

**Do foods sold in Portugal meet the international sodium benchmarks?
A case-study of a national food retail company**

***Os alimentos vendidos em Portugal
cumprem os valores de referência de
sódio internacionais? Um caso de
estudo de uma empresa nacional de
retalho alimentar***

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TRABALHO DE INVESTIGAÇÃO

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Abstract

Introduction: Cardiovascular disease is a leading cause of death globally and hypertension and an inadequate salt intake are risk factors. Several efforts have been made to revert this trend, including food reformulation.

Objective: Characterize sodium content of own brand foods from a Portuguese food retail company and compare sodium content with global benchmarks for different food categories.

Methodology: The salt content (g) of foods was supplied by the company and was converted to sodium (mg). Sodium was estimated based on food composition tables when products were not industrially packaged. Foods were classified into subcategories according to World Health Organization global sodium benchmarks and were included groups with a established benchmark. Median sodium content, percentual difference between the median value and benchmark and the percentage of products above the benchmark were calculated. The difference between median and the benchmark was analyzed using the one-sample Wilcoxon signed rank test.

Results: A total of 1031 products were analyzed from 54 subcategories. Bouillon and soup stock (concentrated) had the highest median sodium content (18640mg/100g) and minimally processed breakfast cereals had the lowest (4mg/100g). Canned vegetables and legumes were the group with the highest median sodium content comparing to the sodium benchmark.

Conclusions: Almost 60% of food groups had a median sodium content higher than the benchmark and had more than 50% of products exceeding the sodium benchmark. Food reformulation should follow international guidelines, to reduce salt intake.

Keywords

Sodium, Eating habits, Food reformulation, Food policies, Food availability

Resumo

Introdução: A doença cardiovascular é a principal causa de morte mundial, sendo hipertensão e a ingestão inadequada de sal, fatores de risco. Vários esforços pretendem reverter essa tendência, incluindo a reformulação alimentar.

Objetivo: Caracterizar o teor de sódio de alimentos de marca própria de uma cadeia de retalho alimentar portuguesa e comparar com valores de referência globais de sódio para diferentes categorias de alimentos.

Metodologia: O sal (g) dos alimentos foi fornecido pela empresa e convertido em sódio (mg). Nos produtos não embalados industrialmente, foi estimado o seu teor utilizando tabelas de composição de alimentos. Estes foram classificados em subcategorias de acordo com as referências globais de sódio da Organização Mundial da Saúde e foram incluídos grupos com um valor de referência estabelecido. A mediana do teor de sódio, a diferença percentual entre a mediana e o valor de referência e a percentagem de produtos com teor superior a este valor foram calculados. A diferença entre a mediana e o valor de referência foi analisado pelo teste do sinal de Wilcoxon para uma amostra

Resultados: Um total de 1031 produtos de 54 subcategorias foram analisados. OS caldos (concentrados) tiveram a maior mediana (18640mg/100g) e os cereais de pequeno-almoço a menor (4mg/100g). Vegetais e leguminosas enlatados foram o grupo com maior diferença percentual relativamente à referência.

Conclusões: Aproximadamente 60% das categorias tiveram uma mediana superior à referência e mais de 50% dos produtos superiores ao valor de referência. A reformulação alimentar deve acompanhar diretrizes internacionais para reduzir a ingestão de sal.

Palavras-chave

Sódio, Hábitos alimentares, Reformulação alimentar, Políticas alimentares, Disponibilidade alimentar

List of abbreviations and acronyms

CVD - cardiovascular disease

IAN - AF - National Food and Physical Activity Survey

SB - Sodium benchmark

WHO - World Health Organization

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Introduction

Cardiovascular diseases (CVDs), which includes heart disease and stroke, are the leading cause of death globally. Around 17.9 million people died from CVDs in 2019, representing 32% of all global deaths.⁽¹⁾ Hypertension is a major cause of premature death worldwide and the strongest risk factor to CVDs⁽²⁾. In Portugal, despite substantial reductions in mortality from stroke and ischemic heart disease in the last 20 years, these remained the two leading causes of death in 2018 and hypertension is still a major problem in the Portuguese population with an overall prevalence of approximately 42%^(3, 4). One of the most important risk factor of hypertension is an unhealthy diet⁽¹⁾. Particularly important, the reduction of salt in diet has been shown to reduce blood pressure and the risk of CVDs⁽⁵⁾.

The World Health Organization (WHO) recommends a salt intake of less than 5 grams (approximately 2g of sodium) per person, per day, for the prevention of CVDs. However, data from various countries demonstrate that most populations are ingesting salt highly above the recommendation⁽⁵⁾. In Portugal, according to the National Food and Physical Activity Survey (IAN-AF), 76.4% of individuals had an excessive salt intake⁽⁶⁾. Considering the identical reality observed in other countries, several efforts have been made worldwide to promote a reduction of salt intake, namely through the modulation of food environments. These strategies includes attempts to increase nutrition knowledge about the consequences of having an excessive salt intake, to improve the nutritional labelling that includes salt warning labels and to reformulate products aiming a salt content reduction^(2, 7, 8).

In most countries, salt provided in manufactured foods such as bread, cereal and grains, processed meats and dairy products are the greater contributors to salt intake⁽⁹⁾. According to Rosewarne E, Santos JA ⁽¹⁰⁾, 62 countries developed national strategies focusing on the reformulation of packaged foods, but only 43 of those had established specific sodium targets. In fact, few countries use food reformulation as a strategy to reduce salt intake, which reveals that this strategy is still undervalued, despite its potential interest for reverting the actual trend of high sodium intake⁽¹⁰⁾.

In this context, WHO proposed global sodium benchmarks (SB) for different food categories, which establish a maximum sodium content target for each subcategory (mg/100g of product)⁽¹¹⁾. The accomplishment of these SB would approximate foods available in market of adequate sodium content levels. Thus, a precise and continuous monitoring process toward the reformulation of packaged food focusing on salt reduction, would give us the needed tools to define adequate public health strategies for the promotion of the reduction of salt intake⁽¹⁰⁾.

Objective

Therefore, the aim of this study is to characterize the sodium content of own brand foods from a Portuguese food retail company and to compare the sodium content with global SB for different food categories.

Methodology

A cross-sectional study was conducted focusing on the analysis of sodium content of own brand foods available in a Portuguese food retail company during 2020 and 2021.

Foods' selection and data collection

Own brand foods available for sale during the period of 2020 and 2021, from the following categories were supplied by the company for this study (considering the WHO SB main categories that had, at least, one subcategory with a stablished SB): cakes, biscuits, and other sweet bakery wares; savory snacks; breakfast cereals; cheese; ready-made and convenience foods composite dishes (excluding take away foods); butter and other fats; bread and bread products; processed meat, fish and similar; processed fruit, vegetables and legumes; plant-based foods and sauces, dips and dressings. From these categories, both frozen, refrigerated and grocery foods were collected. Salt content of foods was also supplied by the company and expressed per 100g or ml of product. For some processed meat, fish and similar foods that were not industrially packaged, the sodium content was estimated, using the Portuguese Food Composition Table⁽¹²⁾ or McCance and Widdowson's The Composition of Foods integrated dataset⁽¹³⁾ or French Food Composition (CIQUAL, ANSES)⁽¹⁴⁾ or USDA Food Composition Databases⁽¹⁵⁾.

Food classification

Foods were classified into subcategories according to WHO global SB ⁽¹¹⁾ and were only included in this study the products which were classified in subcategories with a stablished benchmark (Appendix A).

For a more precise descriptive characterization of the available food products, some adaptations were made based on the existing subcategories: the subcategory 11b was divided in 3 subcategories based on the type of additions, considering the typical large diversity of additions in Portuguese bread products: 11bi. Leavened

bread without additions, 11bii. Leavened bread with additions (meat) and 11biii. Leavened bread with additions (others). For all these subcategories, the SB of original subcategory 11b was considered (330mg/100g). On the other hand, the subcategory 14i. Fish and seafood products, heat treated was created considering the need of a category that included products that have suffered a simple cooking process such as boiling. For this subcategory, the benchmark of subcategory 14a (270mg/100g) was considered.

Database preparation

The sodium content per 100g of product was obtained using the direct conversion 1g of salt contains 400mg of sodium. In cases which the sodium content was expressed per 100ml of product, it was converted to 100g using the density factor available in the McCance and Widdowson's The Composition of Foods integrated dataset⁽¹³⁾. A dehydrated chicken soup was excluded, due to lack of accurate sodium content.

Data Analysis

Statistical analysis was performed using IBM SPSS Statistics v27. A total of 1031 products were considered for analysis in this study. Normality test was conducted for sodium content per 100g of product. Descriptive statistics were performed: median, minimum, and maximum values were used to describe salt content (mg/100g) of foods and the percentage of products above the benchmark for each subcategory was obtained. For the study of differences between median sodium content of each subcategory and the respective benchmark, the percentual difference was calculated according to the following procedures: [percentual difference = ((median - SB)/SB) x 100] and the one-sample nonparametric test,

Wilcoxon signed rank test, was used. A significance value of 0.05 was considered. When the food subcategory only had one product, the percentual difference was calculated using the sodium content (mg/100g) of that specific product.

Results

A total of 1031 products were analyzed from 54 subcategories. Prepared salads (9e) (0.1%); soups (ready-to-serve, canned and refrigerated soups) (9gi) (0.1%); flatbreads (11c) (0.1%); whole muscle meat products heat treated (frozen and canned products) (14ei) (0.1%); whole muscle meat products, heat treated (refrigerated products) (14eii) (0.1%); frozen vegetables and legumes with seasoning (16e) (0.1%); soy sauce and fish sauce (18f) (0.1%) and other Asian-style sauces (18g) (0.1%) were the groups with least products available for sale. On the other hand, leavened bread (without additions) (11bi) represented the largest food group available for sale of own brand products (11,4%), followed by cookies/sweet biscuits (2a) (9.9%) and ready-to-eat meals (9f) (7.9%) (Table 1, Appendix B).

Regarding the sodium content, bouillon and soup stock (concentrated) (18aii) had the highest median value [18640mg/100g (6040 (minimum) - 22800 (maximum))], followed by marinades and thick pastes (18h) [5120mg/100g, (5000 (minimum) - 5160 (maximum))]. On the opposite, minimally processed breakfast cereals (6a) showed the lowest median sodium content [4mg/100g, (0 (minimum) - 40 (maximum))], followed by frozen potatoes and other potato products (ready-to-eat) (16f) [80mg/100g (40 (minimum) - 1000 (maximum))] (Table 1).

Table 1: Median, minimum and maximum values of sodium content (mg/100g), percentual difference of median sodium content comparing with SB $[((\text{median} - \text{SB})/\text{SB}) \times 100]$ (%) and percentage of foods above the benchmark (%) for each subcategory

Subcategory*	N (%)	Median (min - max)	Sodium Benchmark	Percentual Difference	P-value	Percentage of products > SB
	(N= 1031)	(mg/100g)	(mg /100g)	(%)		(%)
2a	102 (9.9)	240 (0 - 560)	265	-9.4	0.008***	39.2
2b	70 (6.8)	300 (40 - 800)	205	46.3	< 0.001***	72.9
2c	45 (4.4)	284 (8 - 760)	120	136.7	< 0.001***	84.4
2d	9 (0.9)	76 (40 - 120)	100	-24.0	0.035***	22.2
2e	7 (0.7)	160 (120 - 400)	330	-51.5	0.041***	14.3
3a	36 (3.5)	440 (92 - 960)	600	-26.7	< 0.001***	22.2
3b	7 (0.7)	600 (120 - 760)	280	114.3	0.063	71.4
3c	36 (3.5)	360 (40 - 640)	500	-28.0	< 0.001***	11.1
3d	5 (0.5)	200 (124 - 840)	520	-61.5	NA	40.0
6a	5 (0.5)	4 (0 - 40)	100	-96.0	NA	0.0
6b	39 (3.8)	120 (4 - 680)	280	-57.1	< 0.001***	20.5
8a	24 (2.3)	320 (40 - 520)	190	68.4	< 0.001***	91.7
8b	23 (2.2)	600 (160 - 1036)	520	15.4	0.060	65.2
8c	25 (2.4)	680 (480 - 2320)	625	8.8	0.366	52.0
8e	4 (0.4)	540 (480 - 600)	510	5.9	NA	75.0
8g	3 (0.3)	960 (760 - 1080)	720	33.3	NA	100.0
9bii	11 (1.1)	880 (328 - 1160)	770	14.3	0.423	72.7
9c	19 (1.8)	520 (320 - 680)	450	15.6	0.058	63.2
9d	4 (0.4)	560 (480 - 640)	430	30.2	NA	100.0

Table 1 (continued)

Subcategory*	N (%)	Median (min - max)	Sodium Benchmark	Percentual Difference	P-value	Percentage of products > SB
	(N= 1031)	(mg/100g)	(mg /100g)	(%)		(%)
9e	1 (0.1)	320**	390	- 17.9**	NA	0.0
9f	81 (7.9)	416 (160 - 800)	250	66.4	< 0.001***	88.9
9gi	1 (0.1)	236**	235	0.4**	NA	100.0
9gii	3 (0.3)	4880 (4720 - 6520)	1200	306.7	NA	100.0
10a	10 (1.0)	560 (404 - 1000)	400	40.0	0.005***	100.0
11a	13 (1.3)	344 (50 - 492)	310	11.0	0.116	69.2
11bi	118 (11.4)	400 (5 - 660)	330	21.2	< 0.001***	76.3
11bii	9 (0.9)	600 (444 - 840)	330	81.8	0.008***	100.0
11biii	7 (0.7)	568 (240 - 940)	330	72.1	0.028***	85.7
11c	1 (0.1)	480**	320	50.0**	NA	100.0
14a	17 (1.6)	300 (160 - 600)	360	-16.7	0.831	35.3
14b	12 (1.2)	440 (38 - 720)	270	63.0	0.023***	75.0
14c	10 (1.0)	820 (640 - 1160)	800	2.5	0.203	50.0
14d	22 (2.1)	320 (24 - 880)	230	39.1	0.014***	68.2
14ei	1 (0.1)	240**	270	-11.1**	NA	0.0
14eii	1 (0.1)	210**	600	-65.0**	NA	0.0
14f	17 (1.6)	1600 (1080 - 2080)	950	68.4	< 0.001***	100.0
14g	48 (4.7)	880 (480 - 1680)	540	63.0	< 0.001***	97.9
14h	24 (2.3)	1260 (400 - 2040)	830	51.8	< 0.001***	87.5
14i	14 (1.4)	399 (212 - 1600)	270	47.8	0.072	57.1
16a	50 (4.8)	280 (32 - 1960)	50	460.0	< 0.001***	96.0
16b	3 (0.3)	360 (360 - 440)	550	-34.5	NA	0.0

Table 1 (continued)

Subcategory*	N (%)	Median (min - max)	Sodium Benchmark	Percentual Difference	P-value	Percentage of products > SB
	(N= 1031)	(mg/100g)	(mg /100g)	(%)		(%)
16c	9 (0.9)	1200 (760 - 1520)	780	53.8	0.016***	88.9
16e	1 (0.1)	200**	180	11.1**	NA	100.0
16f	9 (0.9)	80 (40 - 1000)	260	-69.2	0.232	33.3
16g	2 (0.2)	246 (240 - 252)	510	-51.8	NA	0.0
17b	9 (0.9)	520 (360 - 1440)	250	108.0	0.008***	100.0
18aii	10 (1.0)	18640 (6040 - 22800)	15000	24.3	0.575	70.0
18b	9 (0.9)	320 (200 - 848)	330	-3.0	0.592	44.4
18c	2 (0.2)	360 (360 -360)	360	0.0	NA	0.0
18d	24 (2.3)	323,64 (105 - 1418)	500	-35.3	0.103	29.2
18e	13 (1.3)	800 (328 - 2320)	650	23.1	0.173	61.5
18f	1 (0.1)	3571**	4840	-26.2**	NA	0.0
18g	1 (0.1)	1643**	680	141.6**	NA	100.0
18h	4 (0.4)	5120 (5000 - 5160)	1425	259.3	NA	100.0

* 2a.Cookies/sweet biscuits; 2b.Cakes and sponges; 2c.Pies and pastries; 2d.Baked and cooked desserts; 2e.Pancakes, waffles and French toast; 3a.Crackers/savory biscuits; 3b.Nuts, seeds and kernels; 3c.Potato, vegetable and grain chips; 3d.Extruded snacks; 6a.Minimally processed breakfast cereals (includes all types - prepared, ready-made and dry-mixes); 6b.Highly processed breakfast cereals; 8a.Fresh unripened cheese; 8b.Soft to medium ripened cheese; 8c.Semi-hard ripened cheese; 8e.Mould ripened cheese, white and red; 8g.Processed cheese; 9bii.Pasta, noodles, and rice or grains with sauce or seasoned (dry-mix, concentrated); 9c.Pizza and pizza snacks; 9d.Sandwiches and wraps; 9e.Prepared salads; 9f.Ready-to-eat meals composed of a combination of carbohydrate and either vegetable or meat, or all three combined; 9gi.Soups (ready-to-serve, canned and refrigerated soups); 9gii.Soups (dry soup only) (concentrated); 10a.Salted butter, butter blends, margarine and oil-based spreads; 11a.Sweet and raisin breads; 11bi.Leavened bread without additions; 11bii.Leavened bread with additions (meat); 11biii.Leavened bread with additions (other); 11c.Flatbreads; 14a.Canned fish; 14b.Processed fish and seafood products, raw; 14c.Processed fish and seafood products, non-heat-treated; 14d.Raw meat products and preparations; 14ei. Whole muscle meat products, heat treated (frozen and canned products); 14eii.Whole muscle meat products, heat treated (refrigerated products); 14f.Whole muscle meat products, non-heat preservation; 14g.Comminuted meat products, heat treated (cooked); 14h.Comminuted meat products, non-heat preservation; 14i.Fish and seafood products, heat treated; 16a.Canned vegetables and legumes; 16b.Pickled vegetables; 16c.Olives and sundried tomatoes; 16e.Frozen vegetables and legumes; 16f.Frozen potatoes and other potato products (ready-to-eat); 16g.Battered or breaded vegetables; 17b.Meat analogues; 18aii.Bouillon and soup stock (concentrated); 18b.Cooking sauces including pasta sauces and tomato sauces (not concentrated); 18c.Dips and dipping sauces; 18d.Emulsion-based dips, sauces and dressings; 18e.Condiments; 18f.Soy sauce and fish sauce; 18g.Other Asian-style sauces; 18h.Marinades and thick pastes.

** For these subcategories, n=1; median value was not calculated and the sodium content of that specific product was used.

*** statistically significant p < 0.05

NA: Not applicable

The percentual difference of the median sodium content compared to SB of each subcategory is described in Table 1 (and Appendix C). A significant higher median content of sodium, comparing to the reference value, was observed for the following food groups: cakes and sponges (2b) (+46.3% of the SB; $p < 0.001$); pies and pastries (2c) (+136.7% of the SB; $p < 0.001$); fresh unripened cheese (8a) (+68.4% of the SB; $p < 0.001$); ready-to-eat meals (9f) (+66.4% of the SB; $p < 0.001$); salted butter, butter blends, margarine and oil-based spreads (10a) (+40.0% of the SB; $p = 0.005$); leavened bread without additions (11bi) (+21.2% of the SB; $p < 0.001$); leavened bread with additions (meat) (11bii) (+81.8% of the SB; $p = 0.008$); leavened bread with additions (other) (11biii) (+72.1% of the SB; $p = 0.028$); processed fish and seafood products, raw (14b) (+63.0% of the SB; $p = 0.023$); raw meat products and preparations (14d) (+39.1% of the SB; $p = 0.014$); whole muscle meat products, non-heat preservation (14f) (+68.4% of the SB; $p < 0.001$); comminuted meat products, heat treated (cooked) (14g) (+63.0% of the SB; $p < 0.01$); comminuted meat products, non-heat preservation (14h) (+51.8% of the SB; $p < 0.001$); canned vegetables and legumes (16a) (+460.0% of the SB; $p < 0.001$); olives and sundried tomatoes (16c) (+53.8% of the SB; $p = 0.016$) and meat analogues (17b) (+108.0% of the SB; $p = 0.008$).

On the other hand, a significant lower median content of sodium than the reference value were observed for the following food groups: cookies/sweet biscuits (2a) (-9.4% of the SB; $p = 0.008$); baked and cooked desserts (2d) (-24.0% of the SB; $p = 0.035$); pancakes, waffles and French toast (2e) (-51.5% of the SB; $p = 0.041$); crackers/savory biscuits (3a) (-26.7% of the SB; $p < 0.001$); potato,

vegetable and grain chips (3c) (-28.0% of the SB; $p < 0.001$) and highly processed breakfast cereals (6b) (-57.1% of the SB; $p < 0.001$).

Additionally, the percentage of products of each subcategory that showed a higher sodium content than the benchmark was analyzed and are represented in Table

1. For the following food subcategories, more than 50% of products exceeded the benchmark: cakes and sponges (2b) (72.9% of products > SB); pies and pastries (2c) (84.4% of products > SB); nuts, seeds and kernels (3b) (71.4% of products > SB); fresh unripened cheese (8a) (91.7% of products > SB); soft to medium ripened cheese (8b) (65.2% of products > SB); semi-hard ripened cheese (8c) (52% of products > SB); mould ripened cheese, white and red (8e) (75% of products > SB); processed cheese (8g) (the totality of products > SB); pasta, noodles and rice or grains with sauce or seasoned (dry-mix, concentrated) (9bii) (72.7% of products > SB); pizza and pizza snacks (9c) (63.2% of products > SB); sandwiches and wraps (9d) (the totality of products > SB); ready-to-eat meals (9f) (88.9% of products > SB); soups (ready-to-serve, canned and refrigerated soups) (9gi) (the totality of products > SB); soups (dry soup only) (9gii) (the totality of products > SB); salted butter, butter blends, margarine and oil-based spreads (10a) (the totality of products > SB); sweet and raisin bread (11a) (69.2% of products > SB); leavened bread without additions (11bi) (76.3% of products > SB); leavened bread with additions (meat) (11bii) (the totality of products > SB); leavened bread with additions (other) (11biii) (85.7% of products > SB); flatbreads (11c) (the totality of products > SB); processed fish and seafood products, raw (14b) (75% of products > SB); raw meat products and preparations (14d) (68.2% of products > SB); whole muscle meat products, non-heat preservation (14f) (the totality of products > SB); comminuted meat products, heat treated (cooked) (14g) (97.9% of products > SB);

comminuted meat products, non-heat preservation (14h) (87.5% of products > SB); fish and seafood products, heat treated (14i) (57.1% of products > SB); canned vegetables and legumes (16a) (96% of products > SB); olives and sundried tomatoes (16c) (88.9% of products > SB); frozen vegetables and legumes (16e) (the totality of products > SB); meat analogues (17b) (the totality of products > SB); bouillon and soup stock (concentrated) (18a_{iii}) (70% of products > SB); condiments (18e) (61.5% of products > SB); other Asian-style sauces (18g) (the totality of products > SB) and marinades and thick pastes (18h) (the totality of products > SB).

Discussion

Regarding own brand foods' availability, the most available food category was leavened bread without additions, followed by cookies/sweet biscuits and ready-to-eat meals. Both leavened bread and ready-to-eat meals had more than 50% of products exceeding the benchmark, which is in line with the significant higher median sodium content found in comparison with the respective benchmark. Bread represents an important food for the Portuguese population with an average consumption of approximately 100.3 g/day/person in the adult population⁽⁶⁾. Considering the high sodium content of these type of food, bread contributes to a total of 18% of sodium intake of the Portuguese population⁽⁶⁾. In this context, a national attempt to reduce salt content of bread had been made through the definition of an upper limit of 1.4g of salt per 100g ⁽¹⁶⁾. However, this value is higher than the global benchmark recently proposed by WHO (1.4g vs 0.8g of salt per 100g, respectively). Considering the fact that Portuguese population values the salty taste, and it determines the acceptability of foods⁽¹⁷⁾, the established limit assured a gradual transition. In our study, leavened bread without additions

had a median sodium content of 400mg/100g. When comparing this value to Portuguese legal limit, only 5 products were above, which could have happened due to the fact that these type of breads/bread products may not be covered by the legislation. However, if it is compared to the established benchmark (330 mg/100g), 76.3 % of products exceeded this value. This highlights the need for a continuous effort to reach the global SB. Indeed, in May 2019, an extended commitment between national health and industry entities, was signed for the promotion of food reformulation focusing, namely, on the reduction of salt content. This protocol set a target for salt content for different types of foods, including bread (1g/100g), for 2021⁽¹⁸⁾. This is particularly interesting considering that the median salt content of bread found in this study was 1g/100g, which seems to reveal the potential of this action.

Additionally, other categories were also covered by this protocol: potato chips and other savory snacks, breakfast cereals, ready-to-eat pre-packaged soups and ready-to-eat prepackaged meals⁽¹⁸⁾. In this study, potato, vegetable and grain chips showed to have a median sodium content lower than the benchmark, and the same was observed for highly processed breakfast cereals, and extruded snacks (but in this case was not statistically significant), which may be explained by the referred reformulation efforts. However, an interesting result was the median sodium content observed for nuts, seeds and kernels, which was 114.3% higher than the SB (despite not statistically significant, considering the low number of products). Considering that these types of foods are also consumed as a savory snack, focusing particularly on these snacks may be important.

Ready-to-eat meals have become more attractive for society, considering the growing demand for convenience and alternatives easy to prepare ⁽¹⁹⁾. However,

they are typically processed foods which seems to have a negative impact on health⁽¹⁹⁾. In fact, our results showed that the median sodium content of ready-to-eat meals was 66.4% higher than the SB, with approximately 90% of products above this reference value. Considering that ready-to-eat refrigerated meals from take-away section were not included in this study, and the fact that added salt is the greater contributor to Portuguese sodium intake ⁽⁶⁾, these results may be underestimated.

Processed meat is also a food group frequently consumed by the Portuguese population (6.3% of Portuguese population consume more than 50g of processed meat and delicatessen per day). Our results demonstrate a higher median sodium content than the SB of different subcategories of these type of foods, and more than 65% of products exceeded the benchmark in all these subcategories. This result is not surprising considering that these type of products represents 7% of salt intake of the Portuguese population⁽⁶⁾. However, it is important to increase the population awareness to the importance of diminishing the consumption of processed meat and meat products, and to control the availability of these type of products, which may have a positive impact on the reduction of salt intake and health of the Portuguese population⁽²⁰⁾.

The Portuguese gastronomic tradition is typically characterized by dishes that includes pulses. However, with the actual trend of preferring easy and quick options to eat, the cooking time appears as a barrier to its consumption⁽²¹⁾. In this context, canned pulses seem to appear as a solution for this problem. However, in our study it was observed that canned vegetables had a median sodium content approximately 500% higher than the benchmark and 96% of food products

exceeded the SB. Considering that part of the amount of salt can be removed, for example, by washing it before consumption, it may be important to educate and alert the population to these practices, which will allow individuals to continuing to eat canned pulses, that contribute to an adequate health status ⁽²²⁾. Furthermore, with the growing demand for vegetarian alternatives and adherence to vegetarian food patterns⁽²³⁾, the availability of plant-based foods have accompanied this trend. Interesting results were observed for this group, where the median sodium content was 108% higher than the benchmark and the totality of products exceeded this value. In a context where growing concerns regarding the meat consumption and environmental issues appears, it seems important to evaluate the contribution that these products may have to an inadequate intake of salt.

In this context, along with national public health strategies, it is clear that food industry has a potential role on the promotion of a healthier diet, considering the importance of food availability on food habits⁽²⁴⁾. Product reformulation is a WHO “best buy” strategy (effective and cost-effective intervention)⁽²⁵⁾, but it seems that had been a limited global progress. In Portugal, product reformulation strategies resulted in a reduction of 11.5% of sodium content⁽¹⁸⁾. For more progress, complementary strategies should be implemented to maximize the impact of this action⁽¹⁰⁾. Therefore, interventions that enable consumers to correctly interpret labels are equally important for making healthier food choices. Our results support this fact, considering that even within the same subcategory, a wide range of sodium content exists, namely in cheese or processed meat, for example).

This study has some limitations that are worthily to mention. First, foods that were analyzed were products of one unique brand, that may, therefore, not be representative of national food availability. Furthermore, this brand is already committed in reducing salt content, which could imply an underestimation of sodium content, comparing to other foods. Secondly, for some categories a low number of products were studied, which could difficult the detection of statistically significant differences. Thus, for future research, it could be important to include a higher number of foods from other brands and companies. Particularly interesting, it would be to study sodium content of ready-to-eat refrigerated meals and soups, which are important contributors to salt intake of Portuguese population ⁽⁶⁾.

Conclusion

In this study, bouillon and soup stock (concentrated) had the highest median sodium content and minimally processed breakfast cereals had the lowest. Approximately 60% of food groups had a median sodium content higher than the benchmark (30% were statistically significant) and had more than 50% of products exceeding the SB.

A comprehensive and continuous monitoring of foods' salt content available for sale in the Portuguese market is important to allow the definition of adequate food reformulation policies. Legislation should also seek to follow international guidelines, to reduce hypertension and the global burden of CVDs.

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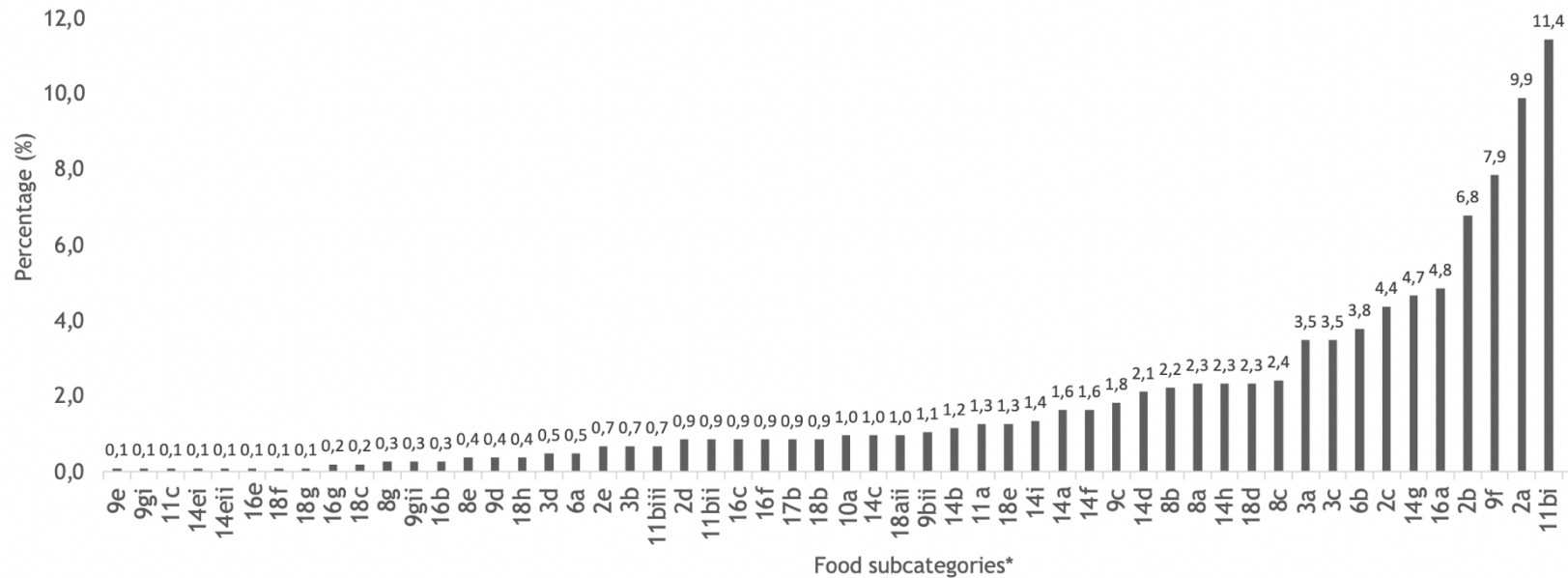
Appendix A

Table 2: Foods' classification according to the WHO SB subcategories

SUBCATEGORY FOOD PRODUCTS	2a	2b	2c	2d	2e	3a	3b	3c	3d
	Cookies/sweet biscuits	Cakes and sponges	Pies and pastries	Baked and cooked desserts	Pancakes, waffles and French toast	Crackers/savory biscuits	Nuts, seeds and kernels	Potato, vegetable and grain chips	Extruded snacks
SUBCATEGORY FOOD PRODUCTS	6a	6b	8a	8b	8c	8e	8g	9bii	9c
	Minimally processed breakfast cereals (includes all types - prepared, ready-made and dry-mixes)	Highly processed breakfast cereals	Fresh unripened cheese	Soft to medium ripened cheese	Semi-hard ripened cheese	Mould ripened cheese, white and red	Processed cheese	Pasta, noodles, and rice or grains with sauce or seasoned (dry-mix, concentrated)	Pizza and pizza snacks
SUBCATEGORY FOOD PRODUCTS	9d	9e	9f	9gi	9gii	10a	11a	11bi**	11bii**
	Sandwiches and wraps	Prepared salads	Ready-to-eat meals composed of a combination of carbohydrate and either vegetable or meat, or all three combined	Soups (ready-to-serve, canned and refrigerated soups)	Soups (dry soup only) (concentrated)	Salted butter, butter blends, margarine and oil-based spreads	Sweet and raisin breads	Leavened bread without additions	Leavened bread with additions (meat)
SUBCATEGORY FOOD PRODUCTS	11biii*	11c	14a	14b	14c	14d	14ei	14eii	14f
	Leavened bread with additions (other)	Flatbreads	Canned fish	Processed fish and seafood products, raw	Processed fish and seafood products, non-heat-treated	Raw meat products and preparations	Whole muscle meat products, heat treated (frozen and canned products)	Whole muscle meat products, heat treated (refrigerated products)	Whole muscle meat products, non-heat preservation
SUBCATEGORY FOOD PRODUCTS	14g	14h	14i*	16a	16b	16c	16e	16f	16g
	Comminuted meat products, heat treated (cooked)	Comminuted meat products, non-heat preservation	Fish and seafood products, heat treated	Canned vegetables and legumes	Pickled vegetables	Olives and sundried tomatoes	Frozen vegetables and legumes	Frozen potatoes and other potato products (ready-to-eat)	Battered or breaded vegetables
SUBCATEGORY FOOD PRODUCTS	17b	18aii	18b	18c	18d	18e	18f	18g	18h
	Meat analogues	Bouillon and soup stock (concentrated)	Cooking sauces including pasta sauces and tomato sauces (not concentrated)	Dips and dipping sauces	Emulsion-based dips, sauces and dressings	Condiments	Soy sauce and fish sauce	Other Asian-style sauces	Marinades and thick pastes

* Subcategories that have been adapted from the existing subcategories

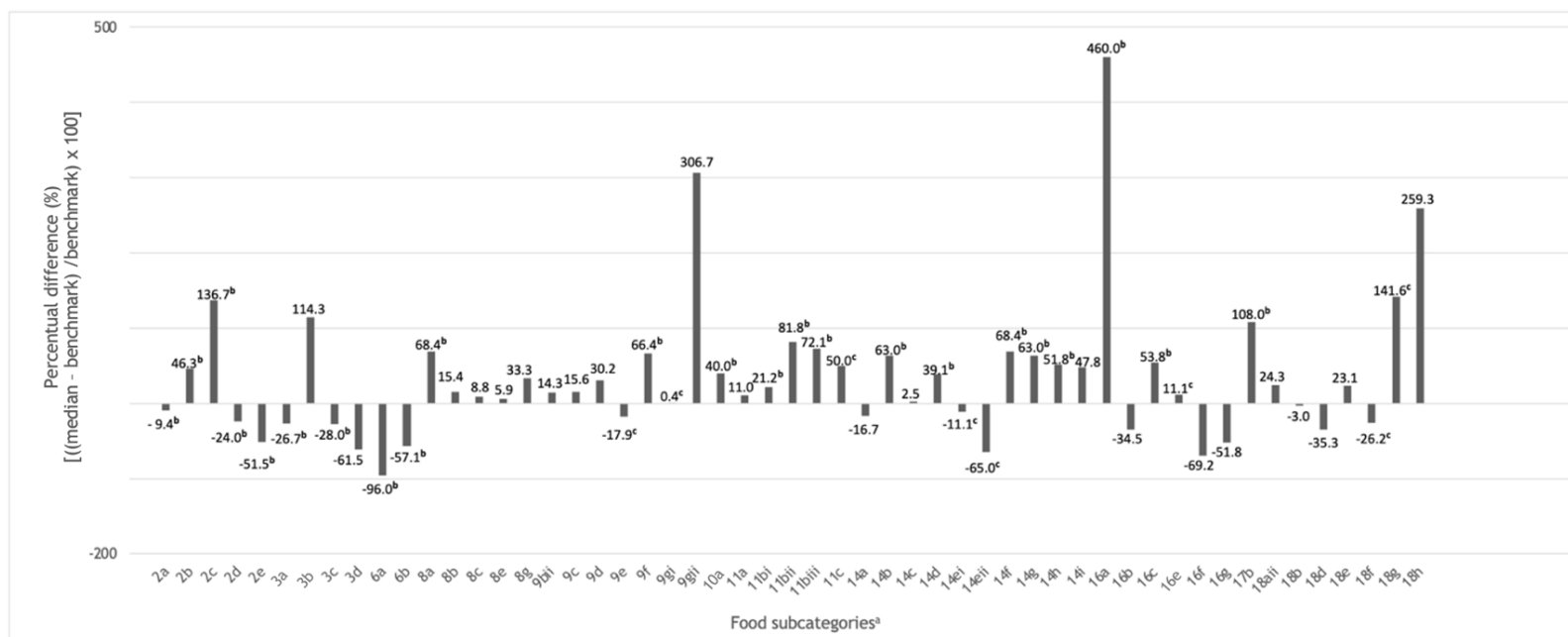
Appendix B



*2a.Cookies/sweet biscuits; 2b.Cakes and sponges; 2c.Pies and pastries; 2d.Baked and cooked desserts; 2e.Pancakes, waffles and French toast; 3a.Crackers/savory biscuits; 3b.Nuts, seeds and kernels; 3c.Potato, vegetable and grain chips; 3d.Extruded snacks; 6a.Minimally processed breakfast cereals (includes all types - prepared, ready-made and dry-mixes); 6b.Highly processed breakfast cereals; 8a.Fresh unripened cheese; 8b.Soft to medium ripened cheese; 8c.Semi-hard ripened cheese; 8e.Mould ripened cheese, white and red; 8g.Processed cheese; 9bii.Pasta, noodles, and rice or grains with sauce or seasoned (dry-mix, concentrated); 9c.Pizza and pizza snacks; 9d.Sandwiches and wraps; 9e.Prepared salads; 9f.Ready-to-eat meals composed of a combination of carbohydrate and either vegetable or meat, or all three combined; 9gi.Soups (ready-to-serve, canned and refrigerated soups); 9gii.Soups (dry soup only) (concentrated); 10a.Salted butter, butter blends, margarine and oil-based spreads; 11a.Sweet and raisin breads; 11bi.Leavened bread without additions; 11bii.Leavened bread with additions (meat); 11biii.Leavened bread with additions (other); 11c.Flatbreads; 14a.Canned fish; 14b.Processed fish and seafood products, raw; 14c.Processed fish and seafood products, non-heat-treated; 14d.Raw meat products and preparations; 14ei. Whole muscle meat products, heat treated (frozen and canned products); 14eii.Whole muscle meat products, heat treated (refrigerated products); 14f.Whole muscle meat products, non-heat preservation; 14g.Comminuted meat products, heat treated (cooked); 14h.Comminuted meat products, non-heat preservation; 14i.Fish and seafood products, heat treated; 16a.Canned vegetables and legumes; 16b.Pickled vegetables; 16c.Olives and sundried tomatoes; 16e.Frozen vegetables and legumes; 16f.Frozen potatoes and other potato products (ready-to-eat); 16g.Battered or breaded vegetables; 17b.Meat analogues; 18aii.Bouillon and soup stock (concentrated); 18b.Cooking sauces including pasta sauces and tomato sauces (not concentrated); 18c.Dips and dipping sauces; 18d.Emulsion-based dips, sauces and dressings; 18e.Condiments; 18f.Soy sauce and fish sauce; 18g.Other Asian-style sauces; 18h.Marinades and thick pastes.

Figure 1: Distribution of foods by WHO SB food subcategories (n = 1031)

Appendix C



a- 2a.Cookies/sweet biscuits; 2b.Cakes and sponges; 2c.Pies and pastries; 2d.Baked and cooked desserts; 2e.Pancakes, waffles and French toast; 3a.Crackers/savory biscuits; 3b.Nuts, seeds and kernels; 3c.Potato, vegetable and grain chips; 3d.Extruded snacks; 6a.Minimally processed breakfast cereals (includes all types - prepared, ready-made and dry-mixes); 6b.Highly processed breakfast cereals; 8a.Fresh unripened cheese; 8b.Soft to medium ripened cheese; 8c.Semi-hard ripened cheese; 8e.Mould ripened cheese, white and red; 8g.Processed cheese; 9bii.Pasta, noodles, and rice or grains with sauce or seasoned (dry-mix, concentrated); 9c.Pizza and pizza snacks; 9d.Sandwiches and wraps; 9e.Prepared salads; 9f.Ready-to-eat meals composed of a combination of carbohydrate and either vegetable or meat, or all three combined; 9gi.Soups (ready-to-serve, canned and refrigerated soups); 9gii.Soups (dry soup only) (concentrated); 10a.Salted butter, butter blends, margarine and oil-based spreads; 11a.Sweet and raisin breads; 11bi.Leavened bread without additions; 11bii.Leavened bread with additions (meat); 11biii.Leavened bread with additions (other); 11c.Flatbreads; 14a.Canned fish; 14b.Processed fish and seafood products, raw; 14c.Processed fish and seafood products, non-heat-treated; 14d.Raw meat products and preparations; 14ei. Whole muscle meat products, heat treated (frozen and canned products); 14eii.Whole muscle meat products, heat treated (refrigerated products); 14f.Whole muscle meat products, non-heat preservation; 14g.Comminuted meat products, heat treated (cooked); 14h.Comminuted meat products, non-heat preservation; 14i.Fish and seafood products, heat treated; 16a.Canned vegetables and legumes; 16b.Pickled vegetables; 16c.Olives and sundried tomatoes; 16e.Frozen vegetables and legumes; 16f.Frozen potatoes and other potato products (ready-to-eat); 16g.Battered or breaded vegetables; 17b.Meat analogues; 18aai.Bouillon and soup stock (concentrated); 18b.Cooking sauces including pasta sauces and tomato sauces (not concentrated); 18c.Dips and dipping sauces; 18d.Emulsion-based dips, sauces and dressings; 18e.Condiments; 18f.Soy sauce and fish sauce; 18g.Other Asian-style sauces; 18h.Marinades and thick pastes.

b - Statistically significant $p < 0.05$

c - For this subcategory, $n=1$; median value was not calculated, and the sodium content of that specific product was used

Figure 2: Percentual difference of median sodium content compared to the SB $[((\text{median} - \text{SB})/\text{SB}) \times 100]$ (%) for subcategories ($n= 53$)

