.34 ± 1.45	1.34 ± 1.32
Eggs variety	0.64 ± 0.51	0.66 ± 0.51	0.70 ± 0.51	0.68 ± 0.50	0.60 ± 0.51	0.65 ± 0.51
Vegetables variety	5.12 ± 2.55	4.94 ± 2.41	5.08 ± 2.61	4.77 ± 2.40	5.14 ± 2.52	5.14 ± 2.41
Fruits variety	1.80 ± 1.85	1.68 ± 1.68	1.72 ± 1.87	1.50 ± 1.56	1.86 ± 1.83	1.89 ± 1.80
Fruits and vegetables variety	6.92 ± 3.58	6.63 ± 3.26	6.79 ± 3.74	6.28 ± 3.17	7.01 ± 3.47	7.03 ± 3.31
Cereals variety	4.18 ± 1.89*	3.96 ± 1.81*	4.11 ± 1.71	3.89 ± 1.79	4.23 ± 2.00	4.04 ± 1.83
Whole cereals variety	0.31 ± 0.61*	0.23 ± 0.5*	0.23 ± 0.52	0.19 ± 0.47	0.37 ± 0.66	0.28 ± 0.53
Pulses variety	0.51 ± 0.68	0.50 ± 0.65	0.55 ± 0.72	0.52 ± 0.68	0.49 ± 0.65	0.47 ± 0.63
Dairy products variety	2.97 ± 1.62***	2.65 ± 1.6***	2.80 ± 1.59	2.65 ± 1.60	3.08 ± 1.63***	2.65 ± 1.59***

SD: Standard deviation WHtR: Waist-to-Height Ratio

*p < 0.05; **p < 0.01; ***p < 0.001 (significantly different between WHtR < 0.5 and WHtR ≥ 0.5). The Student t test (or the Mann–Whitney U test if the distribution of results was not homogeneous) was used to compare variables between WHtR < 0.5 and WHtR ≥ 0.5.

Without abdominal obesity, WHtR < 0.5; with abdominal obesity, WHtR ≥ 0.5.



Support to future strategies

The results of this work, framed within the ANIBES Study, suggest that dietary strategies to reduce the prevalence of abdominal obesity should consider both what we eat and when we do it, and could be:

- Consume at least four meals daily, with a breakfast containing less than 25 % of total daily energy intake.
- Include a mid-morning and a mid-afternoon snack, which provide at least 15 % of total daily energy intake.
- Have lunch at an appropriate time (about 14.00 hours) and with an energy contribution not exceeding 35 % of total daily energy intake.
- Include the maximum number of foods belonging to the groups of dairy products, cereals and whole grains.

References

Aparicio A, Rodríguez-Rodríguez E, Aranceta-Bartrina J, Gil A, González-Gross M, Serra-Majem Ll, Varela-Moreiras G, Ortega RM. Differences in meal patterns and timing with regard to central obesity in the ANIBES ('Anthropometric data, macronutrients and micronutrients intake, practice of physical activity, socioeconomic data and lifestyles in Spain') Study. Public Health Nutrition, 2017:1-10; doi:10.1017/S1368980017000635.

Dehghan M, Akhtar-Danesh N, Merchant AT. Childhood obesity, prevalence and prevention. Nutr J, 2005;4:24.

Kumanyika SK, Obarzanek E, Stettler N et al. Population-based prevention of obesity: the need for comprehensive promotion of healthful eating, physical activity, and energy balance: a scientific statement from American Heart Association Council on Epidemiology and Prevention, Interdisciplinary Committee for Prevention (formerly the expert panel on population and prevention science). Circulation, 2008;118:428-464.

López-Sobaler AM, Aparicio A, Aranceta-Bartrina J, Gil A, González-Gross M, Serra-Majem Ll, Varela-Moreiras G. Overweight and general and abdominal obesity in a representative sample of Spanish adults: Findings from the ANIBES Study. BioMed Research International, 2016;2016:8341487; doi:10.1155/2016/8341487.

López-Sobaler AM, Rodríguez-Rodríguez E, Aranceta-Bartrina J, Gil A, González-Gross M, Serra-Majem Ll, Varela-Moreiras G, Ortega RM. General and abdominal Obesity is related to physical activity, smoking and sleeping behaviours and mediated by the educational level: Findings from the ANIBES Study in Spain. PLoS ONE, 2016;11(2):1-13; doi:10.1371/journal.pone.0169027.

Mielgo-Ayuso J, Aparicio-Ugarriza R, Castillo A, Ruiz E, Ávila JM, Aranceta-Bartrina J, Gil A, Ortega RM, Serra-Majem Ll, Varela-Moreiras G, González-Gross M. Physical activity patterns of the Spanish population are mostly determined by sex and age: Findings in the ANIBES Study. PLoS ONE, 2016;11(2):1-22; doi:10.1371/journal.pone.0149969.

Ruiz E, Ávila JM, Castillo A, Valero T, del Pozo S, Rodríguez P, Aranceta-Bartrina J, Gil A, González-Gross M, Ortega RM, Serra-Majem Ll, Varela-Moreiras G. The ANIBES Study on energy balance in Spain: Design, protocol and methodology. Nutrients, 2015;7:970-998; doi:10.3390/nu7020970.

Varela-Moreiras G, Ávila JM, Ruiz E. Energy Balance, a new paradigm and methodological issues: The ANIBES Study in Spain. Nutr Hosp, 2015;31(3):101-112; doi:10.3305/nh.2015.31.sup3.8758.

World Health Organization (WHO). Obesity: Preventing and Managing the Global Epidemic. Report of a WHO Consultation. WHO Technical Report Series, No. 894. Geneva, 2000.

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The final protocol of the ANIBES scientific study was previously approved
by the Clinical Research Ethics Committee of the Autonomous Region of Madrid (Spain).


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