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Intake and Dietary Food Sources of Fibre in Spain: Differences with Regard to the Prevalence of Excess Body Weight and Abdominal Obesity in Adults of the ANIBES Study

With the participation of:

Spanish Nutrition and Food Sciences Academy (AEN)

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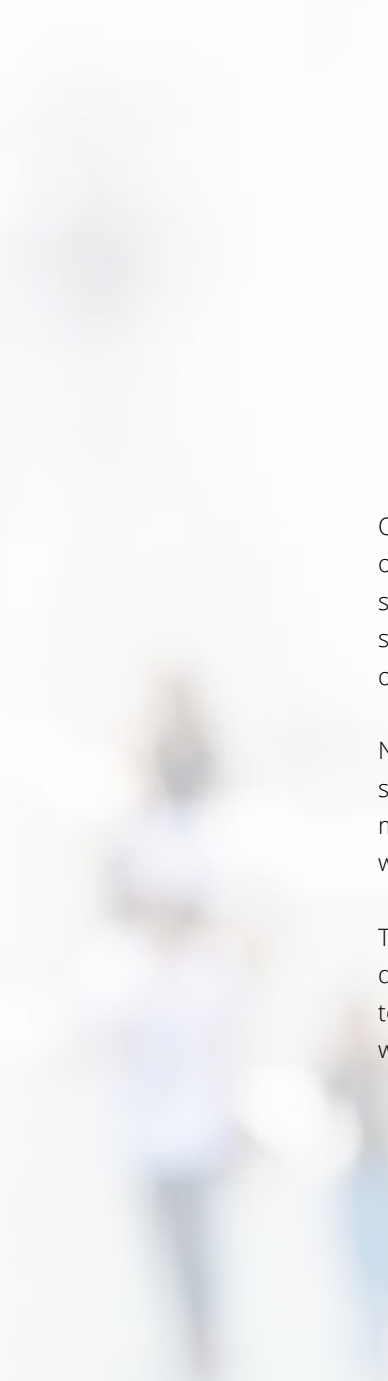
Introduction

In recent decades, there has been a significant increase in the prevalence of overweight and obesity in children and adults, in both developed and developing countries.

Excess body weight is associated with an increased risk of developing various diseases with an important health and social impact, such as cardiovascular disease, type 2 diabetes, some types of cancers, musculoskeletal disorders and neurodegenerative diseases.

Diet and physical activity are the main factors that influence the development of overweight and obesity. In this respect, several studies have shown that the intake of dietary fibre may have a positive effect on body weight control; however, the available results are still inconsistent.

Several mechanisms could explain the anti-obesogenic effect of dietary fibre. Among them are those that refer to the benefits of the fibre capacity (mainly soluble fibre) to form viscous gels that delay the gastric emptying, which helps to increase the satiety sensation and helps to control the postprandial glycaemia by delaying the intestinal absorption.



Other mechanisms are associated with short-chain fatty acid produced during fermentation of fibre in the gastrointestinal tract, which can contribute to regulating the secretion of some gastrointestinal hormones, such as glucagon-like peptide-1 (GLP-1), involved in satiety, and ghrelin, involved in appetite control. Furthermore, they can also increase the oxidation of fatty acids and energy expenditure and to regulate glucose metabolism.

None of the recent studies regarding the intake of fibre in a representative Spanish adults sample have analyzed the relation between the fibre intake throughout the different moments of the day, its food sources and the relation with the problematic of excess body weight and abdominal obesity.

The aim of the present work that is part of the ANIBES Study was to study the intake and dietary food sources of fibre in a representative sample of Spanish adults (18-64 years) and to analyze the differences in fibre intake between people with different body weight and with or without abdominal obesity.

Materials and Methods

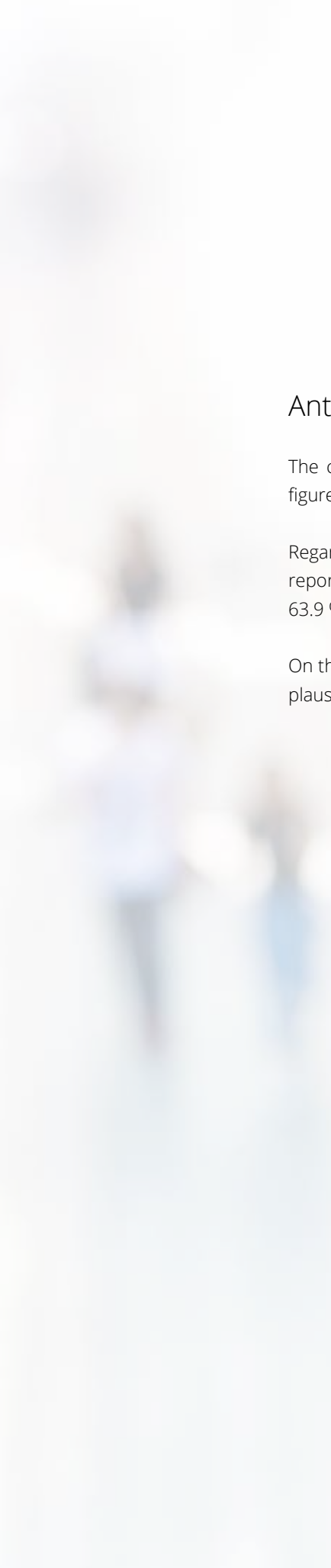
The design, protocol and methodology of the ANIBES Study have been already described in detail in Ruiz E. et al. 2015 and Varela-Moreiras G. et al. 2015.

Likewise, macronutrient distribution and dietary sources have been described by Ruiz E. et al. 2016, anthropometric data have been reviewed in López-Sobaler AM. et al. 2016, and physical activity has been analyzed in Mielgo-Ayuso J. et al. 2016.

This work is focused on the adult population ranging from 18 to 64 years, with a total sample of 1,655 people.

For the assessment of misreporting of energy intake records, the protocol implemented by the European Food Safety Authority (EFSA) has been used. This method evaluates the reported energy intake against the presumed energy requirements, thus classifying the population into two groups: plausible reporters and misreporters.

In this sense, 26.1 % of the studied adults (n = 433) were classified into the group of plausible reporters (158 men and 275 women).



Anthropometric data

The combined prevalence of overweight and obesity in the whole sample was 55.7 %, figure that dropped down to 32.8 % in the group of plausible reporters.

Regarding the prevalence of abdominal obesity, it was 58.4 % (39.3 % in the plausible reporters). For its part, the presence of excess body weight and/or abdominal obesity was 63.9 % (42.7 % in the plausible reporters).

On the other hand, 44.4 % of the whole sample was sedentary (44.3 % in those that were plausible reporters).

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Anthropometric and physical activity data in adults (18-64 years)

PERSONAL, ANTHROPOMETRIC AND PHYSICAL ACTIVITY DATA	WHOLE SAMPLE	PLAUSIBLE REPORTERS
n	**1,655**	**433**
Age (years)*	39.9 ± 12.1	38.5 ± 11.6
Weight (kg)*	74.1 ± 16.4	65.7 ± 13.0
Height (cm)*	167.6 ± 9.3	165.9 ± 9.5
Body mass index (kg/m^2)*	26.3 ± 5.1	23.7 ± 3.8
Underweight (%)	1.8	4.6
Normal (%)	42.5	62.6
Overweight (%)	35.8	25.2
Obesity (%)	19.9	7.6
Waist circumference (cm)*	88.0 ± 14.5	81.4 ± 11.7
Waist to height ratio*	0.52 ± 0.08	0.49 ± 0.07
Non-abdominal obesity (%)	41.6	60.7
Abdominal obesity (%)	58.4	39.3
Non-excess body weight and/or abdominal obesity (%)	36.0	57.3
Overweight and abdominal obesity (%)	63.9	42.7
Physical activity (minutes/week)*	856.6 ± 637.7	889.2 ± 640.2
Vigorous physical activity (minutes/week)*	149.2 ± 264.1	168.6 ± 275.1
Sedentary activity level (%)	44.4	44.3
Active activity level (%)	55.6	55.7

* Mean ± standard deviation. Abdominal obesity: Waist to height ratio (WHtR) ≥ 0.5. Overweight and/or abdominal obesity: body mass index ≥ 25 kg/m^2 and/or waist to height ratio ≥ 0.5.

Mean fibre intake

Mean fibre intake was 12.5 ± 5.66 g/day in the whole sample and 15.8 ± 6.29 g/day in the plausible reporters. In both cases, it was below the adequate intake established by the European Food Safety Authority (EFSA) of 25 g/day.

The main fibre dietary food sources were the groups consisting of grains and flours, followed by vegetables, fruits, and pulses.

In the whole sample, mean fibre intake was higher in those subjects who had normal weight (13.4 g/day), without abdominal obesity (13.5 g/day) and without excess body weight and/or abdominal obesity (13.5 g/day). On the contrary, this intake was lower in those individuals who were overweight (12.3 g/day), with general obesity (11.8 g/day), with abdominal obesity (12.0 g/day), or those with excess body weight and/or abdominal obesity (12.2 g/day).

There were no significant differences in relation with the fibre intake and the body mass index (BMI), presence or absence of abdominal obesity or excess body weight and/or abdominal obesity in the plausible reporters considering sex, and after adjusting for age and physical activity.

Regarding the intake throughout the different moments of the day, fibre from afternoon snacks was higher in subjects with normal weight (6.9 %) and without abdominal obesity (6.9 %) or without excess body weight and/or abdominal obesity (7.2 %). Conversely, these differences were not observed in the plausible reporters.

Fibre Intake and Dietary Food Sources by Sex

While mean intake of fibre (raw) both in men and women was below the adequate intake established by the European Food Safety Authority (EFSA), it was significantly lower in the female population than in the male population.

However, when intake was expressed as grams per 1,000 kcal/day in the whole sample, the data were reversed and intake was higher in women than in men; in the group of plausible reporters, there were no significant differences. This may be explained because women are usually more concerned about following healthy eating habits and tend to include more healthy foods in their diet compared to men.

Both lunch and dinner were the two moments of the day that contributed the highest proportion of fibre intake (75.8 % in the whole sample and 70.5 % in the plausible reporters). Moreover, the analysis of the daily fibre intake depending on the different meals throughout the day, revealed that nearly half came from lunch (47.4 % and 42.9 %) and almost a third from dinner (28.3 % and 27.6 %) in the whole sample and plausible reporters, respectively.

It is noteworthy the fact that the amount of fibre from breakfast was too low (13.0 % in the whole sample and 14.2 % in the plausible reporters) and higher in women, while the fibre intake from dinner was higher in men.

For its part, the mid-morning and afternoon snacks provided the 11.0 % and the 15.1 % of the daily fibre intake in the whole sample and in the plausible reporters, respectively.

Furthermore, the pattern of fibre intake from the different meals of the day differs according to sex. The proportion of fibre from breakfast and afternoon snacks was higher in women and was only higher in men from dinner. These differences in the pattern of fibre intake are probably due to the differences in the food choices made by the subjects at each meal of the day. A better contribution of fibre from breakfast or afternoon snack, with respect to other meals, could help to reduce appetite and food intake at subsequent meals. This could be related to the better situation observed in women compared to men in connection with the presence of excess body weight and abdominal obesity.

The main food sources of fibre in the whole sample and in the plausible reporters were grains and flours (39.1 % in both cases), vegetables (24.1 % and 20.9 %), fruits (16.6 % and 18.5 %), pulses (9.2 % and 9.1 %), ready-to-eat-meals (4.5 % and 4.9 %), sauces and condiments (2.1 % and 1.9 %), appetizers (1.5 % and 2.3 %), sugars and sweets (0.6 % and 1.1 %), non-alcoholic beverages (0.4 % and 0.5 %), milk and dairy products (0.3 % and 0.2 %), and supplements and meal replacements (0.1 % and 0.09 %, respectively).

Fibre intake in the whole sample and in plausible reporters of the ANIBES Study of the Spanish adult population (18–64 years) by sex.

	TOTAL		MEN		WOMEN	
	Whole Sample	Plausible Reporters	Whole Sample	Plausible Reporters	Whole Sample	Plausible Reporters
	n = 1,655	n = 433	n = 798	n = 158	n = 857	n = 257
Energy (kcal/day)*						
Whole Sample	1,815.5 ± 511.9		1,966.2 ± 543.2****		1,675.3 ± 436.8****	
Plausible Reporters	2,352 ± 425		2,712 ± 358****		2,145 ± 306****	
Total fibre (g/day) (raw)*						
Whole Sample	12.5 ± 5.6		13.0 ± 6.0***		12.1 ± 5.2***	
Plausible Reporters	15.8 ± 6.2		17.9 ± 7.1****		14.6 ± 5.3****	
Total fibre (g/day) (adjusted by energy intake)*						
Whole Sample	12.5 ± 4.9		12.2 ± 5.1****		12.9 ± 4.6****	
Plausible Reporters	15.8 ± 5.8		15.9 ± 6.8		15.8 ± 5.1	
Fibre per 1,000 kcal/day*						
Whole Sample	7.0 ± 2.8		6.7 ± 2.6****		7.3 ± 2.9****	
Plausible Reporters	6.7 ± 2.4		6.6 ± 2.5		6.8 ± 2.3	
Fibre from breakfast (%)*						
Whole Sample	13.0 ± 11.5		12.1 ± 11.6****		13.8 ± 11.4****	
Plausible Reporters	14.2 ± 11.3		13.6 ± 10.8		14.6 ± 11.6	
Fibre from mid-morning snack (%)*						
Whole Sample	5.1 ± 8.1		4.9 ± 8.2		5.3 ± 8.1	
Plausible Reporters	6.3 ± 8.3		5.9 ± 7.9		6.5 ± 8.6	
Fibre from lunch (%)*						
Whole Sample	47.4 ± 16.6		48.0 ± 16.8		46.9 ± 16.3	
Plausible Reporters	42.9 ± 14.8		44.0 ± 15.0		42.3 ± 14.7	
Fibre from afternoon snack (%)*						
Whole Sample	5.9 ± 8.6		5.4 ± 8.9****		6.3 ± 8.3****	
Plausible Reporters	8.8 ± 9.6		8.1 ± 9.7		9.1 ± 9.6	
Fibre from dinner (%)*						
Whole Sample	28.3 ± 14.0		29.3 ± 14.4**		27.4 ± 13.6**	
Plausible Reporters	27.6 ± 12.5		28.1 ± 12.1		27.3 ± 12.7	

* Mean ± standard deviation. ** $p < 0.05$. *** $p < 0.01$. **** $p < 0.001$. NS: non-significant.

Fibre Intake and Dietary Food Sources by Body Mass Index (BMI)

Participants with normal weight had a significantly higher intake of fibre than those with overweight or obesity, taking into account sex, and after adjusting for physical activity. However, the differences on fibre intake adjusted by the energy intake only were observed in the male sex, where men with normal weight had a greater intake than those who had overweight or obesity.

Moreover, the pattern of fibre intake in the different meals during the day varied depending on the body weight situation only in the whole sample. Specifically, it was found that the percentage of fibre that comes from the afternoon snack was higher in individuals with normal weight than those with overweight or obesity, while the fibre from dinner was higher in individuals who had obesity than those who had overweight.

This difference could be related to the fact that a higher fibre content may favour a reduced appetite which, in turn, can help to take in less amount of food at subsequent meals, in this case during dinner, thus balancing the daily energy intake. On the other hand, this also could be explained due to an afternoon snack that contains a higher amount of fibre by including healthier foods with a lower content of energy or fat.

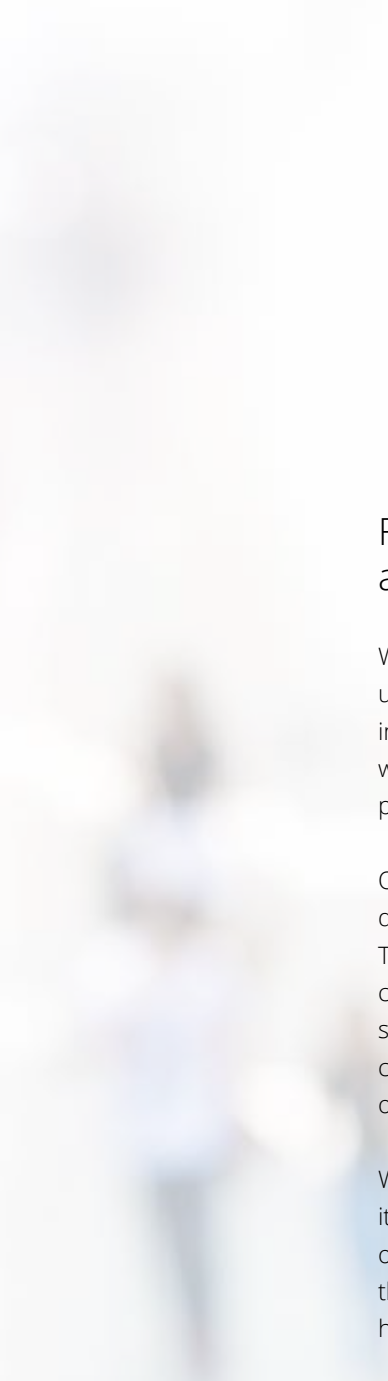
Although grains and flours were the most important fibre food sources in the present study, there were no significant differences according to BMI in the whole sample. Conversely, we found that the intake of fibre coming from fruits was higher in men with normal weight compared to those who had overweight or obesity. These differences may be explained due to fruits that are rich in soluble fibre, which may help control appetite, or because people who consume fruits and vegetables regularly also tend to have a healthier lifestyle.

It was only observed in the male plausible reporters that fibre from pasta was higher in those with underweight than in those with normal weight or overweight. This may be due to subjects who have an excessive body weight try to control their weight by the reduction of carbohydrates of the diet reducing the intake of this type of food.

Fibre intake in the whole sample and in plausible reporters of the ANIBES Study of the Spanish adult population (18–64 years) by body mass index (BMI)

	UNDERWEIGHT		NORMAL WEIGHT		OVERWEIGHT		OBESITY		TWO-WAY ANOVA	TWO-WAY ANCOVA
	Whole Sample	Plausible Reporters	Whole Sample	Plausible Reporters	Whole Sample	Plausible Reporters	Whole Sample	Plausible Reporters		
	n = 30	n = 20	n = 704	n = 271	n = 542	n = 109	n = 329	n = 33		
Energy (kcal/day)*										
Whole Sample	1,930.9 ± 592.4		1,872.5 ± 526.9		1,773.4 ± 502.3[b]		1,759.0 ± 475.6[b]		S*** BMI****	S*** BMI****
Plausible Reporters	2,153 ± 466		2,307 ± 425		2,443 ± 394[ab]		2,539 ± 395[ab]		BMI***	S**** BMI****
Total fibre (g/day) (raw)*										
Whole Sample	12.8 ± 6.3		13.0 ± 5.9		12.2 ± 5.4[b]		12.1 ± 5.3[b]		BMI*** I**	BMI**** I**
Plausible Reporters	14.1 ± 6.3		15.5 ± 6.3		16.6 ± 5.8		16.7 ± 6.9			
Total fibre (g/day) (adjusted by energy intake)*										
Whole Sample	12.2 ± 4.5		12.7 ± 5.1		12.5 ± 4.7		12.5 ± 4.8			BMI**** I**
Plausible Reporters	15.2 ± 4.9		15.8 ± 5.8		16.1 ± 5.8		15.6 ± 6.4			
Fibre per 1,000 kcal/day*										
Whole Sample	6.5 ± 2.3		7.0 ± 2.7		7.0 ± 2.7		7.0 ± 2.9		S**	S** BMI***
Plausible Reporters	6.4 ± 2.1		6.7 ± 2.4		6.9 ± 2.4		6.5 ± 2.4			
Fibre from breakfast (%)*										
Whole Sample	10.5 ± 11.8		13.2 ± 11.5		13.1 ± 11.7		12.6 ± 11.3			
Plausible Reporters	11.8 ± 13.3		14.4 ± 11.6		14.1 ± 10.6		14.6 ± 10.8			
Fibre from mid-morning snack (%)*										
Whole Sample	6.2 ± 9.9		5.3 ± 8.0		5.1 ± 8.4		4.6 ± 7.9			
Plausible Reporters	9.0 ± 11.1		6.4 ± 8.5		6.1 ± 7.8		4.1 ± 5.3			
Fibre from lunch (%)*										
Whole Sample	47.1 ± 15.6		45.8 ± 16.2		48.9 ± 16.8[b]		48.2 ± 16.7		BMI***	
Plausible Reporters	42.4 ± 15.0		42.6 ± 15.1		43.7 ± 14.5		43.9 ± 14.0			
Fibre from afternoon snack (%)*										
Whole Sample	7.4 ± 5.9		6.9 ± 9.1		5.3 ± 8.4[b]		4.7 ± 7.9[b]		BMI***	BMI**
Plausible Reporters	8.1 ± 6.0		8.6 ± 9.2		9.5 ± 11.3		8.4 ± 8.5			
Fibre from dinner (%)*										
Whole Sample	28.5 ± 12.3		28.6 ± 13.9		27.3 ± 14.0		29.6 ± 14.3			BMI**
Plausible Reporters	28.6 ± 12.8		27.8 ± 12.6		26.4 ± 11.8		28.7 ± 13.2			

* Mean ± Standard deviation. Two-way ANOVA was performed taking into account sex (S) and the body mass index (BMI).
Two-way ANCOVA was performed taking into account sex, BMI, and the age and physical activity as covariates.
Significant differences according to BMI: a: regarding underweight; b: regarding normal weight; c: regarding overweight; I: Interaction;
** $p < 0.05$. *** $p < 0.01$. **** $p < 0.001$.



Fibre Intake and Dietary Food Sources by the presence of abdominal obesity using the waist to height ratio (WHtR)

When the data were analyzed according to the presence or absence of abdominal obesity using the waist to height ratio, we found that the intake of fibre (raw, adjusted by energy intake and express per 1,000 kcal per day) in the whole sample was higher in those subjects without abdominal obesity. In this manner, it is shown that the fibre intake adjusted by physical activity may help to avoid the appearance of abdominal obesity.

On the other hand, the pattern of fibre intake in the different meals during the day varied depending on the presence or absence of abdominal obesity only in the whole sample. The proportion of fibre from lunch was higher in the individuals with abdominal obesity compared to those with normal weight. This could be due to the style of eating in Spain, since in general, lunch is characterized by the presence of an abundant amount of foods like cereals and grains, pulses and vegetables that provide a great amount of fibre, respect to other meals of the day.

While lunch is largely respected by the general population, regardless of individual food habits, it does not happen the same in relation to the snack and dinner. Moreover, the percentage of fibre from afternoon snacks was higher in individuals without abdominal obesity than in those who suffered from it. This suggests that a higher intake of fibre in the afternoon could have a beneficial effect in relation to the abdominal accumulation of body fat.

Likewise, when analyzing the excess body weight and abdominal obesity individually, it was confirmed that there was a greater fibre intake in subjects without excess body weight and abdominal obesity compared with those who had one or two of these problems.

Fibre from the afternoon snack seems to play a major role in the body weight situation and abdominal obesity. Even when considering the presence or absence of both problems in the individual, it was also found that those subjects with excess body weight or abdominal obesity had a lower percentage of fibre from the afternoon snack and higher from lunch. This suggests that, probably, the moment of the day in which the fibre is consumed is of relevance to obtaining the benefits of the fibre in relation to excess body weight or abdominal obesity.

The contribution to the intake of fibre from bread and pasta was higher only in subjects with abdominal obesity of the whole sample. Fibre from fruits was higher only in men of the whole sample without abdominal obesity than in those with this problem. This difference could be explained because of the beneficial effect of soluble fibre on the reduction of the appetite or due to a healthier lifestyle. A similar trend was also observed in relation to the group of sugars and sweets and, in particular, with the subgroup of chocolates.

It was only observed in the group of plausible reporters that fibre from ready-to-eat-meals was higher in individuals with abdominal obesity compared to subjects without abdominal obesity.

In relation to the dietary fibre sources, a higher proportion of fibre from bread and pasta (in men and women), and less from fruits (only in men), is associated with excess body weight and/or abdominal obesity in comparison with subjects with normal weight and without abdominal obesity.

Fibre from fruits was significantly higher in individuals without overweight and/or abdominal obesity compared to subjects with any of these problems. However, only in the group of plausible reporters, the fibre from ready-to-eat-meals was higher in those subjects with excess body weight and/or abdominal obesity than those without any of these problems.

Fibre intake of the adult population (18–64 years) by the presence or absence of abdominal obesity using the waist to height ratio (WHtR)

	NON-ABDOMINAL OBESITY		ABDOMINAL OBESITY		TWO-WAY ANOVA	TWO-WAY ANCOVA
	Whole Sample	Plausible Reporters	Whole Sample	Plausible Reporters		
	n = 689	n = 263	n = 966	n = 170		
Energy (kcal/day)*						
Whole Sample	1,886.0 ± 543.2		1,765.3 ± 482.4		S****WHtR****	S****WHtR****
Plausible Reporters	2,319.0 ± 446.7		2,401.7 ± 384.4		S****	S****
Total fibre (g/day) (raw)*						
Whole Sample	12.9 ± 5.9		12.3 ± 5.4		S****WHtR*** I***	S****WHtR**** I***
Plausible Reporters	15.3 ± 6.2		16.6 ± 6.2		S****	S****
Total fibre (g/day) (adjusted by energy intake)*						
Whole Sample	12.5 ± 5.0		12.6 ± 4.8		I**	WHtR**** I***
Plausible Reporters	15.5 ± 5.5		16.3 ± 6.1			
Fibre per 1,000 kcal/day*						
Whole Sample	6.9 ± 2.8		7.1 ± 2.8		S****	S ****WHtR**** I**
Plausible Reporters	6.6 ± 2.3		7.0 ± 2.5			
Fibre from breakfast (%)*						
Whole Sample	13.1 ± 11.8		12.9 ± 11.4		S***	S**
Plausible Reporters	14.3 ± 11.9		14.1 ± 10.4			
Fibre from mid-morning snack (%)*						
Whole Sample	5.7 ± 8.5		4.7 ± 7.8		WHtR**	
Plausible Reporters	6.8 ± 9.0		5.4 ± 7.1			
Fibre from lunch (%)*						
Whole Sample	45.3 ± 16.2		48.9 ± 16.6		WHtR****	WHtR***
Plausible Reporters	41.9 ± 14.9		44.5 ± 14.5			
Fibre from afternoon snack (%)*						
Whole Sample	6.9 ± 8.9		5.1 ± 8.3		WHtR****	WHtR***
Plausible Reporters	8.5 ± 9.1		9.1 ± 10.4			
Fibre from dinner (%)*						
Whole Sample	28.8 ± 14.2		28.0 ± 13.9		S***	S**
Plausible Reporters	28.1 ± 12.6		26.7 ± 12.3			

* Mean ± standard deviation. Two-way ANOVA was performed taking into account sex (S) and the waist to height ratio (WHtR). Two-way ANCOVA was performed taking into account sex, waist to height ratio, and the age and physical activity as covariates. I: interaction. ** $p < 0.05$. *** $p < 0.01$. **** $p < 0.001$.

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Fibre intake of the adult population (18–64 years) by the presence or absence of excess body weight and/or abdominal obesity using the body mass index (BMI) and the waist to height ratio (WHtR)

	NO OVERWEIGHT AND/OR ABDOMINAL OBESITY		OVERWEIGHT AND/OR ABDOMINAL OBESITY		TWO-WAY ANOVA	TWO-WAY ANCOVA
	Whole Sample	Plausible Reporters	Whole Sample	Plausible Reporters		
	n = 597	n = 248	n = 1,058	n = 185		
Energy (kcal/day)*						
Whole Sample	1,892.5 ± 539.4		1,772.1 ± 490.7		S**** BMI_WHtR****	S*** BMI_WHtR***
Plausible Reporters	2,296 ± 434		2,426 ± 402		S****	S**** BMI_WHtR***
Total fibre (g/day) (raw)*						
Whole Sample	13.0 ± 5.9		12.3 ± 5.4		S**** BMI_WHtR*** I***	S**** BMI_WHtR**** I***
Plausible Reporters	15.1 ± 6.0		16.8 ± 6.4		S****	S****
Total fibre (g/day) (adjusted by energy intake)*						
Whole Sample	12.5 ± 5.0		12.6 ± 4.8		I**	BMI_WHtR**** I***
Plausible Reporters	15.4 ± 5.4		16.4 ± 6.2			
Fibre per 1,000 kcal/day*						
Whole Sample	6.9 ± 2.7		7.1 ± 2.8		S****	S**** BMI_WHtR*** I**
Plausible Reporters	6.6 ± 2.3		7.0 ± 2.5			
Fibre from breakfast (%)*						
Whole Sample	13.2 ± 11.8		12.9 ± 11.4		S** I**	S** I**
Plausible Reporters	14.3 ± 12.1		14.1 ± 10.3			
Fibre from mid-morning snack (%)*						
Whole Sample	5.6 ± 8.3		4.8 ± 8.1			
Plausible Reporters	6.9 ± 9.0		5.4 ± 7.1			
Fibre from lunch (%)*						
Whole Sample	45.1 ± 16.1		48.7 ± 16.7		BMI_WHtR****	BMI_WHtR***
Plausible Reporters	41.9 ± 14.9		44.4 ± 14.5			
Fibre from afternoon snack (%)*						
Whole Sample	7.2 ± 9.0		5.2 ± 8.3		BMI_WHtR****	BMI_WHtR***
Plausible Reporters	8.7 ± 9.2		8.9 ± 10.2			
Fibre from dinner (%)*						
Whole Sample	28.7 ± 13.8		28.1 ± 14.1		S***	S**
Plausible Reporters	28.0 ± 12.8		27.0 ± 12.1			

* Mean ± standard deviation. Two-way ANOVA was performed taking into account sex (S) and the waist to height ratio (WHtR). Two-way ANCOVA was performed taking into account sex, waist to height ratio, and the age and physical activity as covariates. I: interaction. ** $p < 0.05$. *** $p < 0.01$. **** $p < 0.001$.

Support to future intervention strategies

When comparing our results with the Food Sources of Nutrients in the Spanish Diet (FANPE) Study in 2009, it was found that the combined prevalence of overweight and obesity of this study (47.8 %) was lower than that observed in the whole sample of the ANIBES Study (55.7 %), but higher than that observed in the plausible reporters (32.8 %).

On the other hand, this combined prevalence was also higher (60.9 %) in the Nutritional Assessment of the Spanish Population (ENPE) in 2014–2015, both in the whole sample and in the group of plausible reporters.

The present study demonstrates an insufficient fibre intake among the Spanish adult population, both in the whole sample and in the plausible reporters. The main dietary sources of fibre were grains and flours, followed by vegetables, fruits and pulses.

It was also observed an association between the fibre intake and excess body weight and abdominal obesity in the whole sample, but not in the plausible reporters. Although further studies are needed to confirm this association, it is advisable to increase the intake of foods rich in fibre in order to prevent diseases related with an insufficient intake.

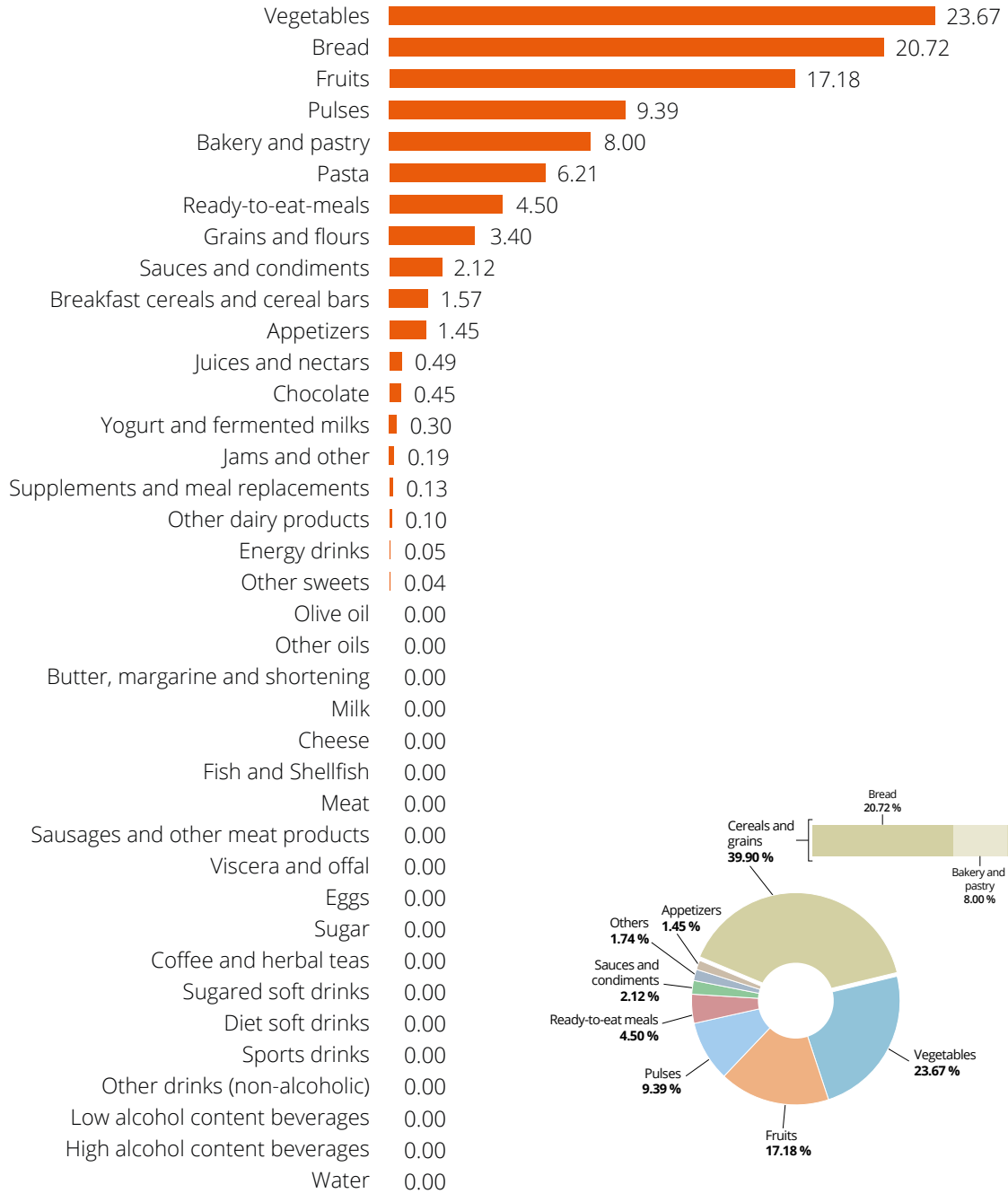
In this sense, the data obtained can support the design of nutrition intervention strategies to increase the intake of fibre in our country.

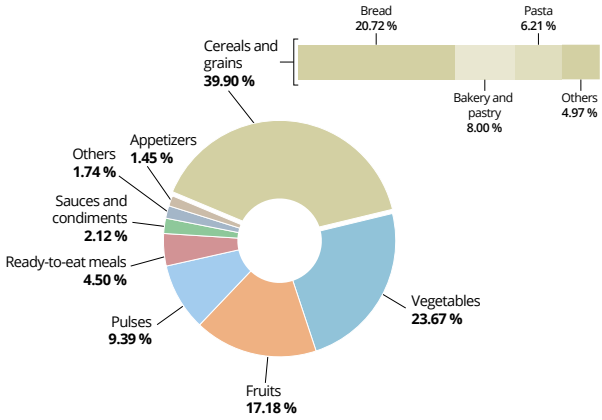
Fibre dietary sources (%) from food and beverage groups and subgroups

Fibre dietary sources (%) from food and beverage groups and subgroups.

1. GENERAL 9-75 YEARS

Sample: 2,009 individuals*



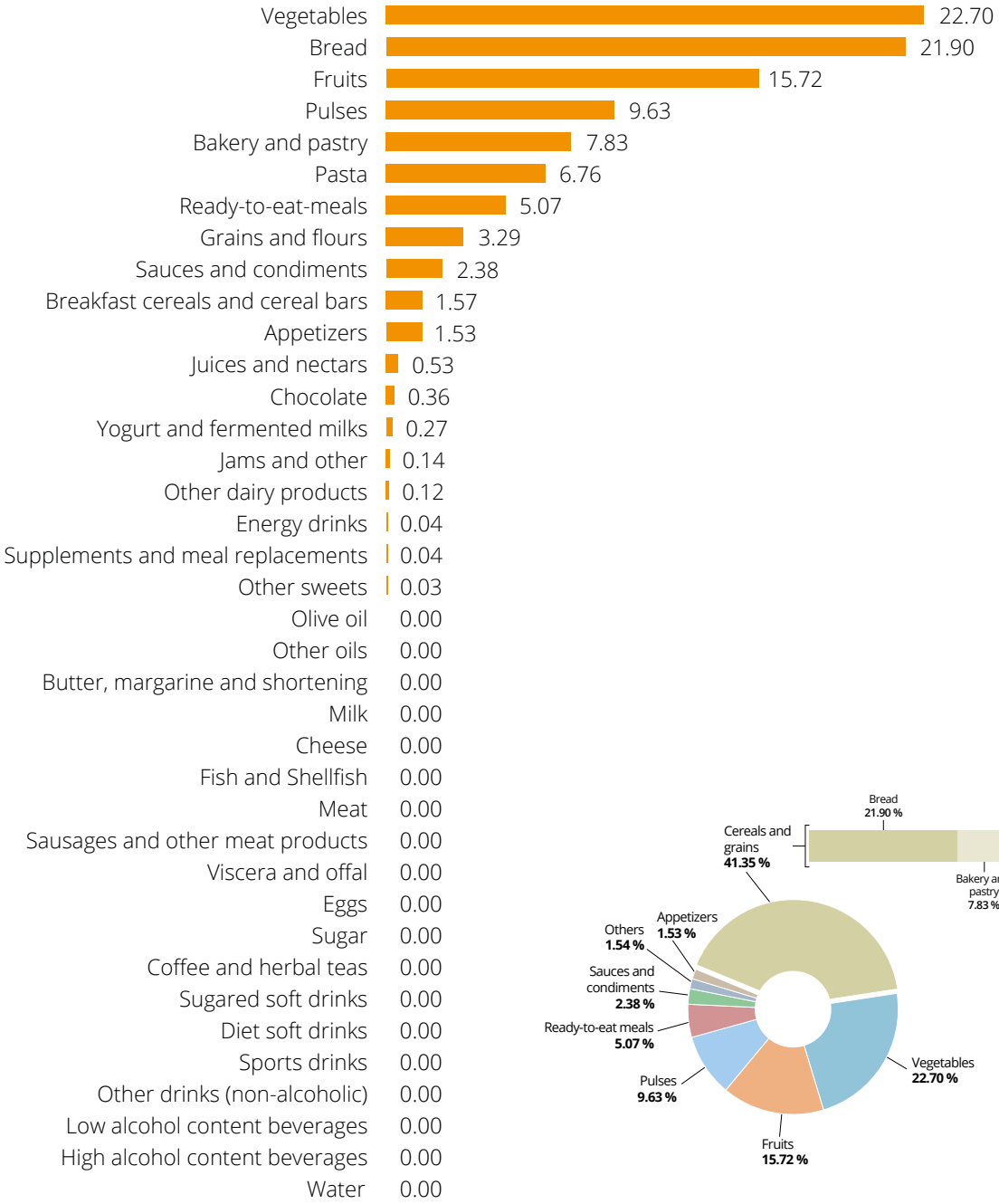


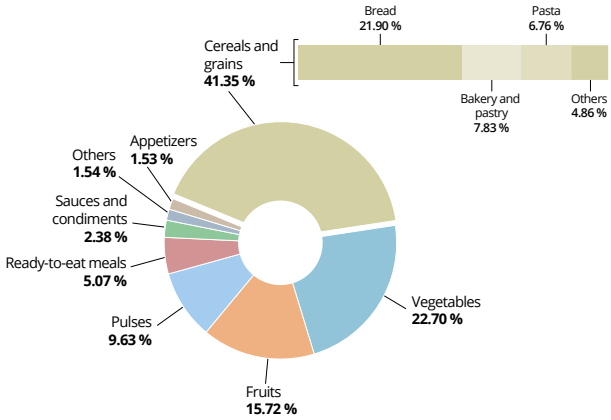
*Random sample

Fibre dietary sources (%) from food and beverage groups and subgroups.

2. GENERAL MEN 9-75 YEARS

Sample: 1,013 individuals*



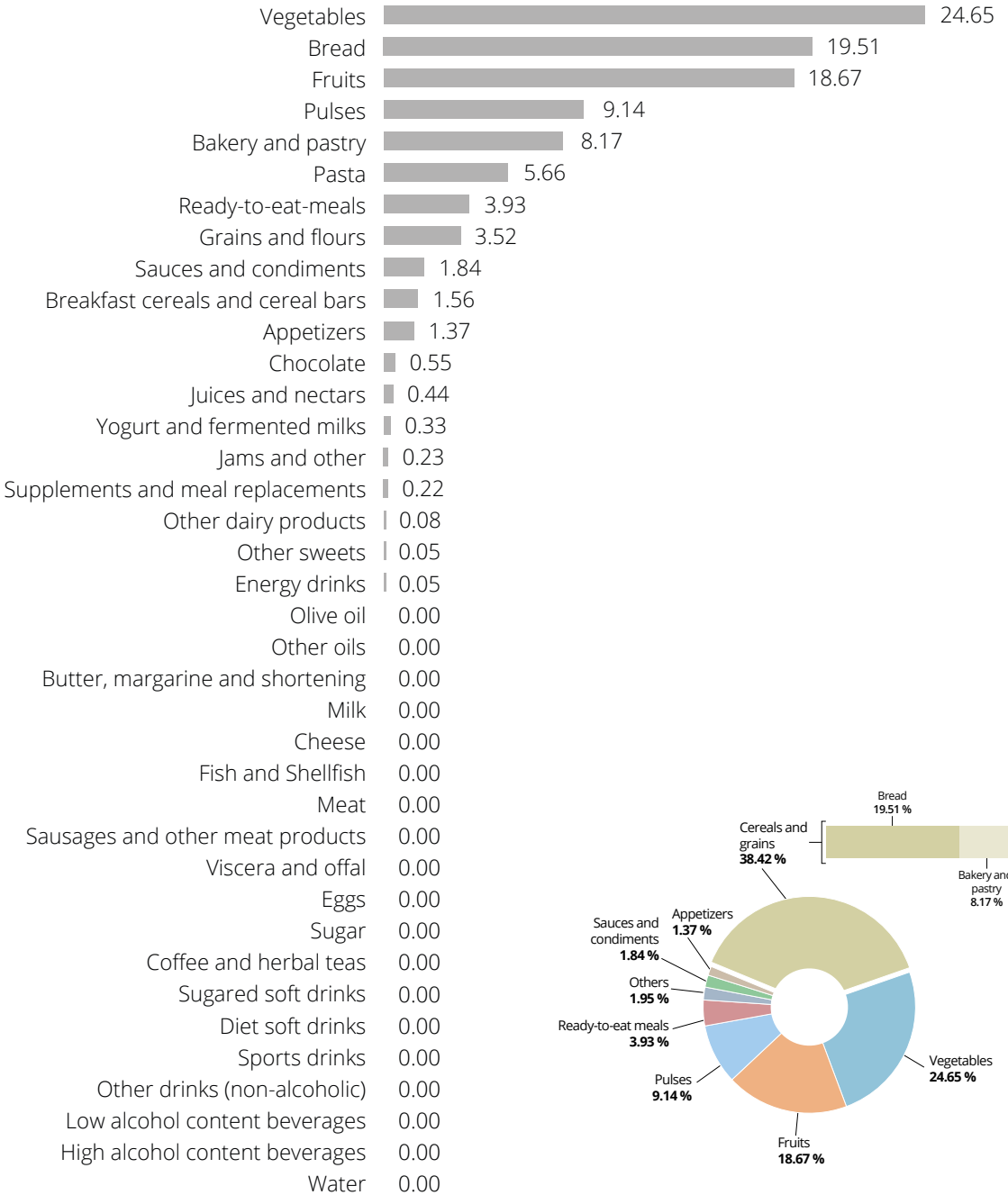


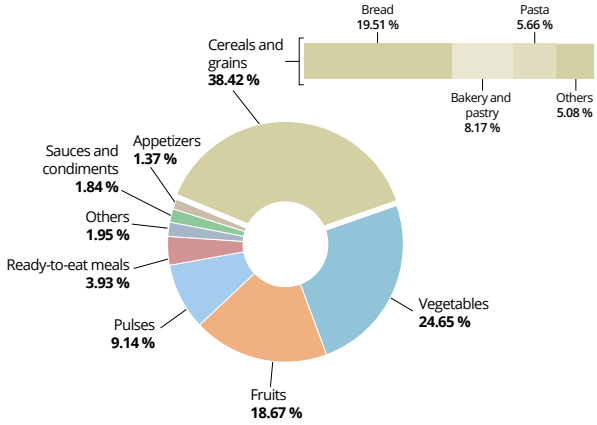
*Random sample

Fibre dietary sources (%) from food and beverage groups and subgroups.

3. GENERAL WOMEN 9-75 YEARS

Sample: 996 individuals*



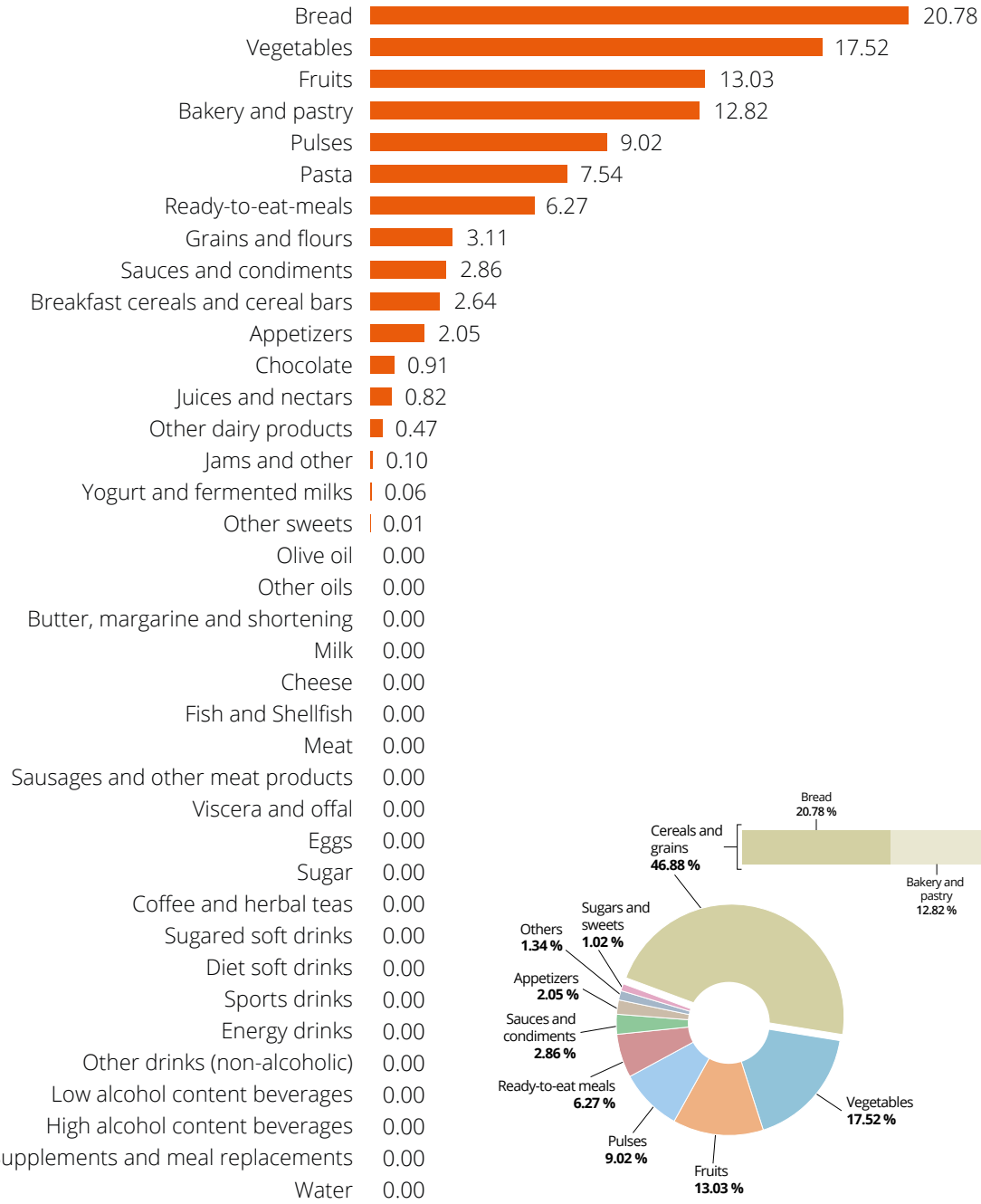


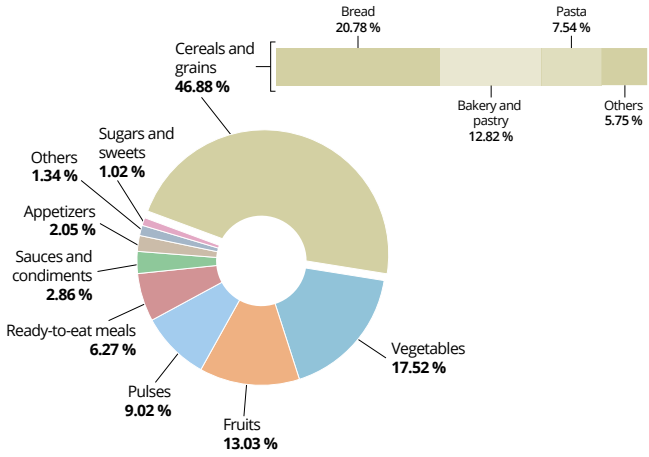
*Random sample

Fibre dietary sources (%) from food
and beverage groups and subgroups.

4. CHILDREN BOYS AND GIRLS 9-12 YEARS

Sample: 213 individuals*



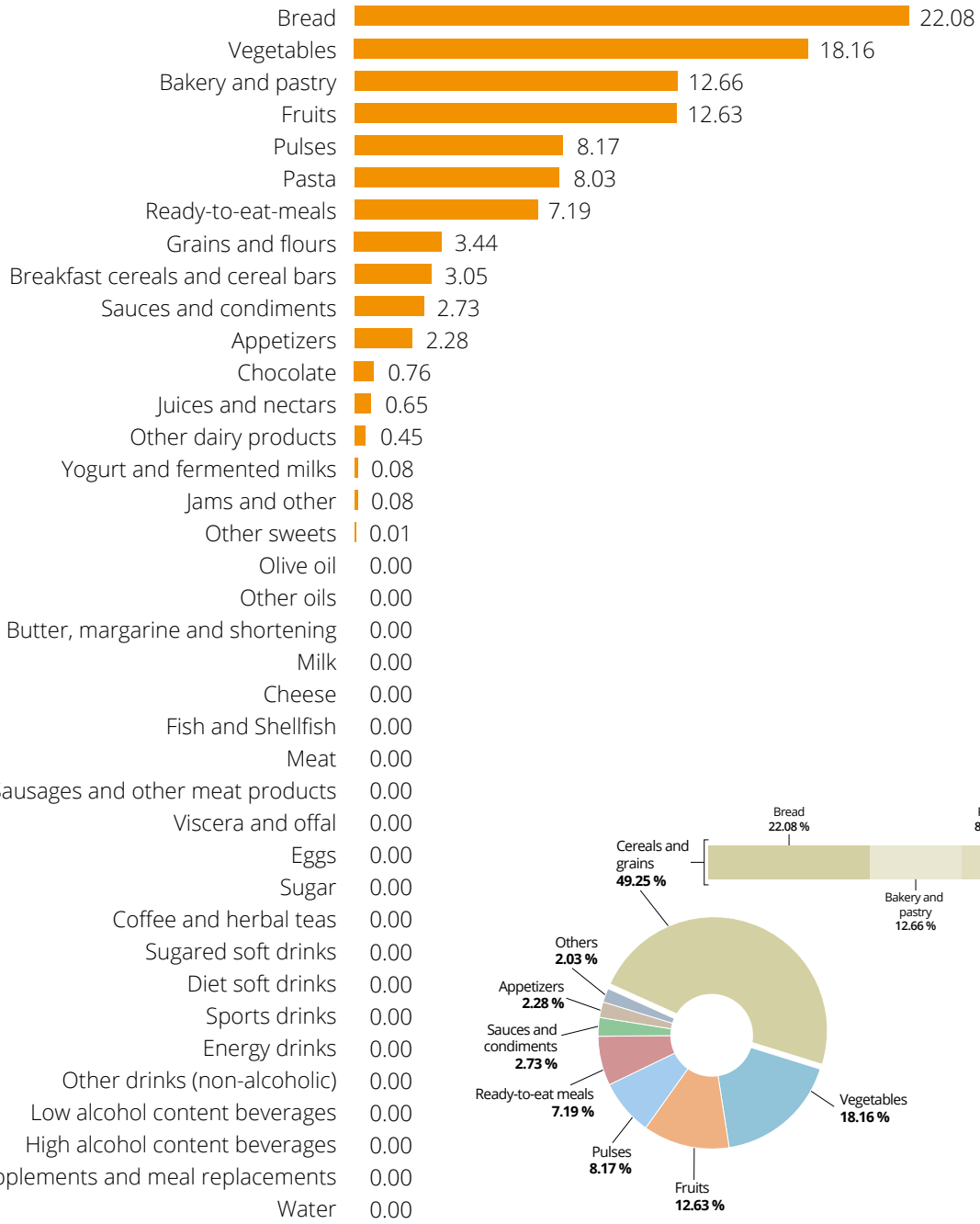


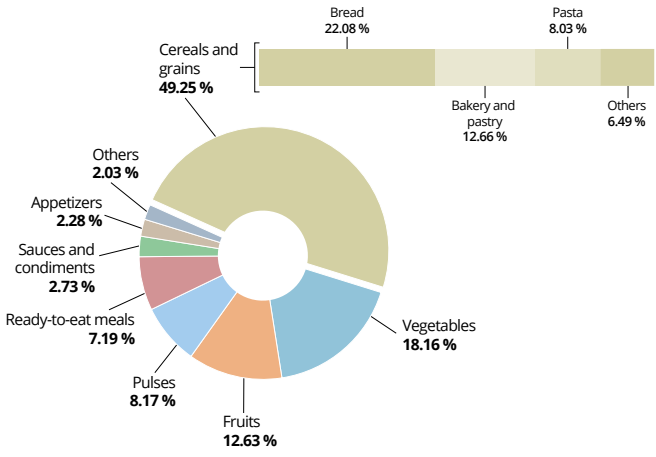
*Random sample plus boost

Fibre dietary sources (%) from food and beverage groups and subgroups.

5. CHILDREN BOYS 9-12 YEARS

Sample: 126 individuals*



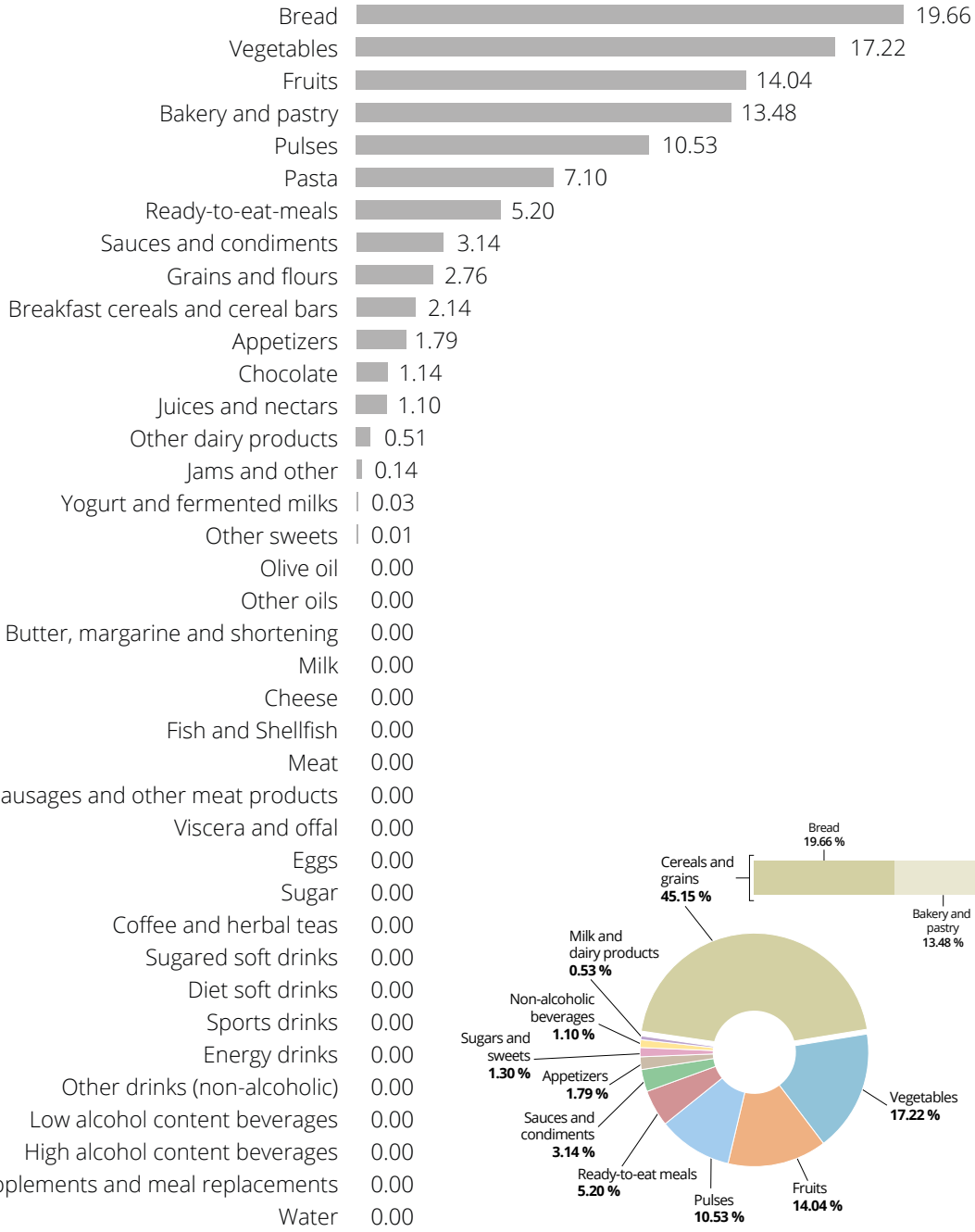


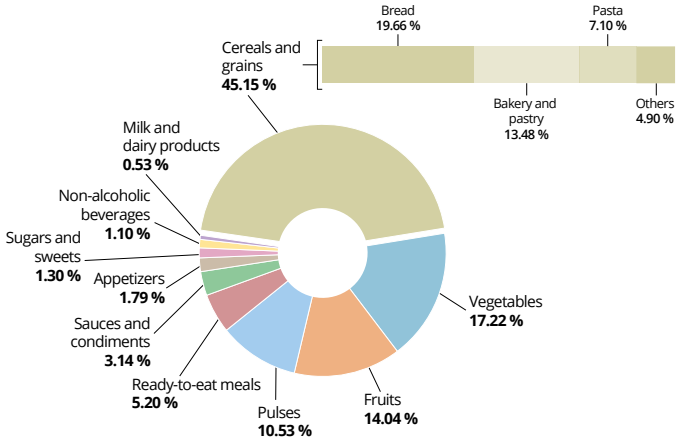
*Random sample plus boost

Fibre dietary sources (%) from food and beverage groups and subgroups.

6. CHILDREN GIRLS 9-12 YEARS

Sample: 87 individuals*



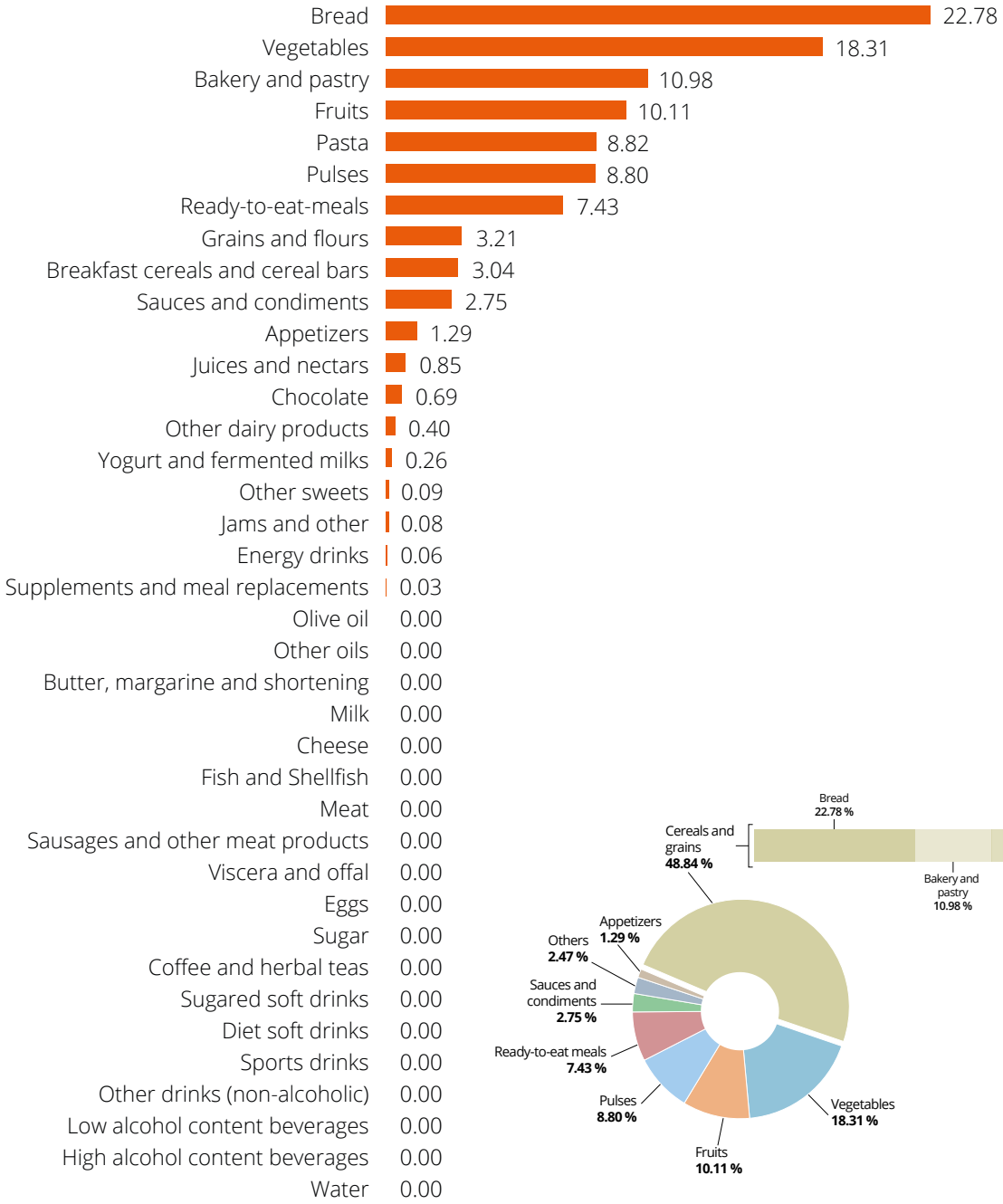


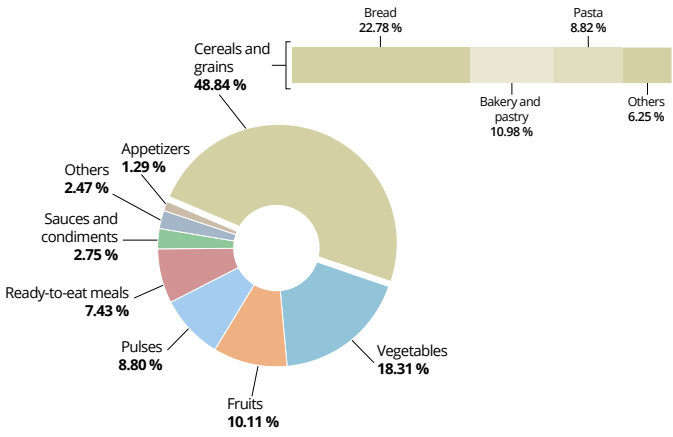
*Random sample plus boost

Fibre dietary sources (%) from food and beverage groups and subgroups.

7. ADOLESCENTS 13-17 YEARS

Sample: 211 individuals*



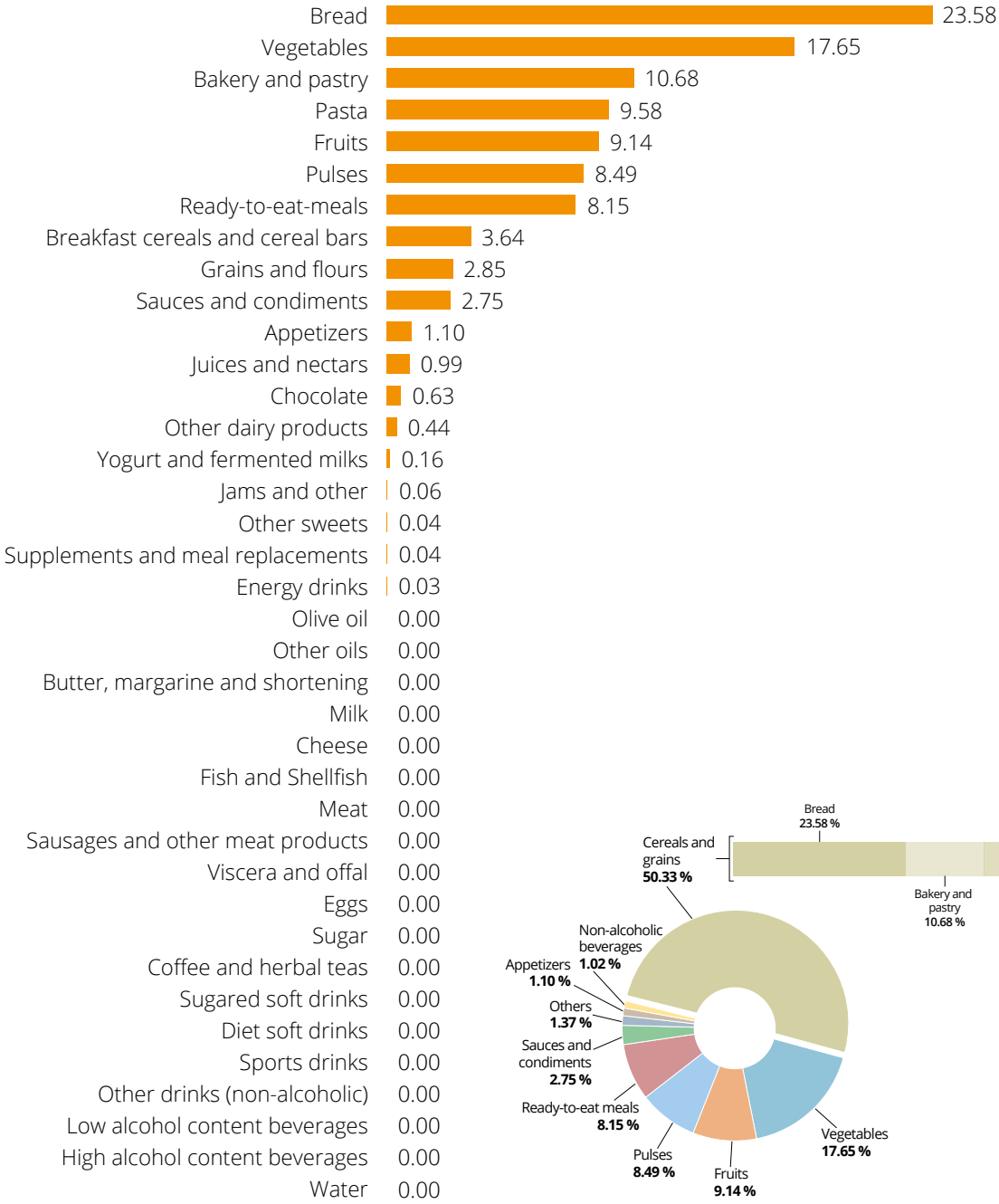


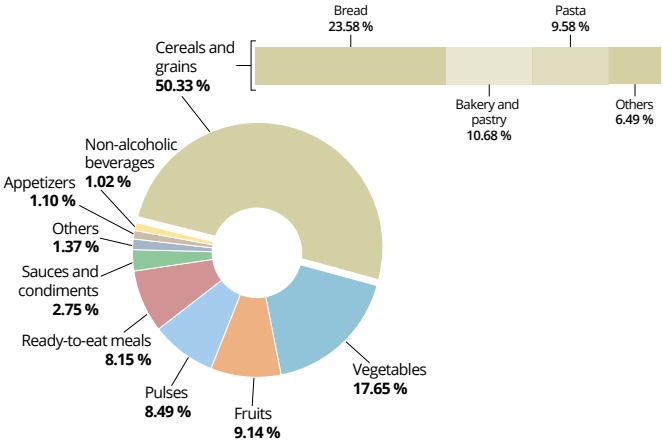
*Random sample plus boost

Fibre dietary sources (%) from food and beverage groups and subgroups.

8. ADOLESCENT BOYS 13-17 YEARS

Sample: 137 individuals*



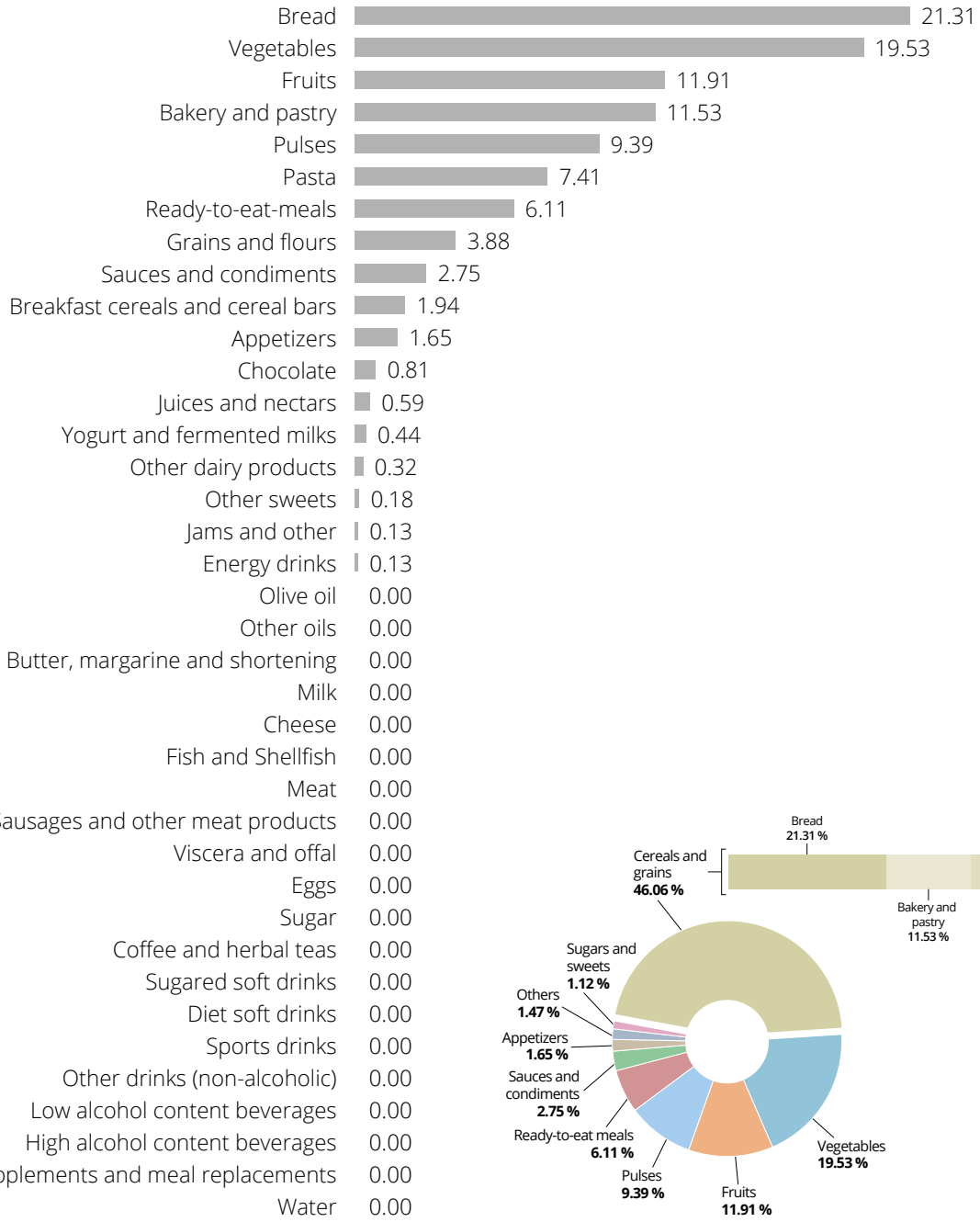


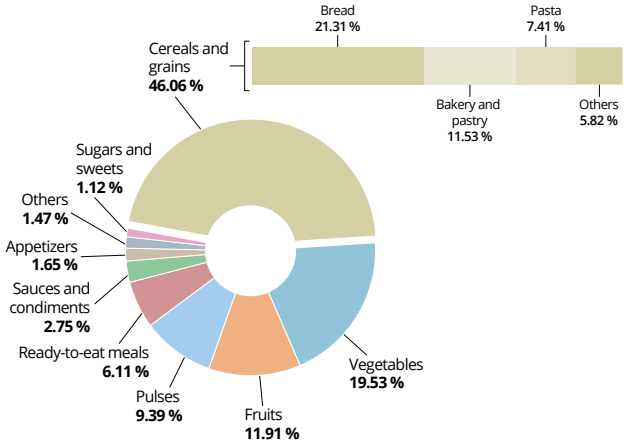
*Random sample plus boost

Fibre dietary sources (%) from food and beverage groups and subgroups.

9. ADOLESCENT GIRLS 13-17 YEARS

Sample: 74 individuals*



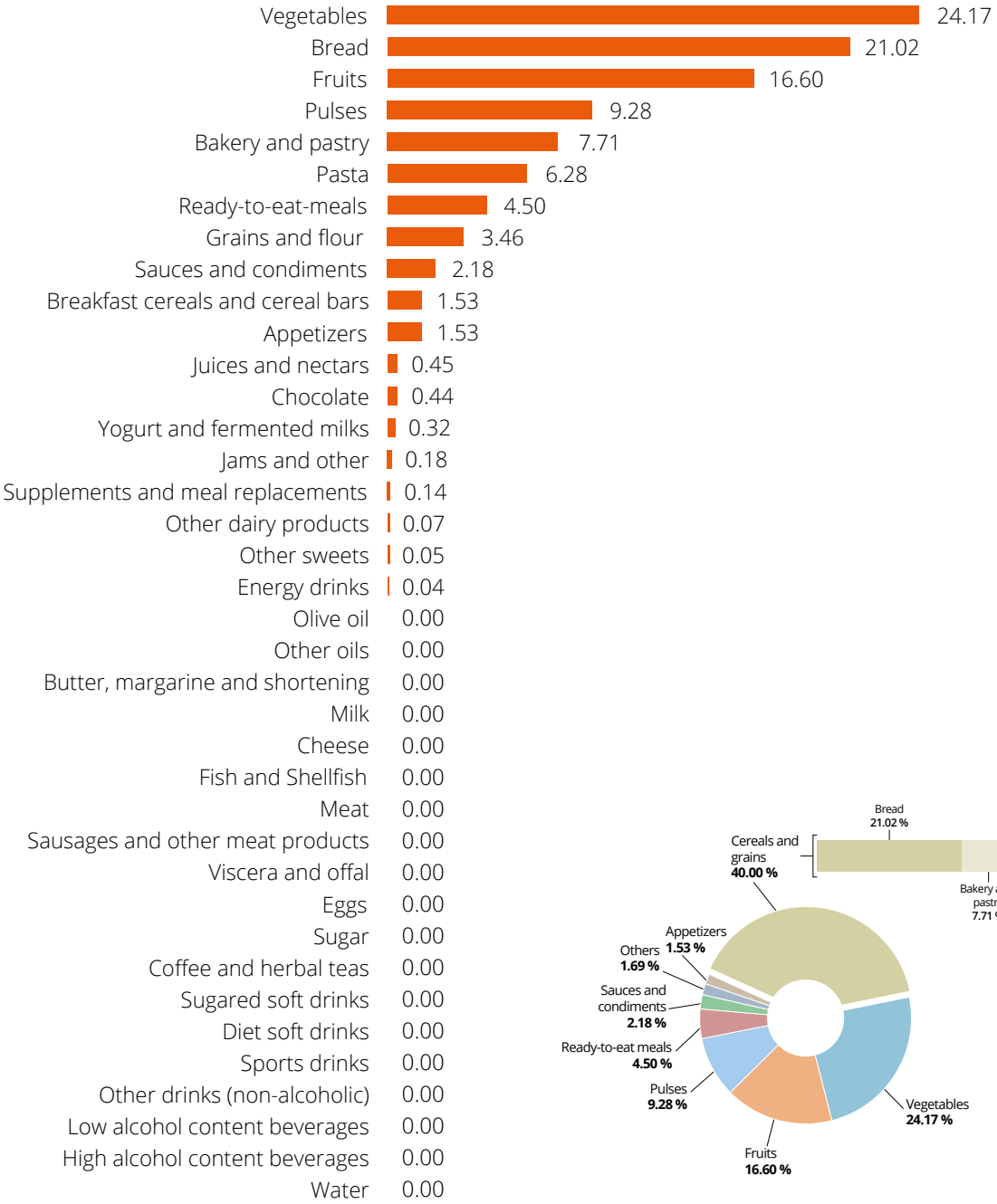


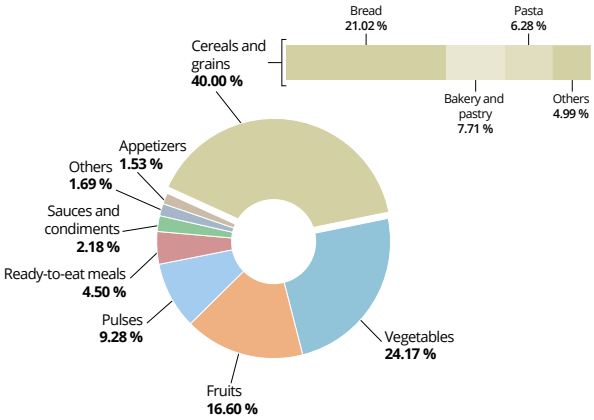
*Random sample plus boost

Fibre dietary sources (%) from food and beverage groups and subgroups.

10. ADULTS 18-64 YEARS

Sample: 1.655 individuals*



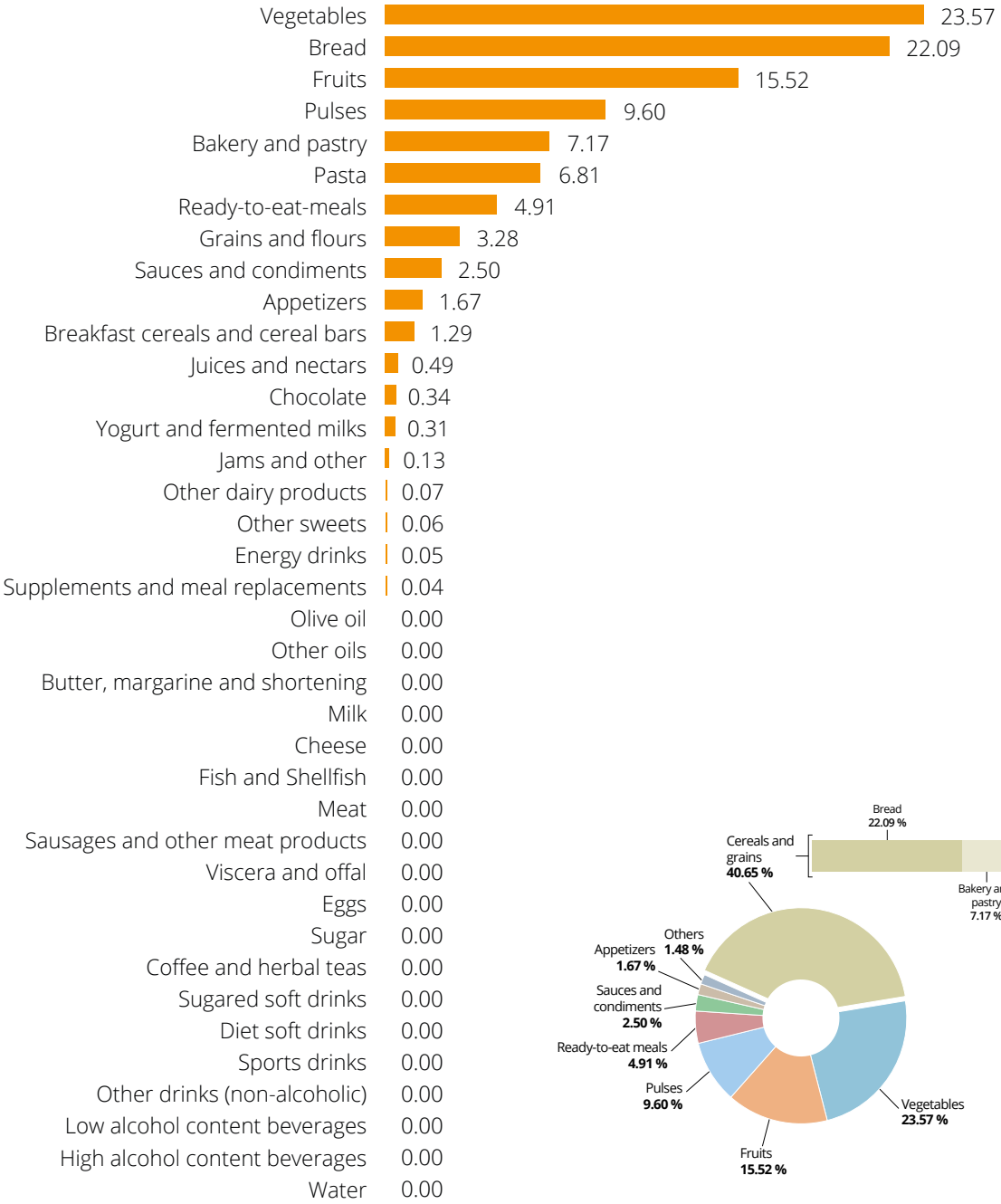


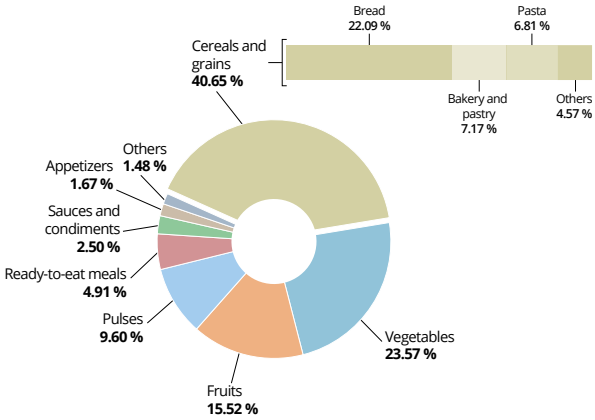
*Random sample

Fibre dietary sources (%) from food and beverage groups and subgroups.

11. ADULT MEN 18-64 YEARS

Sample: 798 individuals*



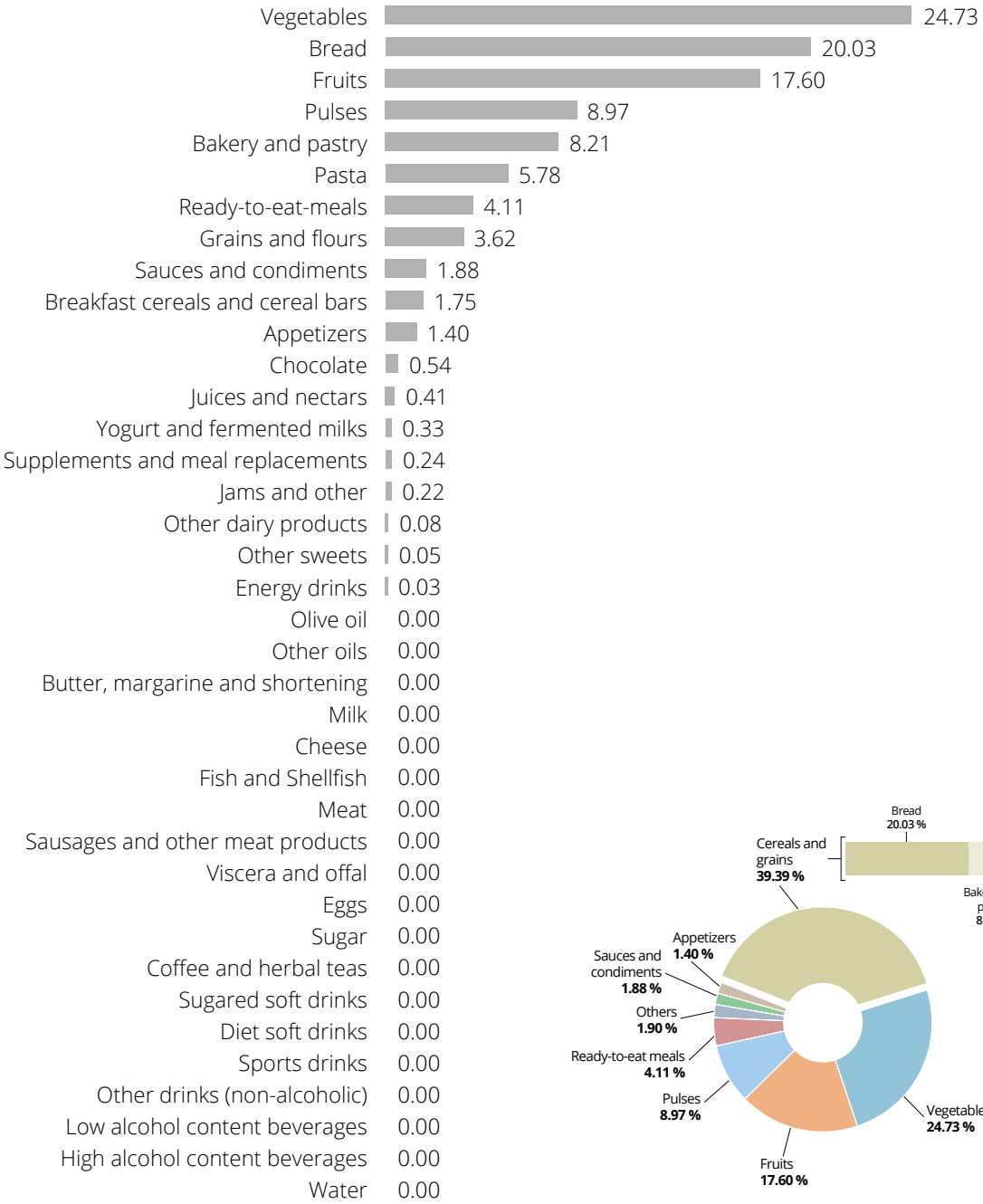


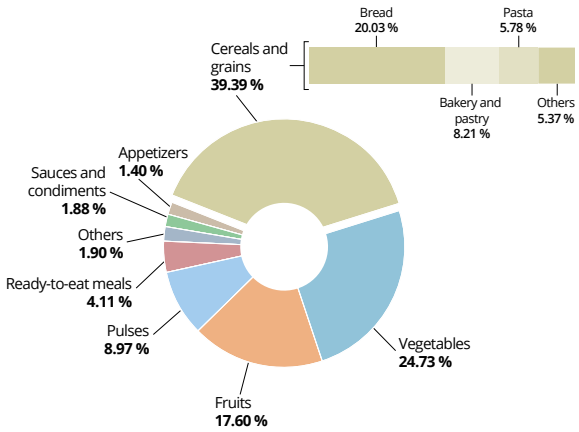
*Random sample

Fibre dietary sources (%) from food and beverage groups and subgroups.

12. ADULT WOMEN 18-64 YEARS

Sample: 857 individuals*



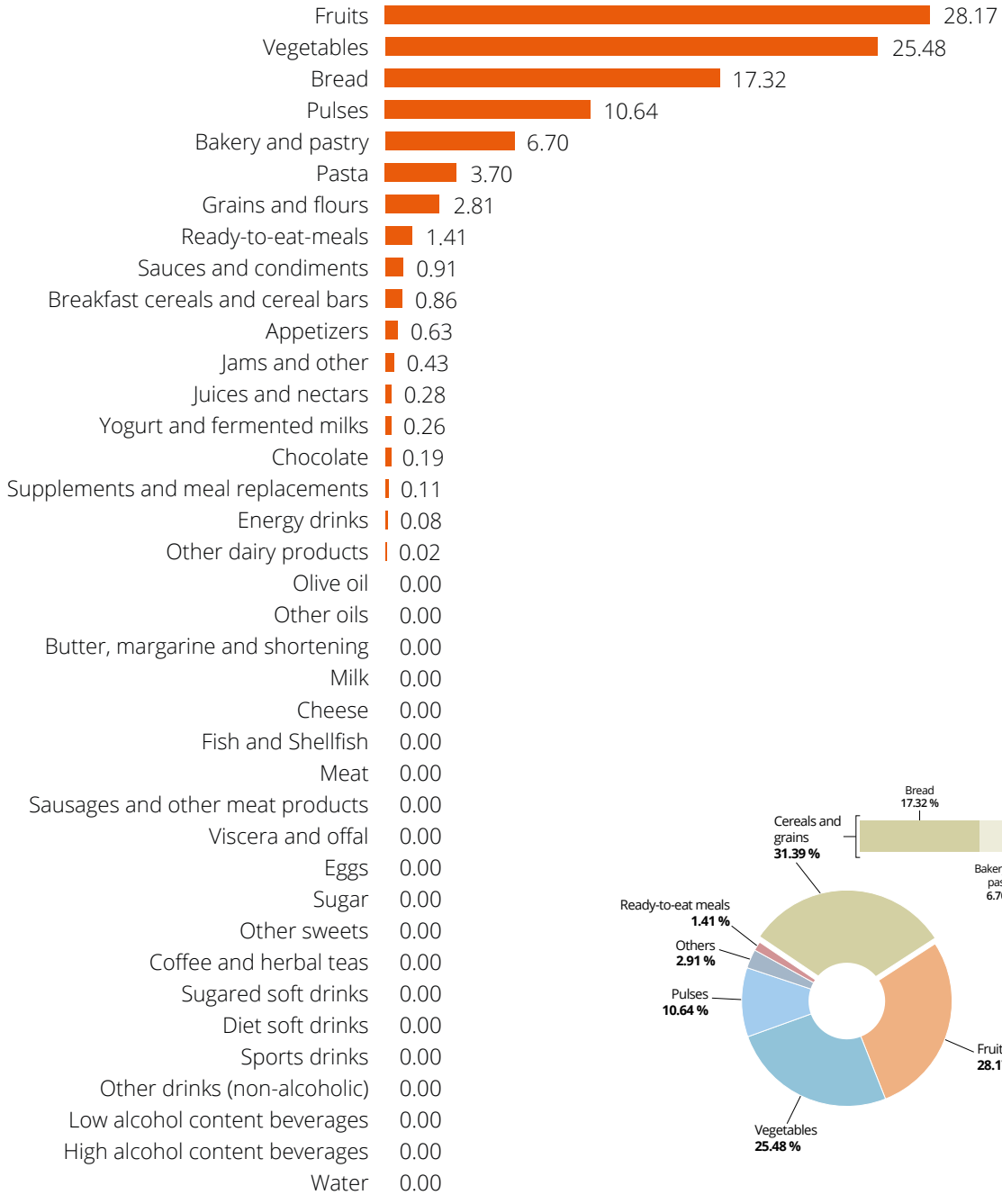


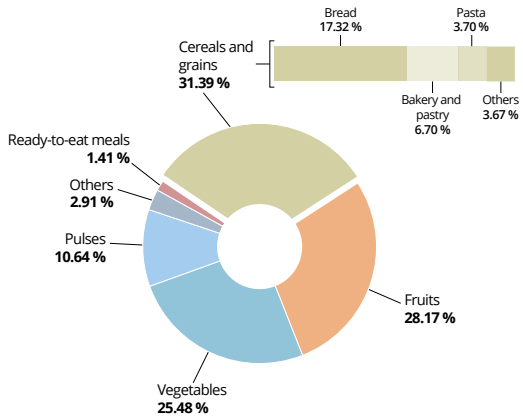
*Random sample

Fibre dietary sources (%) from food and beverage groups and subgroups.

13. ELDERLY 65-75 YEARS

Sample: 206 individuals*



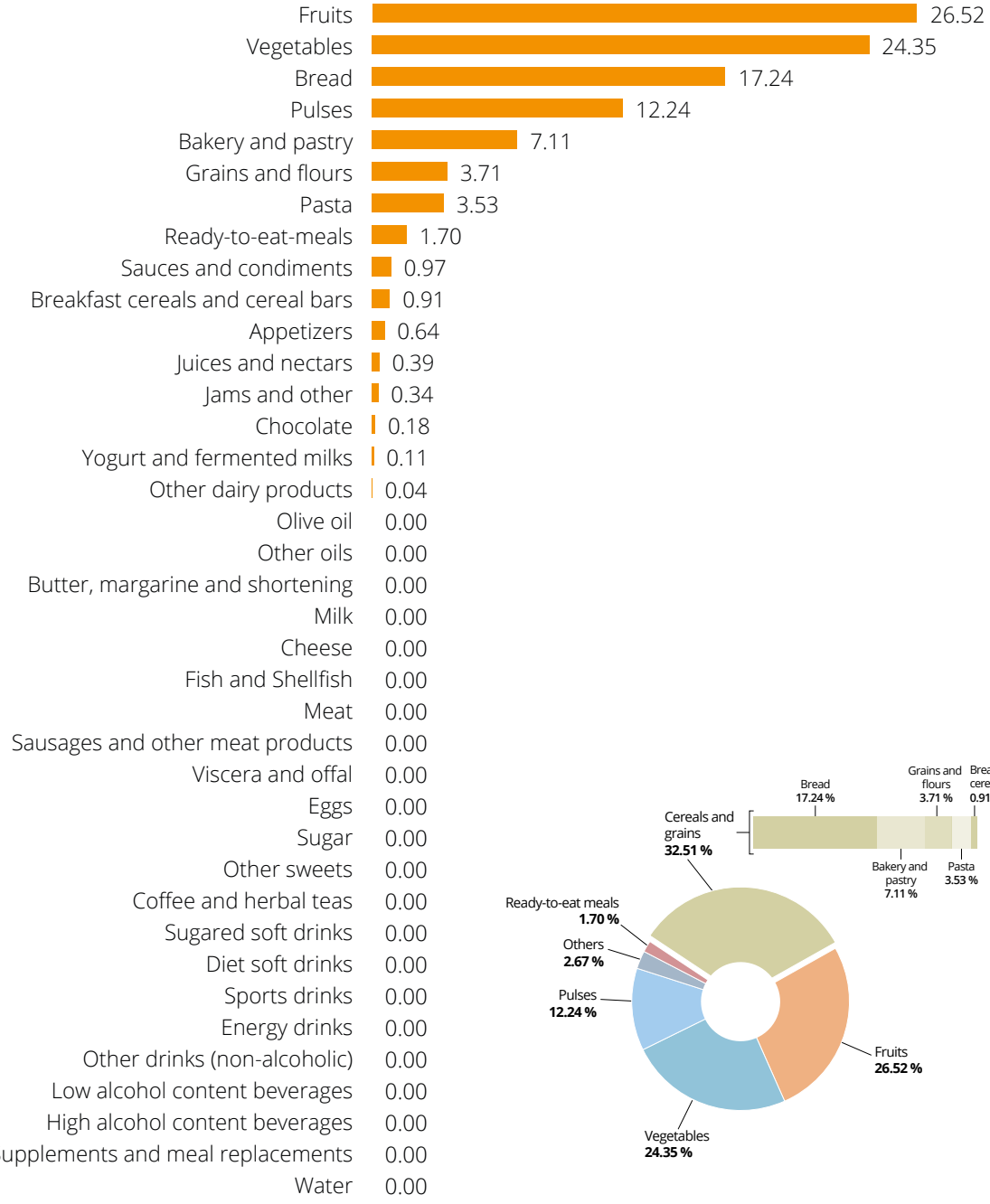


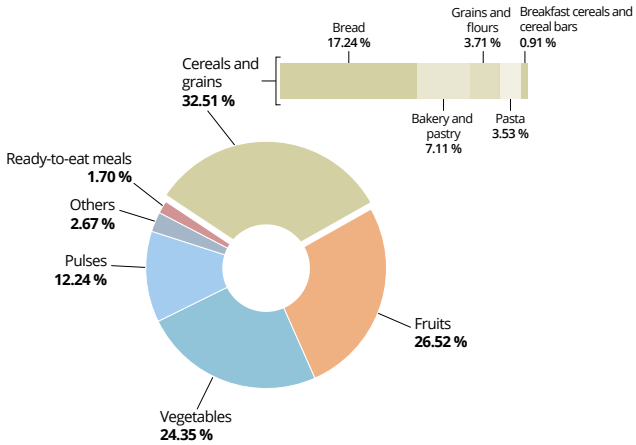
*Random sample

Fibre dietary sources (%) from food and beverage groups and subgroups.

14. ELDERLY MEN 65-75 YEARS

Sample: 99 individuals*





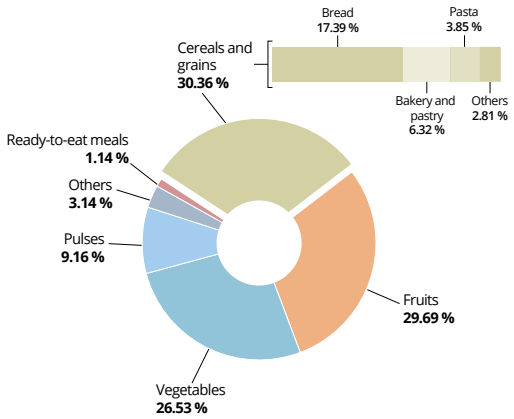
*Random sample

Fibre dietary sources (%) from food and beverage groups and subgroups.

15. ELDERLY WOMEN 65-75 YEARS

Sample: 107 individuals*

Fruits	29.69
Vegetables	26.53
Bread	17.39
Pulses	9.16
Bakery and pastry	6.32
Pasta	3.85
Grains and flours	1.99
Ready-to-eat-meals	1.14
Sauces and condiments	0.86
Breakfast cereals and cereal bars	0.82
Appetizers	0.62
Jams and other	0.52
Yogurt and fermented milks	0.39
Supplements and meal replacements	0.22
Chocolate	0.19
Juices and nectars	0.19
Energy drinks	0.16
Olive oil	0.00
Other oils	0.00
Butter, margarine and shortening	0.00
Milk	0.00
Cheese	0.00
Fish and Shellfish	0.00
Meat	0.00
Sausages and other meat products	0.00
Viscera and offal	0.00
Eggs	0.00
Sugar	0.00
Other sweets	0.00
Coffee and herbal teas	0.00
Sugared soft drinks	0.00
Diet soft drinks	0.00
Sports drinks	0.00
Other drinks (non-alcoholic)	0.00
Low alcohol content beverages	0.00
High alcohol content beverages	0.00
Other dairy products	0.00
Water	0.00



*Random sample

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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).

ANIBES