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FRONT OF PACK LABELLING AND CONSUMER PERCEPTION

Through the Lens of Social Media

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Contents

List of Figures

List of Tables

0 Introduction

Being in a car accident is horrible. Falling down a cliff is horrible. Cancer is horrible. And yet, all these things are unpredictable, and mostly unpreventable. One can live their life in the best, healthiest, sanest way possible and still be caught by one of them.

So, why have ever-lasting effects from something that can easily be predicted and intercepted before anything bad happens?

This is the case of so-called non-communicable diseases, such as diabetes, heart conditions and obesity, that depend not only from sheer luck, genetics and environmental factors, but also by active choices of behavior by people. Specifically, by what we eat, how much we eat, and how we conduct our lifestyles.

Obesity and overweight, in particular, do not only affect individuals. They have been defined the epidemic of the 21st century, because they are so widespread they put the health-care systems of the entire planet under enormous strain. Think about what we could do if we weren't so busy treating people affected by something that they could have even avoided contracting.

The solution to all of this is prevention, and prevention comes from knowledge.
First and foremost, citizens have to know what they're doing wrong, and how they should systematically embrace an active and healthy lifestyle, something very difficult in our sedentary way of life. But the other side of the coin is even more relevant: nutrition. Our diets shape our body, and subsequently the chance that we have to become overweight or contracting any of these non-communicable diseases.

And yet, it is not easy to know whether what we're thinking of buying to eat is good for us or not. What are the metrics? What does "good" mean? Is "good" something absolute, or does it require an holistic approach that takes into consideration the whole diet? Institutions all over the world, both health-related and not, have been asking themselves exactly these questions, and have been looking for the right way to help citizens with these issues for the last few decades.

Specifically, one of the tools that have been designed to direct food purchases towards healthy choices and to simplify the information that customers have to evaluate when deciding what to eat are Front of Pack labels. These labels are indicators placed on food packagings, and their aim is to greatly simplify said nutritional information, to make comparisons easy and quick: on paper, they are the right tool for the job.

Or at least they should be: there is no agreement on which design is right, nor on what kind of information should be displayed on them, and even their effectiveness has been called into question. Especially, one of the biggest questions concerning these labels is whether they are enough on their own, whether they work when trying to push towards a healthier diet without any prior nutritional knowledge from the customer.

States and supra national institutions such as the European Union or ASEAN have been working to define a mandatory, common labelling system to help their own citizens eat better, and to facilitate trade. Yet, we are still far from a decision.

This work will try to answer some of these questions, and to provide tools to further evaluate the effectiveness of the labelling schemes on the real world. All will be framed in the optic of the current situation, in which the ongoing epidemic and contextual lockdown have hampered even more the healthiness and activeness of our lifestyles, and also impacted our eating habits.

The first chapter will provide the reader with a deep overview on why we need to eat better, together with the reasons why only institutions are in the right place to coordinate these efforts. Moreover, alternative methods to Front of Pack labellings that have the aim of improving dietary habits will be discussed, together with the current state of things concerning communication of nutritional information to customers.

The second chapter will deep dive in the world of FoP labels, describing history, goals and features of the most popular schemes across the world. Subsequently, different factors of the theoretical effectiveness of the labels in general will be analyzed and evaluated. These two parts will then come to a synthesis when defining the best practices of a Front of Pack labelling scheme.

The third chapter consists in the definition of a novelty working method of assessing the effectiveness of Front of Pack labelling schemes via an indirect approach. Instead of evaluating the responses of participants to a questionnaire, that will be biased because they are actively being asked to think about these labels, this work will analyze the spontaneous discussion on social media that is related to them, with a specific focus on Twitter.
A reproducible method of defining meaningful search queries will be highlighted, together with the analyses that can be used to evaluate the country-specific effectiveness of these labels by comparing the discourse with some health-related population metrics, such as mindfulness and overweightness rates.

We will conclude by highlighting the pivotal role that new media and social networking can have in

this time when educating customers on how to use and read the labels for their own best interest, and by describing how to properly target and evaluate the effectiveness of educational campaigns sponsored by health institutions by applying the method outlined in this work.

1 Chapter 1 - A Call for Transparency: The Front of Pack Labelling Case

1.1 Why eat healthier? An overview of health risks

"Growing levels of overweight and obesity, continued harmful consumption of alcohol, and the growing threat of Anti Microbial Resistance are some of the greatest challenges to the health of European populations." [Hernández-Quevedo and Rechel, 2018]

In particular, "obesity and overweight are among the greatest public health challenges in the world, and are a major risk factor for several of the leading noncommunicable diseases"[Hernández-Quevedo and Rechel, 2018]. The World Health Organization has gone as far as to define it, in 2000, "the epidemic of the 21st century". It is defined as an epidemic also because of its equity dimension: it affects people from all social classes, ages and countries, and yet a socioeconomic gradient is present.

Specifically, both adults and children show higher obesity rates in lower socio-economic groups and in disadvantaged areas[Hernández-Quevedo and Rechel, 2018; Magnusson et al., 2014][1]. " It is a risk factor or marker for a number of chronic diseases including diabetes, cardiovascular diseases (CVDs) and cancer, and has adverse effects on overall health."[2][Tremmel et al., 2017].

While the issue of obesity is present worldwide, we'd like to bring the analysis a little closer to home, by looking at obesity data from the European Union.

In all the countries analyzed, obesity has increased between 2010 and 2016. Projections made in 2007 in the UK show that by 2050 over half of the country's population could suffer from a form of obesity.

An inattentive reader might think that, as he's not touched by the issue and eats healthy all the time, he should not worry, and that governments should not work towards reducing it. This could not be more wrong. In fact, treating its victims constitutes an enormous toll to the health system.

[1]Social Inequalities in Obesity Persist in the Nordic Region Despite Its Relative Affluence and Equity Maria Magnusson,corresponding author Thorkild I. A. Sørensen, Steingerdur Olafsdottir, Susanna Lehtinen-Jacks, Turid Lingaas Holmen, Berit Lilienthal Heitmann, and Lauren Lissner https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3920028/

[2]Smith S.C. Multiple risk factors for cardiovascular disease and diabetes mellitus. Am. J. Med. 2007;120:S3–S11. doi: 10.1016/j.amjmed.2007.01.002.

Fig. 2.1 *Age-standardized prevalence of overweight (defined as BMI ≥ 25 kg/m²) in people aged 18 years and over, WHO estimates, 2010 and 2016 (%)*

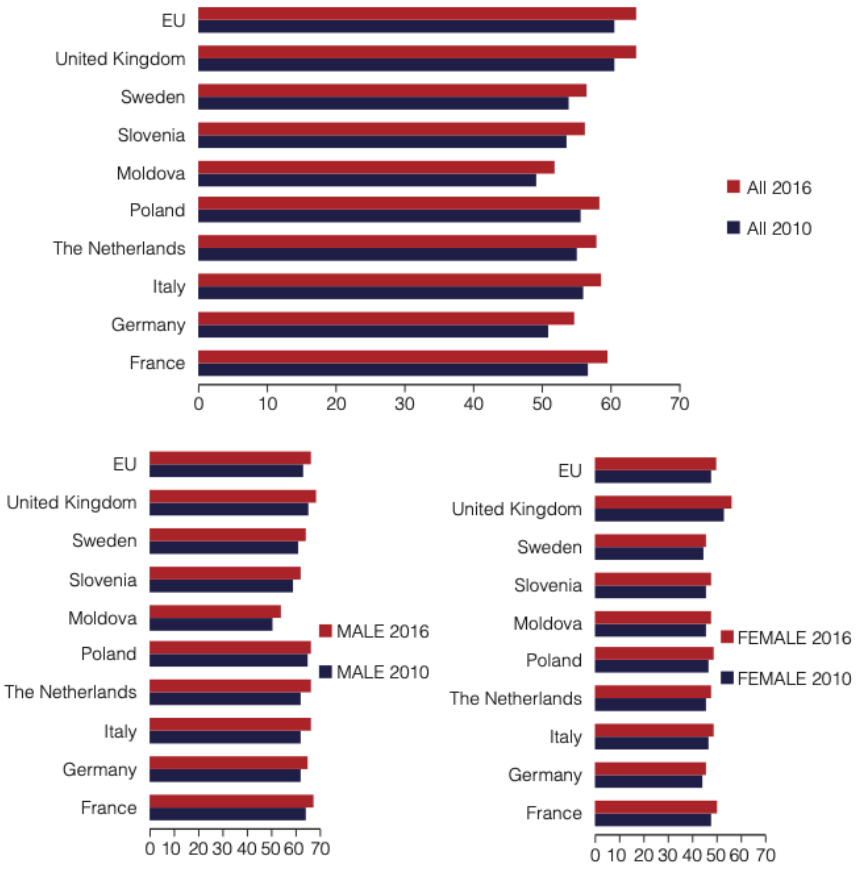

Figure 1: Age-standardized prevalence of overweight (defined as BMI 25 kg/m2) in people aged 18 years and over, WHO estimates, 2010 and 2016 (%)

For example, in the U.S. it is estimated that $190.2 billion or nearly 21% of annual medical spending in the United States is due to obesity treatment.[3] "Treating obesity and its consequences is estimated to cost the English National Health Service (NHS) 6.1 billion pounds (approximately 7 billion euros) per year, with the wider costs of obesity to society being estimated to be around three times this amount" [4]. E.U. countries' levels of expenditure are similar.

And yet, these costs are not only limited to health expenses. On a planetary level, "in 2014 the global economic impact of obesity was estimated to be US $2.0 trillion or 2.8% of the global gross domestic product (GDP)"[5]. [Tremmel et al., 2017]

By looking at the data, it is extremely clear why it is not an issue that can be ignored. It is

[3]https://www.hsph.harvard.edu/obesity-prevention-source/obesity-consequences/economic/

[4]Public Health England (2018). Public Health Profiles [website]. London: Public Health England (https://fingertips.phe.org.uk/)

[5]Dobbs R., Sawers C., Thompson F., Manyika J., Woetzel J.R., Child P., McKenna S., Spatharou A. Overcoming Obesity: An Initial Economic Analysis. McKinsey Global Institute; Jakarta, Indonesia: 2014.

one of the biggest health issues in the world at the moment, and it impacts not only individuals but whole countries. Moreover, as it affects lower social classes more than it does higher ones. "Although previously considered a problem of high income countries (HICs), obesity is now having a major impact on the economy of low and middle income countries (LMICs)" [6] [Cabrera Escobar et al., 2013].

This issue is hindering health care systems worldwide. It is a preventable disease, and the resources that are spent on it could be used on solving many other problems. This is why it is of paramount importance that prevention is strong and early. Moreover, this problem is connected worldwide with loss of productivity of $2 trillion each year, that is equivalents to the effects of armed conflicts and smoking.

It is thus clear that the intervention that must be made in this direction can only originate from institutions: it is their role to guide citizens towards healthiness at a huge scale.

1.2 The role of Institutions

A global action on obesity must include measures "to tackle price, availability, and marketing of energy-dense food and drinks" [Hernández-Quevedo and Rechel, 2018; Malik et al., 2013]

Specifically, "interventions outside the health care system can have a significant impact on a nation's health, as recognised in WHO's 'health-in-all-policies' framework"[7]. In particular, "it has been shown that small changes in diet for many individuals can translate into large population health gains at relatively low cost."" [Cabrera Escobar et al., 2013]

It is clear that these efforts should be shared, coordinated and driven by a common goal. Yet, there is an enormous fragmentation not only in terms of possible solutions but also in the interest of single states towards applying these measures.

An important coordination effort is made by the World Health Organization, that through its World Health Assembly has adopted the Global Action Plan for the Prevention and Control of Non-communicable Diseases 2013–2020.

The Plan "recognizes that an unhealthy diet and physical inactivity trigger major noncommunicable

[6]Malik VS, Willett WC, Hu FB: Global obesity: trends, risk factors and policy implications. Nat Rev Endocrinol 2013, 9(1):13–27.

[7]Leppo K, Ollila E, Pena S, Wismar M, Cook S: Health in all policies-seizing opportunities, implementing policies. Julkaisuja (STM) 2013, 9:2013.

diseases and points to the need for a strong and effective cooperation between different actors and sectors of society, coordinated by national governments to tackle these risk factors".

While a coordination effort is of paramount importance, these guidelines must be received and implemented by national governing bodies, and their respective Ministries of Health. These entities are responsible for the formulation of national health policies, but many of the major threats to health are viewed as falling within the scope of other ministries.

When this happens, commercial considerations are given more importance against health decisions, and thus the role of health ministries is reduced to an advisory position. A confirmation comes from the fact that in the areas of obesity, for example, powerful vested interests promote the idea of food consumption being an individual lifestyle choice rather than a population health challenge and public health organizations have been unsuccessful in challenging this perception.

These interests are those of powerful food manufacturers, and of the food industry as a whole. Only governments and institutions have

This only generates a bigger burden on national health systems, as resources that could be better spent treating unpreventable diseases are employed to fight something that can easily be intercepted before it develops.

Institutions must thus act in this direction, and establish appropriate coordination mechanisms between the many actors and agencies that are involved. Public health organizations are usually in the right position to be granted the role. And yet, coordination is useless when there is no cooperation between actors at different administrative tiers, so this has to be addressed as well when defining said mechanisms.

In conclusion, it is the role of public health organizations, and institutions in general, to coordinate, organize and address public health problems. In particular, they can play a key role in facilitating intersectoral collaboration, setting up professional and policy partnerships and networks, and coordinating different actors in order to fight obesity and health issues in general while raising awareness and educating people.

With this aim, two are the main instruments that they can use: Excises on unhealthy products, and the cognitive approach. Let's see them in more detail.

1.3 The Fat Tax - Can it work to force people towards better eating habits?

It's either the carrot or the stick. Customers can either be educated and learn how and why they should eat better, or be penalized for their bad eating habits. In that regard, "interest is mounting in developing combined approaches to address individual behaviour change together with population-oriented fiscal policies such as tax and subsidies to encourage healthier food consumption patterns". [Cabrera Escobar et al., 2013].

Government finance departments in particular can improve population health by establishing incentives and disincentives to drive change throughout the food system, including consumer purchases.

Studies on the topic have identified several categories of food products to which some sort of excise to disincentive consumption should be applied. "These include processed food (high in salt, sugar and fat), high energy density food[8], fast food, food containing saturated fat, junk food and soft drinks [9]".

Sugary calorie-dense foods, such as a small chocolate bar or a glass of fizzy drink, are easy to overconsume without realising, leading to weight gain and raising the risk of diabetes and heart disease. Sugar and calorie-dense foods are a problem because so much sugar is added to savoury products as well as sweet ones to make them more palatable. [10]

Among these, research shows that a good starting point towards reducing the consumption of unhealthy food, in an effort to curb obesity, could be applying special taxation to Soft drink beverages, also identified as SBBs[11]. SBBs are well regarded in this aspect, as they account to a significant percentage of calories consumed in the US, but they provide little or no nutritional value. Moreover, as they're a profitable product in high demand, "they're easily accessible to all age groups through vending machines, restaurants, schools, cafeterias and shops, as well as at home."[12] [Cabrera Escobar et al., 2013]

Links between obesity, osteoporosis and dental caries and the intake of SBBs are well proven, and this is why the quantity that is consumed as part of a person's diet must be limited.

[8]Rolls BJ, Drewnowski A, Ledikwe JH: Changing the energy density of the diet as a strategy for weight management. J Am Diet Assoc 2005, 105(5):98–103.

[9]Stuckler D, Marion Nestle: Big food, food systems, and global health. PLoS Med 2012, 9(6):1–4.

[10]https://www.lshtm.ac.uk/research/research-action/features/uk-sugar-tax-will-it-work

[11]Pomeranz JL: Advanced policy options to regulate sugar-sweetened bev- erages to support public health. J Public Health Policy 2012, 33(1):75–88.

[12]French SA, Lin B-H, Guthrie JF: National trends in soft drink consumption among children and adolescents age 6 to 17 years: prevalence, amounts, and sources, 1977/1978 to 1994/1998. J Am Diet Assoc 2003, 103(10):1326–1331.

A study conducted in the U.K. that proposes a gradual reduction in the sugar content in sweetened beverages estimated, for example, "that a 40% reduction in added sugars over five years would reduce the number of obese adults by roughly half a million and new cases of type 2 diabetes by around 300,000" [Thornton, 2018].

Studies on this topic show that "an increase in SBBs prices is associated with a decrease in consumption" [Cabrera Escobar et al., 2013].

Moreover, higher prices of SBBs bring people to increase the consumption of fruit juices and whole milk tends to increase. Specifically, the few available studies suggest that higher prices of SSBs have the potential to significantly reduce weight gain and body fat gain, across all age groups. Another interesting finding is that the consumption of diet drinks may decrease as the price of SSBs increases[13]

Finally, an interesting finding that can help regulators decide whether to subsidize healthy products or tax unhealthy ones is that people tend to be more responsive to price increases than to decreases. This means that in relative terms, "rising prices may have a greater potential to change what people buy rather than subsidising healthier foods" [14].

And, last but not least, taxes obviously generate revenue. The soft drink industry is worth billions of dollars annually, so even a modest tax would generate an enormous cash flow for governments, that could be used to support health care systems and specific activities targeted at prevention and treatment of obesity.

A taxation approach is also democratic, as it benefits the whole population, compared to an educational effort that is easier to be received by higher social classes. Moreover, a price increase is usually more felt by families with lower income, so this measure should be effective in targeting their consumption.

To date, the vast majority of these so called fat-taxes have been applied to SSBs, in countries such as France, South Africa, Mexico[15], UK, Ireland, as well as several US cities like Berkley and Seattle. "Evidence from experimental studies, observational assessments of real-world taxes, and simulation modelling suggests SSB taxes applied at a rate equivalent to at least 20% of a products' price are likely to be an effective means of reducing purchasing and consumption of high-sugar beverages, as well as a

[13]Veitch J, Singh A, van Stralen MM, Van Mechelen W, Brug J, ChinAPaw Mai JM: Reduction in sugar-sweetened beverages is not associated with more water or diet drinks. Public Health Nutr 2010, 14(8):1388.

[14]http://amsacta.unibo.it/5821/

[15]https://www.economist.com/finance-and-economics/2015/11/26/stopping-slurping

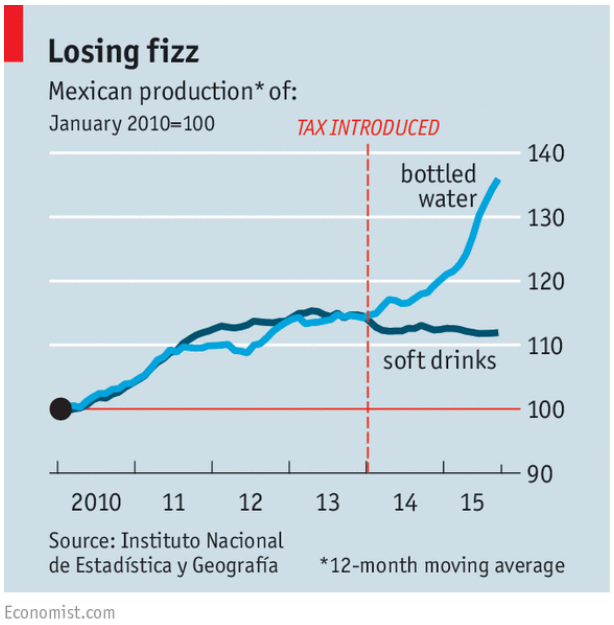

Figure 2: Effect of Sugar Tax in Mexico - The Economist

strong incentive for product reformulation." [16] [Acton et al., 2019]

And yet, establishing an excise on SBBs cannot be the only solution, as it can generate a substitution effect. People substitute them with other products that have not gone up in price but may have similar amounts of sugar, to 'make up' for those that have. They pick chocolate or a fruit juice over Coke, for example. [17].

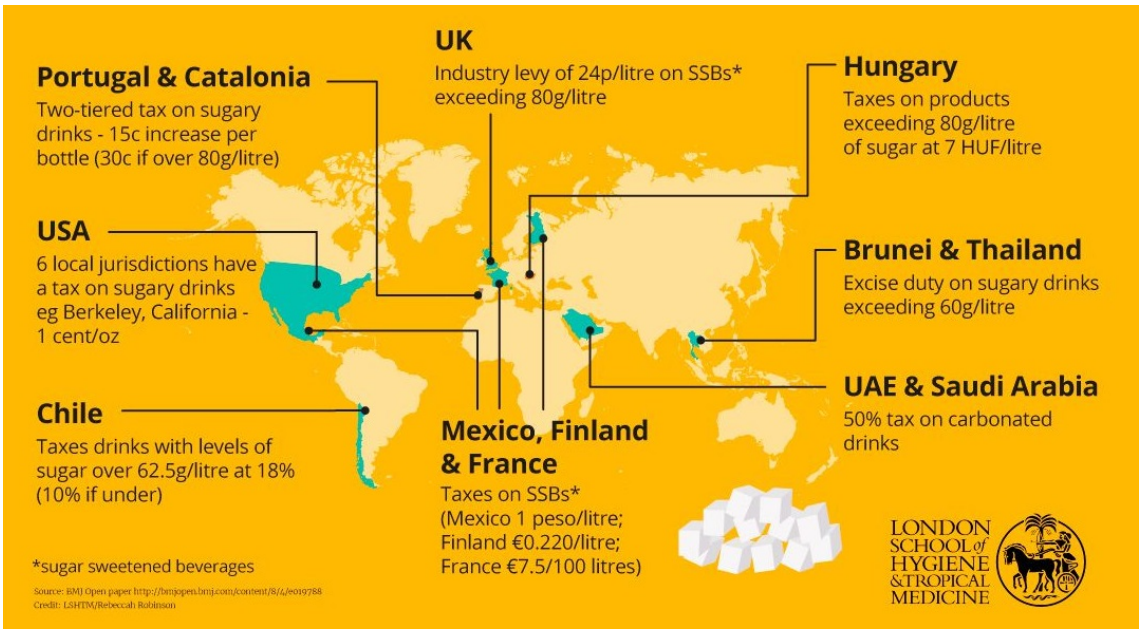

Figure 3: Sugar Tax Around the world - London School of Hygiene and Tropical Medicine

[16] Taxes and front-of-package labels improve the healthiness of beverage and snack purchases: a randomized experimental marketplace Rachel B. Acton , Amanda C. Jones , Sharon I. Kirkpatrick , Christina A. Roberto and David Hammond

[17] https://www.lshtm.ac.uk/research/research-action/features/uk-sugar-tax-will-it-work

This can be solved in two different ways: either all sugary/unhealthy products get taxed, so that the only alternative is to consume healthy food, or customers are made able to understand the reason of this price increases. They have to know why the prices have gone up, and that it is for their own good. Education must complement taxation.

In that regard, another aspect has to be analysed. It is believed that making people aware of why the new tax is levied, and constantly reminding them, might have a stronger effect than the tax alone. The reason for this is that customers should not get used to the new, increased prices, and simply start paying them. They need to be aware that they're paying more while harming themselves. The final goal of rising prices, nevertheless, is not to burden the consumer, but to encourage manufacturers to reformulate their products in order to avoid being subjected to the tax. If they don't, then they pay the price of lowered sales.

The final goal of levying taxes on unhealthy food is obviously to improve people's diets, purchasing habits and eating choices, with the ultimate aim of reducing obesity and non-communicable diseases. And yet, is it better to tell a person what to do, or to teach them why they should do something?

This is where the cognitive approach starts.

1.4 A Cognitive Approach - Why do we need food labels at all?

Strategies to have people eat healthier have been conceived by implementing what is called a "cognitive" approach[18], which assumes that a consumer actually wants to improve his diet and be healthy, and that would do so with the appropriate nutrition information. Thus, the only obstacle is the difficulty of obtaining said information.

So, if people knew more about what they're eating, and what their food choices should be, they would surely pursue a more healthy diet. Or, at least, this is the assumption. So what, should people be learning all about ingredients, calories, appropriate quantities and the Krebs Cycle? Should customers research every single detail about correct and healthy diets before buying? Should evaluating the healthiness of a product become a chore?

We doubt the question actually needs an answer that is not obvious, but just in case: no, the answer is no. And this is where Nutrition labels come into place. "Nutrition information on food labels

[18]Petty, R. E., P. Briñol, and Z. L. Tormala. 2002. Thought confidence as a determinant of persuasion: The self-validation hypothesis. Journal of Personality & Social Psychology 82:722-741.

is thought to be a cost-effective method of communicating nutrition information to consumers because the information appears at the point of sale for most packaged foods " [19][van Buul, 2018] . Specifically, customers that are grocery shopping can immediately evaluate the product they're holding in their hand by looking at the label on the package. But is the label enough?

To find an answer, we will follow a comparative study titled "The effects of nutrition knowledge on food label use. A review of the literature, by Lisa M. Soederberg Miller, Diana L. Cassady" combining the results of 34 articles on food packaging to evaluate the effect of knowledge on how food labels are used by customers.

Let's thus begin with a brief overview of how information is traditionally presented on food packaging, and their effect on health choices and purchase behaviours.

Ingredients List contain list of additives, synthetic or solid fats, added sugars and so on, They provide customers with a list of, well, ingredients that form the product, as basic components. Such lists have to be very comprehensive and extensive, and can become very long very easily, so much that font size is usually a problem as there is not enough space on the pack. [20]. Yet, this does not deter customers from consulting them very frequently, as they represent the most tangible way of knowing what you're going to eat.

Health and Nutrient Claims are intended to communicate scientifically proven health benefits associated with consuming a particular food[21], to highlight the value or relative amount of a specific nutrient within a food product. They have been shown to significantly impact how other food labels are processed, and can influence other dietary behaviours much more than, say, NFPs: they're advertising, basically speaking, much simpler to understand, and as such can also be misleading and confusing[22]

Nutrition Labels such as NFPs, will be examined in more detail in the next section. A simple definition, useful for the purpose of the topic, is that they contain information on calories, serving

[19]Campos, S., Doxey, J., & Hammond, D. (2011). Nutrition labels on pre-packaged foods. A systematic review. Public Health Nutrition, 14(08), 1496–1506. doi:10.1017/ S1368980010003290.

[20]Mackey, M. A., & Metz, M. (2009). Ease of reading of mandatory information on Canadian food product labels. International Journal of Consumer Studies, 33(4), 369–381. doi:10.1111/j.1470-6431.2009.00787.x.

[21]Mathios, A. D., & Ippolito, P. (1999). Health claims in food advertising and labeling disseminating nutrition information to consumers. In E. Frazao (Ed.), America's eating habits. Changes and consequences (Vol. AIB750, pp. 189–212). Agriculture Information Bulletin No. (AIB750).

[22]Hasler, C. M. (2008). Health claims in the United States. An aid to the public or a source of confusion? The Journal of Nutrition, 138(6), 1216S–20S.

size, and amounts and/or daily values of several macronutrients, vitamins, and minerals (e.g., fats, carbohydrate, calcium), and are usually government regulated, by entities like the F.D.A. and the EU. Yet, they present hard, scientific data, and customers have been shown to have difficulties not only reading them, but also using them to make informed purchase decisions.

All of this has to be combined, obviously, with the knowledge that whoever is evaluating a product possesses. "Knowledge of dietary recommendations may support applying these pieces of nutrition information to decide whether the food product represents a healthful choice within the context of other foods the individual consumes that day "[Miller and Cassady, 2015][23].

So, while having a label that is contingent to the product we're holding really helps the evaluation process, but all of this must be corroborated by knowledge that we already have: in simpler terms, customers must be able to understand the label they're reading, know what elements they're looking for to complete their diet, and thus, make a healthier decision. This process is documented in the following diagram, highlighting the fact that a correct dietary intake is the sum of both an appropriate nutrition knowledge, and the usage of the food label.

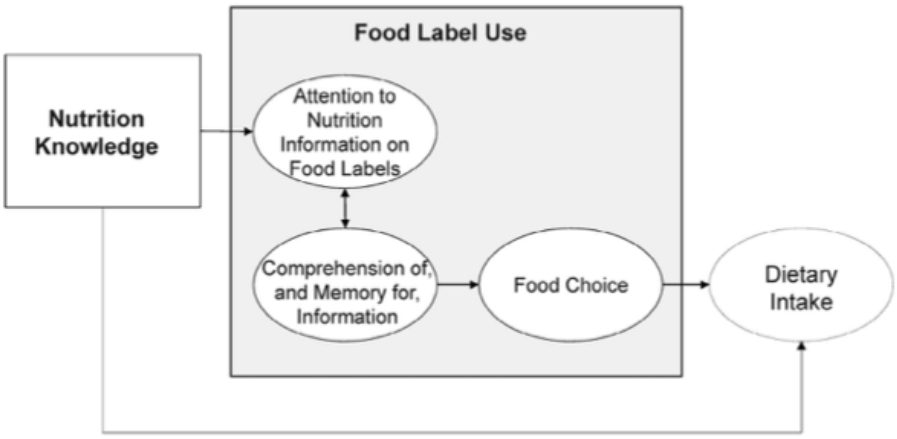

Figure 4: Cognitive processes underlying use of food labels [Miller and Cassady, 2015]

To summarize these concepts, no current label presenting just a list of nutritional information is useful on its own, both as a whole and for its goal of pushing towards a healthy diet: previous nutritional knowledge is necessary. This is not just to read and understand the label itself, but also to impact attitudes and beliefs, and most importantly, to evaluate unlabelled products. In simpler terms, knowing about health and diet best practices strongly affects food choices, regardless of food label use.

Moreover, it has been shown that there is a strong correlation between possessing nutrition knowledge

[23]The effects of nutrition knowledge on food label use. A review of the literature Lisa M. Soederberg Miller, Diana L. Cassady

and actually using labels to perform dietary choices: if people know about how important it is to have the right diet, and know how health correlates with food intake, they're more likely to use labels as tools to perfect their choices.

How do we make this information more accessible to everyone? Let's focus more on the NFPs to find out.

1.5 Why do we need FOP Labels? - Barriers to Traditional Nutrition Label Use

The Nutrition Fact Panel is a table usually shown on the back or on the side of the food package, that displays its energy properties and its content in proteins, fats, carbohydrates, fibres, sodium, vitamins and mineral salts.

These labels are standardized, and are usually made mandatory by national or supranational regulatory bodies. Differences exist between local standards, but the gist of them is the same. For example, EU Regulation NO 1169/2011[24] on the provision of food information to consumers has made labels mandatory, also defining the minimum information that must be displayed on them.

Nutrition Information

	Per 100 g	%Reference Intake RI
Energy	485 kJ / 117 kcal	6% RI
Fat	8 g	11% RI
Of which Saturates	3,7 g	19% RI
Carbohydrate	9 g	3% RI
Of which Sugars	8 g	9% RI
Protein	1,4 g	3% RI
Salt	0,02 g	0% RI
Vitamin C	14,81 mg	19% RI

Salt content is exclusively due to the presence of naturally occurring sodium.

Reference intake of an average adult (8 400 kJ / 2 000 kcal)

INGREDIENTS: Mandarin Oranges (37.9%), Light Whipping Cream (**Milk**), Pears (12.4%), Peaches (7.7%), Thompson Seedless Grapes (7.6%), Apple (7.5%), Banana (5.9%), English Walnuts (**Tree Nuts**)

Figure 5: Sample EU-Approved Nutrition Label

Specifically, the regulation states minimum mandatory nutrient declarations, Energy, Fat, Saturated Fat, Carbohydrate, Sugar, Protein, Salt, and also states that when a nutritional or health claim is made, said nutrient must be on the label. That also involves allergens and vegetable origin of oils and fats.

It also defines the bare minimum graphics standards, in order to achieve readability, such as font size and style[25].

[24]https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A32011R1169

[25]https://esha.com/european-union-label-regulations/

Another example is the FDA Nutrition Facts Label employed in the U.S.A. The current revision is outlined as follows: "The information in the main or top section of the sample nutrition label (below) can vary with each food and beverage product; it contains product-specific information (serving size, calories, and nutrient information). The bottom section contains a footnote that explains the % Daily Value and gives the number of calories used for general nutrition advice"[26].

Mandatory since 1994, has been overhauled in 2016 because studies[27] shown that consumers demonstrated difficulties in understanding nutrition labels. These difficulties were more common among subjects with low level literacy and numeracy skills, but even subjects that were more educated and with higher literacy were shown to have trouble reading them[28]. In particular, close to two-thirds of respondents in a survey report using NFPs to make purchasing decisions[29]. Most individuals are able to understand at least some basic nutrition information on food labels[30]. However, the surveys, and just a simple look at how a label presents its data, highlight how people tend to have difficulties using labels for something more than just finding differences between two products and transitioning the information towards a balanced diet.

Why would we need new labels, someone may ask, if we already have NFP labels on the package that contain all the nutritional information in a standardized and scientific format? The U.S. Label case is the perfect example. It turns out there are many difficulties that consumers encounter when they have to actually use these tables to make informed, healthy, purchases. The main reason is that these labels are simply too hard to read. Let's try to understand more in detail where these issues come from.

First of all, customers actually need to know what the information displayed on the label means: it is not only a matter of literacy or education, it is simply using concepts that are far from everyday life. Thus, a lack of nutrition knowledge "prevents an effective use of the NFP and may actually lower the motivation of some consumers to use the nutrition information on the food label".[31] [Barreiro-Hurlé

[26]https://www.fda.gov/food/new-nutrition-facts-label/how-understand-and-use-nutrition-facts-label

[27]https://www.ajpmonline.org/article/S0749-3797(06)00281-9/fulltext

[28]https://www.fda.gov/media/135197/download

[29]Ollberding, N. J., Wolf, R. L., & Contento, I. (2010). Food label use and its relation to dietary intake among US adults. Journal of the American Dietetic Association, 110(8), 1233–1237. doi:10.1016/j.jada.2010.05.007.

[30]Graham, D. J., & Jeffery, R. W. (2011). Location, location, location. Eye-tracking evidence that consumers preferentially view prominently positioned nutrition information. Journal of the American Dietetic Association, 111(11), 1704–1711. doi:10.1016/ j.jada.2011.08.005.

[31]Barreiro-Hurle, J., A. Gracia, and T. de-Magistris. 2010. Does nutrition information on food products lead to healthier food choices? Food Policy 35:221-229.

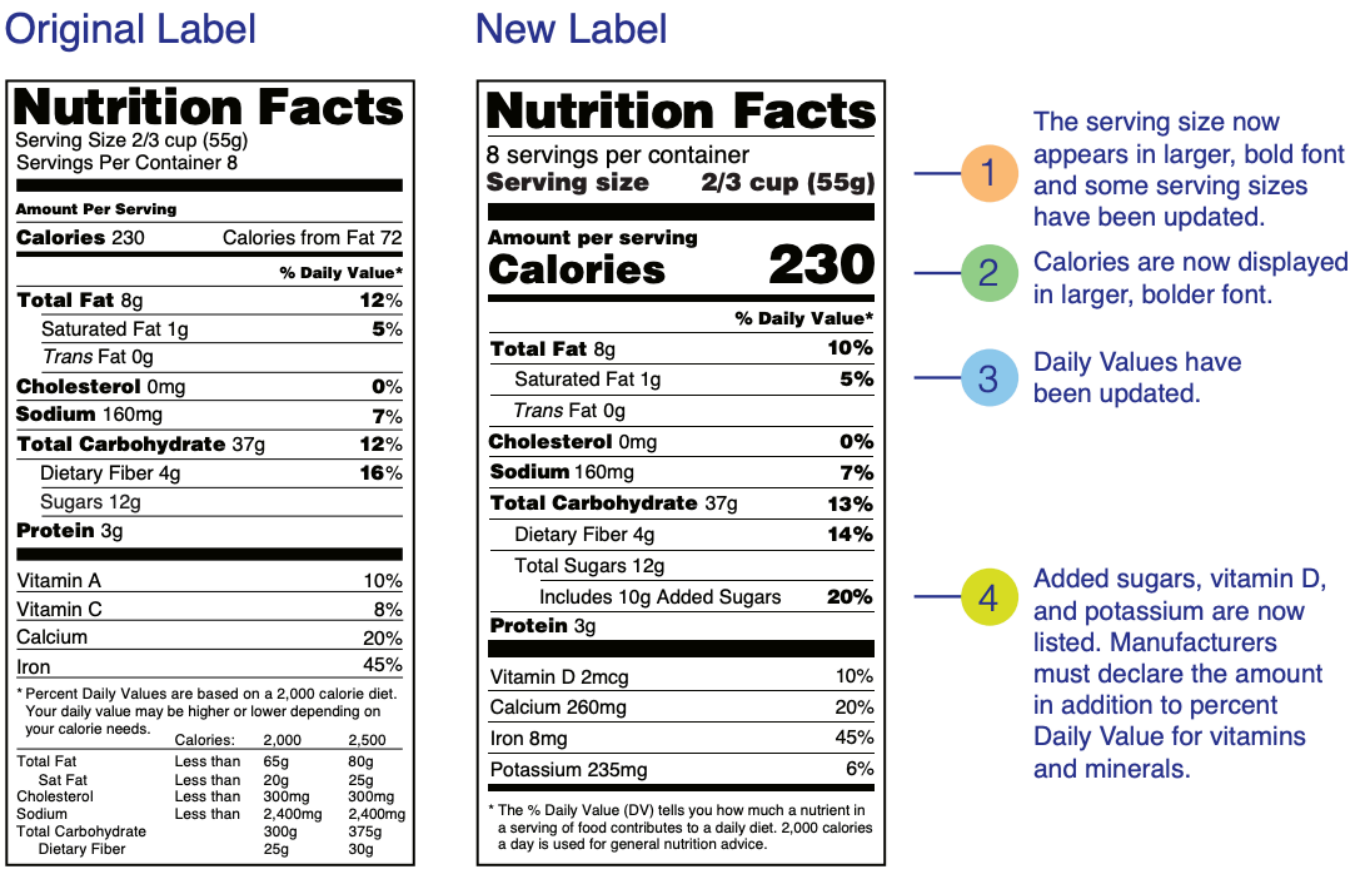

Figure 6: US FDA-Approved Nutrition Label

et al., 2010]

Moreover, grocery shopping is usually not an occasion in which the customer has the luxury of taking the time required to study the label of what he's buying. In this case, "the motivation to process and use nutrition information is even more adversely affected" [32].

In addition to that, the location in which labels and tables are read and employed has to be taken into consideration: research has shown that when shopping customers process products in a cursory manner, scanning shelf after shelf [33], thus reducing the time and attention dedicated to nutritional information even more. Also, the fact that NFP tables are not on the front of the pack makes them even less accessible.

The results of all these studies is that customers have to be encouraged to make an informed decision and select healthier products. The majority of customers cannot base their choices on NFP tables, for the aforementioned reasons. A systematic review of 58 studies conducted in the European

[32] Grunert, K. G., and J. M. Wills. 2007. A review of European research on consumer response to nutrition information on food labels. Journal of Public Health 15:385-399.

[33] Higginson, C. S., M. J. Rayner, S. Draper, and T. R. Kirk. 2002. The nutrition label—which information is looked at? Nutrition and Food Science 32(2-3):92-99.

Union concerning consumer response to nutrition information on food labels[34] confirms that consumers favour simplified information on the front of the package that supplements the more complex nutrition table on the back. Such a nutrition rating system, placed in the front of the pack, "would be most effective in the supermarket, where consumers make quick purchasing decisions and must choose from a wide array of products."

Thus, a solution to all of these issues is a simplified, actionable and usable indicator to compare and select the right products, especially in the light of the total light of each individual: specifically, a FOP label.

[34]Grunert, K. G., and J. M. Wills. 2007. A review of European research on consumer response to nutrition information on food labels. Journal of Public Health 15:385-399.

2 FOP Labels - An Overview

The intention of providing customers with a better understanding of what they are eating, sensitizing them, and the health implications of the food they buy, is shared among nations and citizens. Yet, coordination efforts have not been many.

Without a centralized standard to define visuals, scoring algorithms, or more simply, what kind of message the label is trying to convey to consumers, there has been a proliferation of systems. There's no agreement even on the location of the label on the product.

Moreover, even if various FOP labeling systems have been studied by government institutions, "the implementation of most remains at the discretion of manufacturers and marketers" [Ikonen et al., 2020][35].

This chapter will present to the reader an overview of the different designs, analyzing the aspects that characterize them, the information they try to convey, and the function they serve.

In order to understand the results of this compendium, it is fundamental to keep in mind that the targets of FOP Labels are two.

1. Customers, that through labels can obtain information about healthier food choices, and thus improve their diet.
2. The Industry, for a push towards reformulation of products in healthier options

The importance of this perspective will become clear as we delve into the different approaches towards product labelling. After that, we will analyze in detail the effectiveness of FOP labeling, not only concerning the positive push towards healthier products from both sides, but also the possible negative effects and abuses.

2.1 A Working Definition

An appropriate, easily understandable and complete working definition of FOP nutrition labelling can be inferred from the review "Front-of-pack nutrition labelling schemes: a comprehensive review", published

[35]Kanter, R., Vanderlee, L., & Vandevijvere, S. (2018). Front-of-package nutrition labelling policy: Global progress and future directions. Public Health Nutrition, 21(8), 1399–1408.

in 2020 by the "JRC SCIENCE FOR POLICY REPORT" of the European Commission, and also from the 2011 EU FIC Regulation.

It is applicable in the context of the so-called *principal field of vision*, "the field of vision of a package which is most likely to be seen at first glance by the consumer at the time of purchase and that enables the consumer to immediately identify a product in terms of its character or nature and, if applicable, its brand name". In short, it's the part of the package that we see when we first look at it.

A FOP Label is thus defined as nutrition information in the principal field of vision on food and drinks packaging that either

- Repeats some or all of the numerical information from the mandatory nutrition declaration in a neutral way or in an evaluative way;
- Expresses the overall nutritional value of a food, by using some or all of the information from the nutrition declaration and/or other nutritional elements, to be applied on all products or only on products complying with certain nutritional criteria.

2.2 Who creates labels?

As previously mentioned, there is no standard, no guiding body, no worldwide central authority on FOP Labels. More specifically, there is no agreement on mandatory FOP labelling, or on the specific formats or methodologies to be used in FOP labelling systems.[36]: this has led to the emergence of countless FOP Nutrition Systems.

Thus, all the decisions on what to show, how to show it, and even whether to show it, is in the hands of many organizations, such as manufacturers, grocery retailers, and health organizations [37].

The stakeholders involved in the development of FOPs can thus be divided into three main areas: these areas can also be read chronologically.

NGO's and Government Agencies In 1987 the Heart Guide symbol was created by the American Heart Association to signal to a consumer that a food was Heart Friendly. This can be seen as

[36]. Kanter, R.; Vanderlee, L.; Vandevijvere, S. Front-of-package nutrition labelling policy: Global progress and future directions. Public Health Nutr. 2018, 21, 1399–1408.

[37]Who Uses Facts Up Front? A Baseline Examination of Who is Using Standardized Front-of-Package Nutrition Disclosures JEREMY KEYS

the first effort to provide a simple symbol with the modern characteristics of a FOP Label. This effort, spearheaded by national Heart Health associations, spread around the world, for example in South Africa, Australia and New Zealand.

In 1989 the Keyhole symbol was developed in Sweden by a government agency, and was exported to Denmark and Norway. This marked the beginning of the FOP Labels era as we know it.

Industry While food manufacturers had no hand in the first phase of the conception of FOP Labels, their efforts joined the ones of the government and of consumer organizations in the UK. The Institute for Grocery Distribution published in 1998 guidelines for "voluntary nutritional labelling, including GDAs for energy, fats and saturated fats". While these GDAs provided guidelines on the back of the pack, a streamlined and simplified percentage version was employed on the front of the pack in Europe and Australia.

Meanwhile in the U.S.A., manufacturers and retailers such as Wegman, Kraft, Unilever, PepsiCo, Kellog's developed their own labels and scoring mechanisms. This fact also provides an important example, that will be further discussed in subsequent chapters. Retailers only put proprietary labels on their store-brand products: this was not only seen as an important differentiating factor in the eyes of the consumer, but also led to a phenomenon that is a fundamental psychological side effect of seeing health information on packs. That is, a "positive bias" in which just the fact that a health label is present on the pack increases the perceived healthiness of the product, even when compared to products that have no label. [38]

Consortiums Notwithstanding the efforts of governments and manufacturers, third party entities have always been involved in ways to improve the health of the citizens. One of the biggest contributions to the FOP cause was a round table, the *Food and Nutrition Roundtable* held in 2009 in the USA, after which a standard called *Smart Choice Programme* was developed. The highlight of this labelling scheme was that it applied different criteria for rating product healthiness, dividing by, for example, beverages, dairy, meat rather than using a single one for all kinds of products. This category approach recognised that different foods have different profiles by nature [39]

Meanwhile, the European Union drafted proposals for a new legislation that specified guidelines for FOP Labels, allowing for the *voluntary repetition of specific nutrition information in the principle field of vision*, with the aim of facilitating consumer understanding the dietary results

[38] https://link.springer.com/article/10.1007/s11747-019-00663-9

[39] Lupton, J.R., Balentine, D.A., Black, R.M., Hildine, R., Ivens, B.J., Kennedy, E.T., Packard, P. T., Sperber, B.R., Steffen, D. and Story, M. (2010) "The smart choices front-of-package nutrition labeling program: rationale and development of the nutrition criteria," Am J Clin Nutr, 91(4), 1078S–1089S.

of the food they're considering buying. Moreover, nowadays the EU is the largest sovra-national body working on a shared, mandatory FOP label standard to be applied within all member states.

Once again, the implementation of FoP Labels is at the discretion of manufacturers and marketers[40]. Countries such as Chile, Singapore and Mexico have made their labelling schemes mandatory, and supranational organizations such as the EU are working towards a common regulation. Yet, it's manufacturers and member countries that have the last word on implementation.

2.2.1 A Timeline

FOP labeling has existed for a long time. It started as something voluntary, at the discretion of the manufacturer, but its most current iterations are developed by governments throughout the world and are becoming more and more mandatory.

The first wide-spread, significant effort at making nutritional information more easily readable and available to consumers was in 1989 in Sweden, through the establishment of the Keyhole logo. It is an example of an *health logo*, a simple icon on the pack that highlights whether the food is healthy. Thanks to the simplicity and easiness of understanding of this kind of label, it can also be found in Asian countries such as Singapore, which in 1998 implemented its Healthier Choices program, not only for food products that can be bought in supermarkets, but also for hawker centers, the local version of food courts. Coordination efforts have been made at an ASEAN level, but are still at early stages.

A milestone for FOP Labelling is 2011, as the European Union Regulation 1169/2011 introduced the possibility for member states to complement nutrition tables with simplified indicators. This is the first relevant effort by a supra-national body to regulate and facilitate an easier access to food information. While the goal of this regulation was to establish a common set of guidelines, a framework that could be used to create a common labeling scheme, it generated quite some confusion as it was implemented in many different ways by member states.

For example, in 2013 the United Kingdom developed its non-mandatory Multiple Traffic Lights System, that is among the first to implement colored indicators to identify the healthiness of the food products. Nutriscore, launched in 2017 in France and implemented also by Switzerland in 2018 and Belgium in 2019, is a contestant for the role of official EU-wide food labelling scheme.

[40]Kanter, R., Vanderlee, L., & Vandevijvere, S. (2018). Front-of-package nutrition labelling policy: Global progress and future directions. Public Health Nutrition, 21(8), 1399–1408.

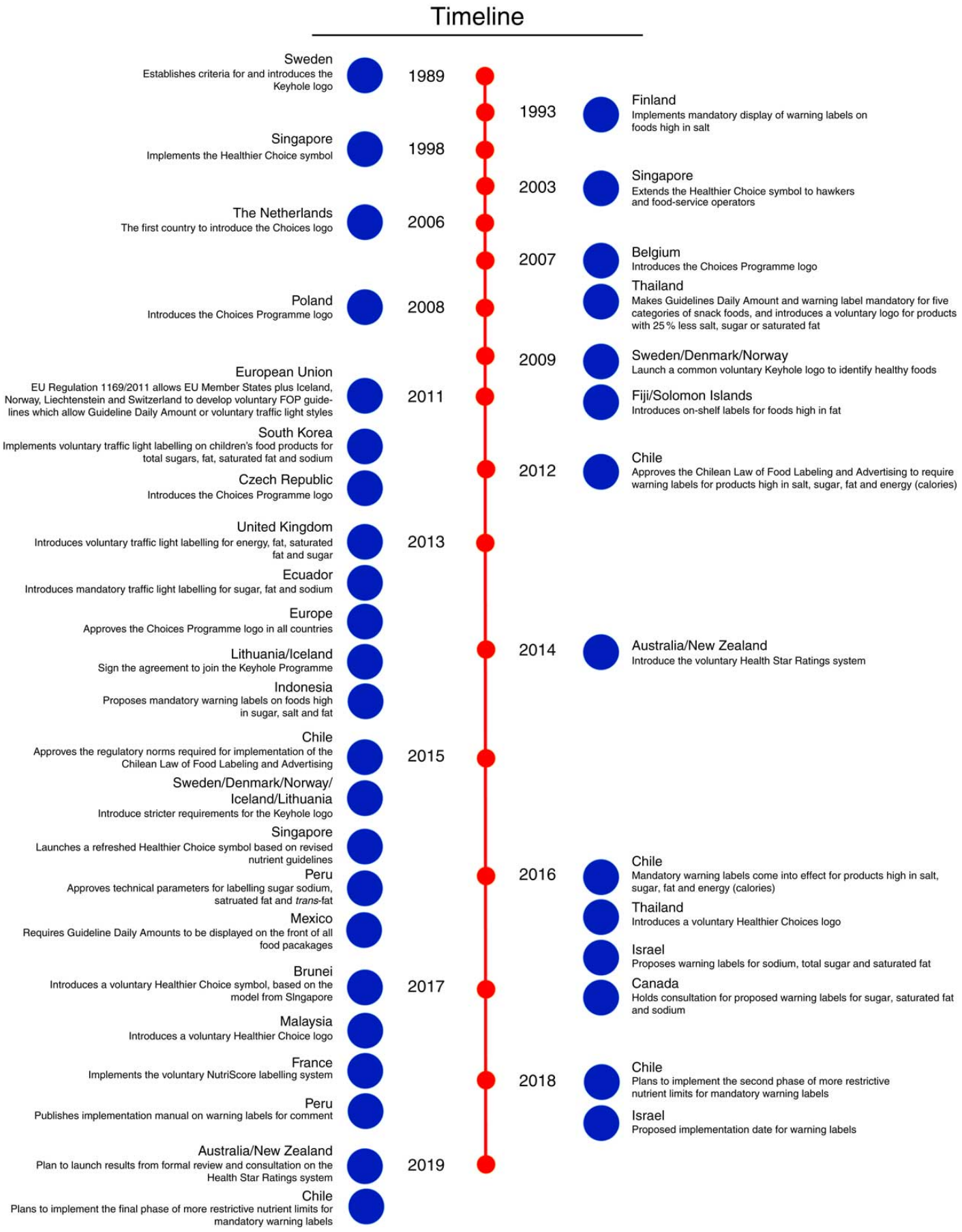

Figure 7: FoPL Timeline - Front-of-package nutrition labelling policy: global progress and future directions, Kanter et Al. 2019

Yet, while there is a huge interest in the field, by national actors, supra-national ones and even food manufacturers, what is missing is an agreement. Even the EU cannot agree on what label is the right one to use in all its states. Let's try to understand why.

2.3 Styles of Labels

[Ikonen et al., 2020] defines FOP labels as providing "consumers with truncated nutrition information and serve to complement the more complex NFP typically found on the back or side of the packaging" [41]

While the NFP information is scientifically accurate and has an absolute value, it is not of easy and fast reading, or better, understanding. This is where the labels come into place: to make information more easily available. Yet, as mentioned before, many organisations have tried their hand at labels, with differences not only in the shape that the information takes, but also in the way the message is conveyed.

Moreover, labelling systems vary in "presentation (e.g. shape, colour, size), type of public health nutrition message (proscriptive, prescriptive or both) and nutrient focus (e.g. focus on 'critical nutrients' or inclusion of both positive and negative nutrients)" [42].

2.3.1 Reductive vs Interpretative

The main distinction in data presentation consists in the kind of message. Is the message simply an instruction to be followed without interpretation, as a judgement, or is it a way to convey simplified information to the consumer?

We thus have two main buckets in which we can sort labels: *Reductive* and *Interpretative.* [43]

Reductive Labels can be defined as showing information only, with no specific judgement, opinion or recommendation [44]. Their goal is indeed to *reduce* the amount of information presented to the

[41] https://link.springer.com/article/10.1007/s11747-019-00663-9 Becker et al. 2015; Newman et al. 2018

[42] Kanter, R., Vanderlee, L., & Vandevijvere, S. (2018). Front-of-package nutrition labelling policy: Global progress and future directions. Public Health Nutrition, 21(8), 1399–1408.

[43] https://link.springer.com/article/10.1007/s11747-019-00663-9

[44] Hamlin R & McNeill L (2016) Does the Australasian 'Health Star Rating' front of pack nutritional label system work? Nutrients 8, E327

customer on the NFP, by selecting only a few, standardised factors that can be read easily.

Yet, they refrain from providing advice or recommendations, or even an interpretation of the values. An advantage they provide is making comparisons easier, because customers only have to compare a small set of values to find the healthier option.

They do have specific downsides. While they represent a great simplification from the NFP as they are less complex and more condensed, together with being more accessible, they still present values that have to be read and understood by customers, without a fast and easy way to find out whether the product is healthy or not.

Moreover, as they do not offer judgement, may it be positive or negative, they might create a positive bias against unlabelled products: customers having to choose between an unlabelled product and a labelled one might prefer the labelled one, regardless of actual healthiness.

Evaluative or Interpretive Labels , on the other hand, employ algorithms that combine nutritional data concerning the product into a single, simple element, a judgement of some sort, without actually presenting the data they refer to.

A further division occurs concerning "the degree of information aggregation they perform" [Talati et al., 2017]:

- *Interpretive Nutrient-Specific Labels* add an evaluative component, an interpretation of the healthfulness of one or more individual nutrient. Colors are used to express whether the level of a particular nutrient is low (green), medium (yellow), or high, with the thresholds scientifically determined when the label is created[45]. They also offer the consumer an interpretation, showing through colors whether a product belongs to the "good" or "bad" threshold. [46].

  While facilitating consumer understanding of the message concerning specific nutritional factors, these labels still require customers to make the effort and evaluate the product's healthiness as a whole. Health claims related to the elements displayed in the label can be combined with them to interpret information about a single nutrient, but they could enable a sort of halo effect.

- *Interpretive summary indicator labels*, on the other hand, provide a summary of the overall nutrition profile of a product, by aggregating nutritional information to form a single indi-

[45]Scarborough P, Matthews A, Eyles H, Kaur A, Hodgkins C, Raats MM, et al. Reds are more important than greens: how UK supermarket shoppers use the different information on a traffic light nutrition label in a choice experiment. Int J Behav Nutr Phys Act. 2015;12:151–9.

[46]Andrews, J. C., Burton, S., & Kees, J. (2011). Is simpler always better? Consumer evaluations of front-of-package nutrition symbols. Journal of Public Policy & Marketing, 30(2), 175–190.

cator, which is readable at a glance. A growing body of research suggests that interpretive FoPLs lead to more accurate impressions of product healthfulness and healthier choices than reductive FoPLs, as they are extremely simple to read and understand.

A huge benefit they offer is that they enormously simplify product comparison: customers simply have to confront a single symbol for each product.

Moreover, the fact that they both encourage the purchase of healthy products and discourage that of unhealthy ones is beneficial for consumer choice. Positive bias in this case is quite limited.

These are the two main approaches to FOP Labelling, but to say that all the existing indicators can be precisely divided into them would be a great mistake. In fact, many labels are hybrids, containing both a simplification of nutritional, scientific values, and a guidance on how to read, compare and evaluate them. They exist on the spectrum depicted below.

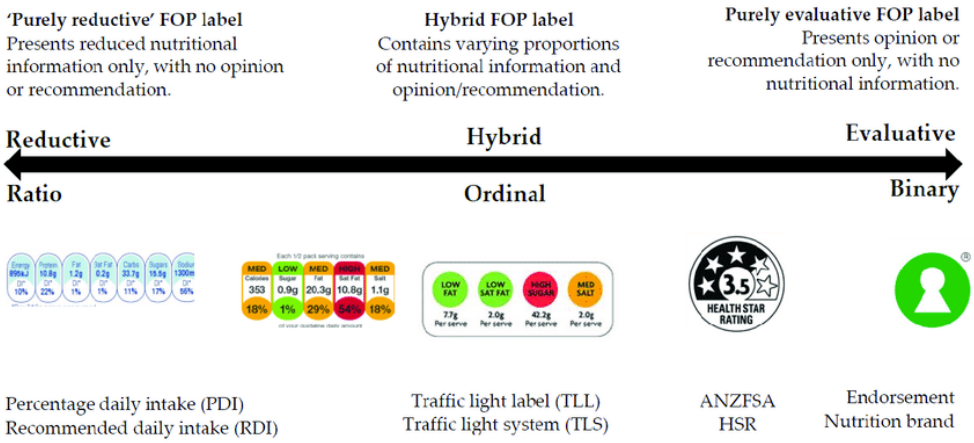

Figure 8: FoPL Continuum - Reductive-Evaluative [Hamlin et al., 2015]

Is there a consensus on what the best approach is? Is there a label that is believed to be the best? The answer to this question is not always black or white. Let's try to see what the current situation is.

2.4 FOP Labels - A Compendium

Now that we know (almost) everything about the theory behind FOP Labels: let's try to outline the way they've been implemented around the world, focusing on Europe, the United States, and Asia, the markets in which health motivations are more felt, and governments are driving the effort towards a simplification of food choice. Specifically, around 40 countries worldwide are using government-endorsed

FOP schemes. [47] In Europe, this is applicable for 15 countries.

As we know, institutions world-wide are working towards creating a single standard, both to help customers compare products using the same metric, and to find the best way to convey important nutritional information in a simple manner. Thus, in order to have a common evaluation method, to be able to compare existing labels and highlight similarities, differences and best practices, Van der Bend et Al[48] have developed a funnel model with a standardized set of characteristics.

Below is a representation of it, together with an explanation of the indicators employed.

Components	Product criteria of FOP labels may take into account qualifying components, i.e., components in a food product beneficial for health, and/or disqualifying components, i.e., components in a food product with a negative impact on health.
Reference Units	Product criteria of FOP labels may be expressed per 100 g/100 mL, per 100 kcal/KJ, in Energy% and/or per serving, amongst others.
Measurement Method	Compliance of foods with the FOP label's product criteria may be determined on the basis of calculated scores and/or threshold values.
Coverage	Product criteria of FOP labels are either developed for a selection of food categories, or they cover all food categories at once. 'All food categories' includes at least all pre-packaged foods, but does not include specific products, such as infant formula, alcoholic beverages and food supplements.
Methodological Approach	When FOP labelling systems make use of the same set of criteria for all or most food categories, they use an across-the-board approach. When different criteria have been developed for different food categories, a food-category-specific approach is used. We do not consider liquid versus solid foods to be food-category specific, as the composition of food categories within these groups can still be very variable.

[47] ANVISA (2018). Relatório Preliminar de Análise de Impacto Regulatório sobre Rotulagem Nutricional. Brasilia. Retrieved from http://portal.anvisa.gov.br/documents/219201/219401/Análise+de+Impacto+Regulatório+sobre+Rotulagem+Nutricional.pdf/c63f2471-4343-481d-80cb-00f4b2f72118

[48] Van der Bend, D.; van Dieren, J.; De Vasconcelos Marques, M.; Wezenbeek, N.L.W.; Kostareli, N.; Guerreiro Rodriques, P.; Temme, E.H.M.; Westenbrink, S.; Verhagen, H. A Simple Visual Model to Compare Existing Front-of-pack Nutrient Profiling Schemes. Eur. J. Nutr. Food Saf. 2014, 4, 429–534

Purpose	The primary aim of FOP labels may be, for example, to inform consumers about the nutritional contribution a food product makes to the diet, help consumers identify healthy foods and/or to stimulate product reformulation by the food industry. FOP labels may have several purposes.
Driver	This refers to the driving force behind a FOP label (at the time of the writing of this article); a driver may be governmental, commercial or be part of a non-governmental organisation (NGO).
Directivity	This specifies to what degree the FOP label leaves interpretation of 'healthiness' of a product to the consumer. Non-directive FOP labels only present factual nutrient information, semi-directive FOP labels combine factual information with easy-to-interpret visuals (e.g., color coding), and directive FOP labels merely summarise the 'healthiness' of a product without displaying any nutritional information.
Tone of Voice	A FOP label may convey a positive ('healthy'), mixed (mixture of 'healthy' or 'unhealthy') or negative ('unhealthy') health message.
Utlization	In case of voluntary use, food firms may choose whether or not to use the FOP label on-pack. When a FOP label is mandatory, often determined by national regulations or legislation, food firms are forced to use the label.

Table 2: Van Der Bend Funnel Model Indicators

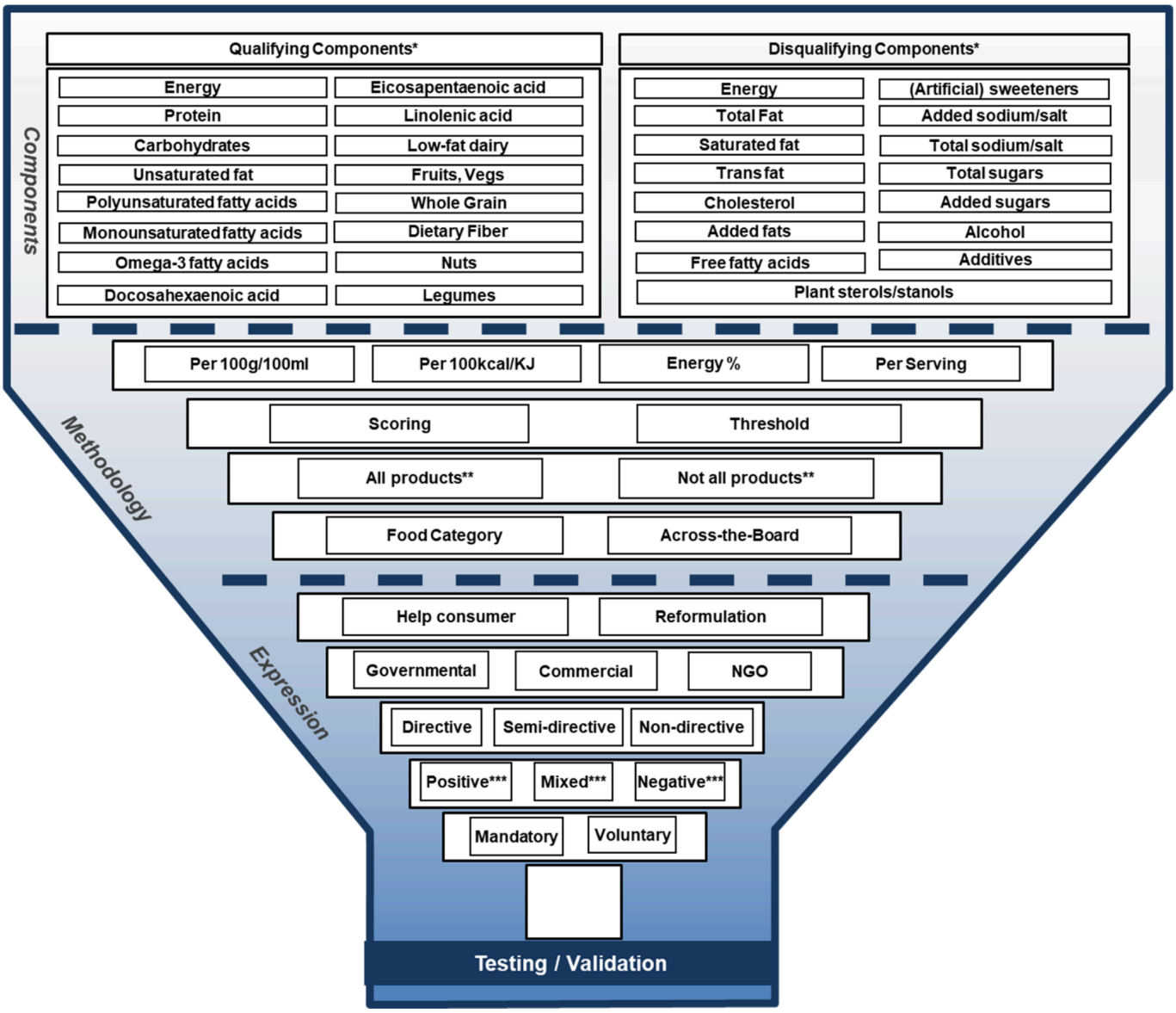

Figure 9: Van Der Bend Funnel Model [van der Bend et al., 2020]

2.4.1 Labels in EU

The European Union is one of the most prolific entities when it comes to FOP Labels. Not only some of the single member states, such as the United Kingdom, France and Sweden, have designed and implemented their own styling, algorithms and designs for Front of Pack Labelling, but the European Union as a whole is working towards defining a single standard to be applied to products that are sold in the entire continent, to help unify the market even more and simplify consumer choices when evaluating international products. Moreover, EU law states that only it can create laws concerning a mandatory labelling scheme for products, so there is a limit to what single national states can do in that regard.

The strongest contenders for the role of approved, mandatory, EU-wide label are the Keyhole Label, the Multiple Traffic Lights, and Nutriscore, that we will proceed to examine using the funnel model as a guide.

2.4.1.1 Keyhole

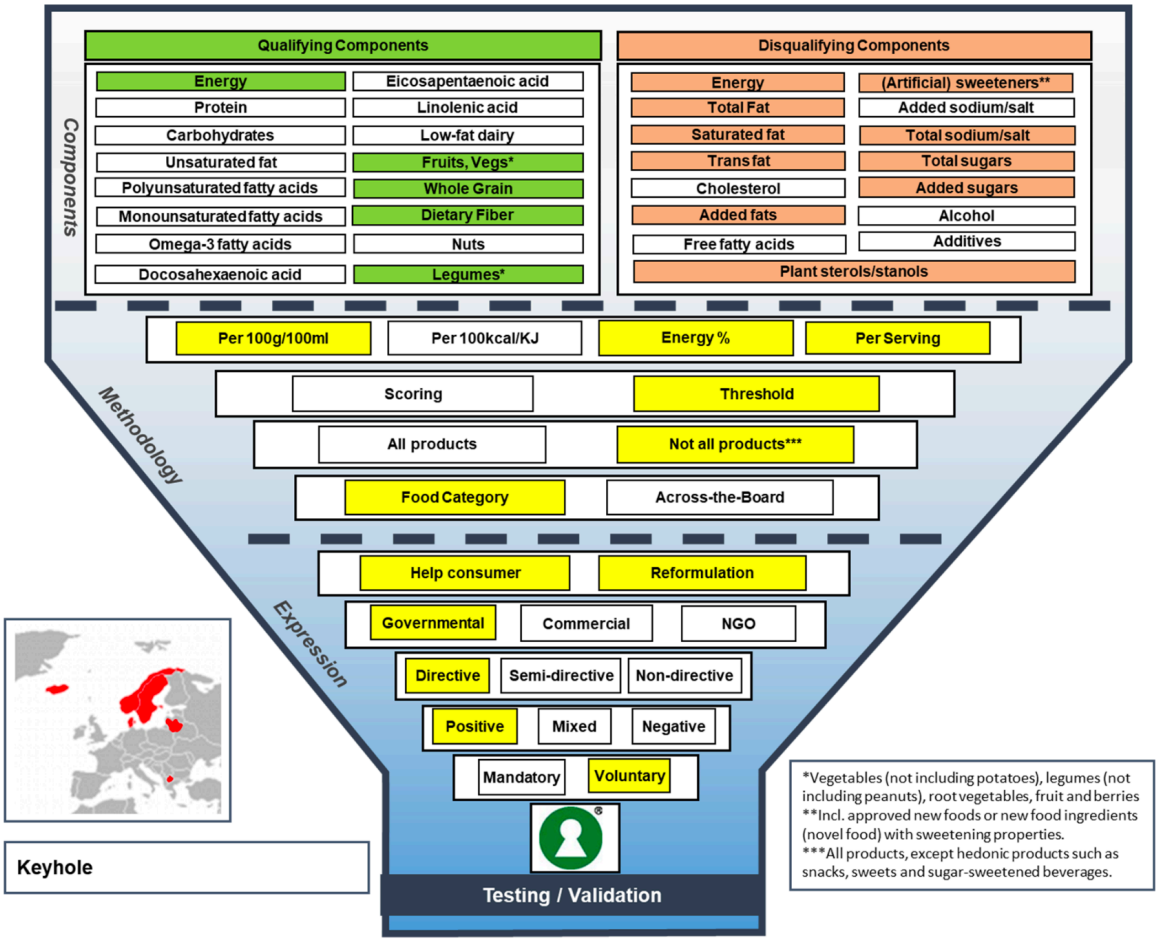

Figure 10: Nutriscore Van Der Bend Funnel

The Keyhole label was established in Sweden in 1989 by the Swedish Food Agency, and is thus the first and oldest effort at simplifying food choice and improving the diet of citizens in the EU. It has been adopted by other countries such as Denmark, Norway, Iceland, Macedonia and Lithuania.

It can be defined as a positive and evaluative/directive label: it highlights only good, healthy products, and it does not present nutritional information, not even in a reduced form. It is simply a tag that defines the healthier products within the product category, to stimulate both the purchase of the better products and product reformulation.

Figure 11: KeyHole

The label logo consists of the combination of two components, the plate model and the food pyramid, that are placed one on top of the other to form, well, a keyhole. The label exists in two versions, one black and one green, and it's up to the retailer to choose which one to use. The most used one is obviously the green one, because of associations of the colour with health.[49]

Employing Keyhole is voluntary: and food manufacturers are responsible for observing the regulations and cannot lie: products are occasionally tested by regulators to see whether they comply with the criteria.

The Keyhole criteria are based on threshold values and expressed per 100 g/100 mL, per serving and in energy %, and they include both qualifying and disqualifying components [van der Bend et al., 2020] [50]. Energy is included as both a disqualifying and qualifying component. Food additives or novel food with sweetening properties are specifically mentioned as disqualifying components.

While this label is extremely simple and thus very easy to read and use to compare products when searching for the healthiest alternative, it sometimes can be too simple. The fact that it communicates very little, albeit in the simplest way possible, means it is not enough for customers to make an informed decision.

Moreover, it only highlights positive products. This, combined with the fact that it's not mandatory,

[49]Using the Keyhole Label on Food Packaging to Increase the Consumption of Healthy Food, FINE CHRISTENSEN

[50]The National Food Agency. The National Food Agency's Code of Statutes. 2015. https://www.livsmedelsverket.se/globalassets/om-oss/lagstiftning/livsmedelsinfo-till-konsum—markning/livsfs-2015-1-particular-symbol-eng.pdf

creates a positive bias towards labelled products.

2.4.1.2 Multiple Traffic Light

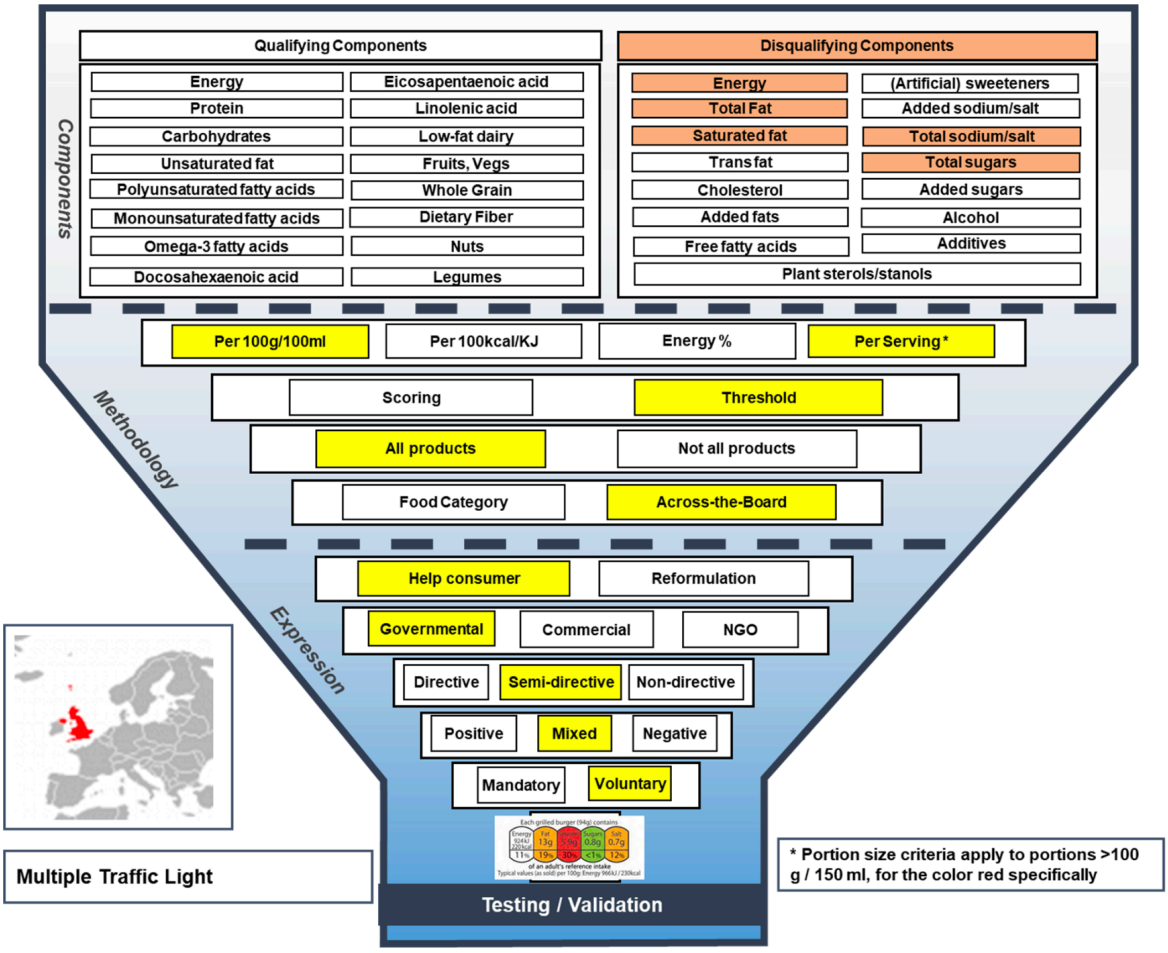

Figure 12: MTL Van Der Bend Funnel

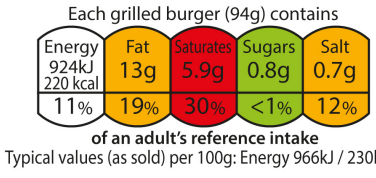

Figure 13: Multiple Traffic Lights

The Multiple Traffic Lights is a nutrient-specific FoPL, implemented by the UK Food Standard Agency (FSA) since 2004[51]. It displays simplified numerical information on the amount of 5 factors: energy, fat, saturates, sugars and salt, together with the percentage contribution to an adult's daily reference intake. This constitutes the reductive part of the label, and is employed in conjunction with color coding to provide directivity.

[51]Food Standard Agency. Front-of-Pack Traffic Light Signpost Labelling Technical Guidance; Food Standard Agency: Kingsway, UK, 2007.

In fact, an assessment of the amounts of nutrients is provided through attribution of a colour for the nutrient content, except energy: Red for high content, amber for medium and green for low content. [52]

The color banding is based on thresholds related to the amount of nutrients per 100g. The thresholds employ nutritional criteria defined by the FSA. Being an across-the-board label, it can be applied to any kind of product.

The UK government provides guidelines on how to use the label, both in terms of design and of thresholding, if a manufacturer decides to apply it. It cannot mandate for it to be displayed on every product because the authority to regulate nutrition labelling falls under EU law.

One of the greatest advantages of this type of label is that, being hybrid, it combines the simplicity and usability of directive labels with the informative style of reductive ones. In other words, it gives a meaning to the simple numbers it provides to the customer. Yet, they are the perfect exemplification of the halo effect. A green indicator can make the customer focus only on specific, positive, food attributes, giving customers a false sense of security and prompting them to ignore all other elements. [53]

2.4.1.3 Nutriscore Nutriscore is a directive labelling scheme based on the Multiple Traffic Lights, first established in France in 2017 and then exported to Belgium, Spain and Portugal. It is also being considered to become the universal FOP Label for the entire European Union, and maybe even be instituted as mandatory to complement NFPs.

The main characteristic of this label is that it both employs scoring and thresholding methods: qualifying and disqualifying components are evaluated by the algorithm, to produce a summary indicator for each food along the continuum from healthy to unhealthy. It can be defined as a summary graded label, providing a single assessment of the nutritional quality of the food. It has been selected not only for its simplicity, but also thanks to studies that showed that "this format was comparatively more efficient than other formats currently available in the world, in particular in vulnerable populations." [54]

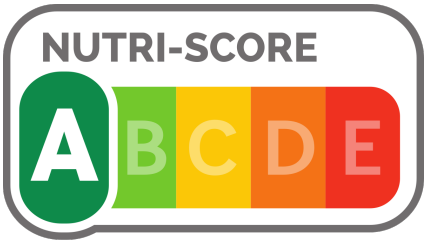

Figure 14: Nutriscore

This continuum is represented by 5 letters, from A to E, that grade foods according to their overall

[52] Impact of Front-of-Pack Nutrition Labels on Portion Size Selection: An Experimental Study in a French Cohort
[53] https://www.tum.de/nc/en/about-tum/news/press-releases/details/31625%20ndr
[54] https://doi.org/10.1371/journal.pone.0202095

nutritional quality; A is the best, E is the worst[55]. The letters are not accompanied by any kind of data or reduction of the information visible on the NFP, making this label purely directive. Moreover, as every food is displayed on the same continuum, it is considered as neither positive nor negative, and can be defined as mixed.

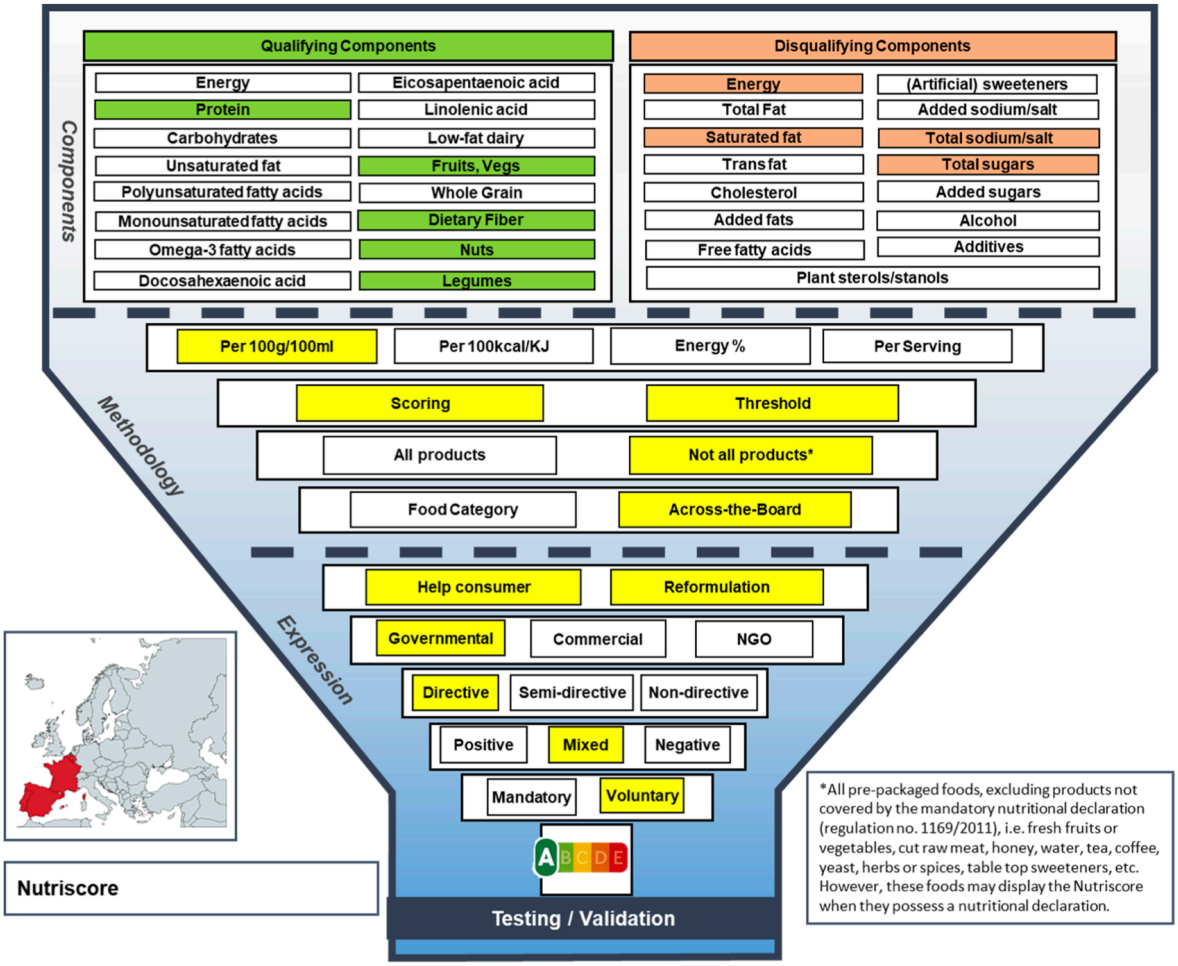

Figure 15: Nutriscore Van Der Bend Funnel

The algorithm is shared by many product categories, but for food such as cheeses, fats and non-alcoholic drinks the ranking is different to avoid penalizing it too much when compared to other products.

Many studies have evaluated the ease of use and the effectiveness of Nutriscore, especially in the optic of a EU-Wide adoption of the label. This label, specifically, showed to have a strong influence on the ability of identifying healthier food products. Yet, the objective understanding of it was "higher

[55]Chauliac, M. Nutriscore: The Front of Pack Nutrition Labelling Scheme Recommended in France. 2018. Available online: https://ec.europa.eu/food/sites/food/files/animals/docs/comm_ahac_20180423_pres4.pdf

among young, non-smokers, participants with higher educational level and for households with children" [Egnell et al., 2018a].

First and foremost, the label offers a "graded summarized information about the overall nutritional quality of the food, through a single indicator limiting potential confusion on nutrition terms" [Egnell et al., 2018a][56]. Secondly, it combines colors and text, which is easier and faster to read and understand. Moreover, Nutriscore's color choices are on point, as it has echoes the known paradigm of "red" for unhealthy and "green" for healthy, thus having a strong impact on customers.

Moreover, the effect of NutriScore clearly outweighed the "differences observed across socio-demographic sub-groups"[Egnell et al., 2018a], meaning that it's easily employable by vulnerable populations.

Nevertheless, one of the biggest advantages of Nutriscore, its simplicity, is also one of its largest downsides. FOP Labels, and Nutriscore in particular, work by dramatically reducing the information presented on the label, not giving the customer hard data but simply directing him towards the best alternative in terms of health. Obviously, this "best" is an approximation, something general, and cannot realistically take into consideration the individual that is evaluating the product. Elements such as context, who the customer is, the frequency of consumption and portion size, alter the "objective" recommendation given by the label.

The most important goal FoP labels is to educate. The aim is to have people become more conscious about their diet, and to evaluate not only what they eat but also their lifestyle as well. Purely directive labels such as Nutriscore simply ask for a person's trust, and give them an imperative, which can be summarized as either "buy me" or "leave me on the shelf", with some degrees in between. If FOP labels were the only element used to make a food purchase decision, that could even work. When factors such as brand preference, taste perception, and personal history come into place, the best approach is to give, yes, a suggestion towards the healthiness of a specific food, but also to empower the customer and educate him, so that he will make a more informed purchase.

2.4.1.4 Nutrinform Battery

The labels we have previously described all give information on the single product, may it be with a simplification goal or to provide some sort of directiveness. Yet, they are all conceived to operate in

[56]Helfer P, Shultz TR (2014) The effects of nutrition labeling on consumer food choice: a psychological experiment and computational model. Ann N Y Acad Sci 1331: 174–185. https://doi.org/10.1111/nyas. 12461 PMID: 24913496

a silo, in an insulated environment, not taking into consideration a person's diet as a whole.

Let's say we pick a food that is positively-labelled with an A by Nutriscore, such as a nice, dry cut of chicken, and since it's well-labelled we eat it 4 times a day for a month. Or, even worse, we eat industrial quantities of a kind of chocolate that scores well. The limitations of these labels become clear.

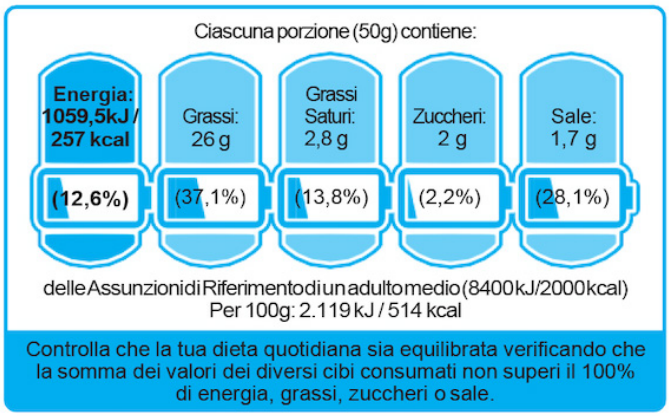

Figure 16: Nutrinform Battery

Italy's approach to FoP Labelling is different: a new "battery" label, called "Nutrinform Battery", has been developed, based on Reference Daily Intakes, that indicates the nutritional contribution of the food in relation to a person's daily required intake and to healthy eating. The label has been notified to the E.U. Commission in January 2020 by the "Ministero delle politiche agricole alimentari e forestali"[57], and is one of the labels that are being evaluated to be adopted as mandatory at a E.U. level. Percentages of calories, fats, sugars and salt per portion are thus presented relatively to a recommended quantity [58] [59]. For a healthy daily diet, the sum of the quantities eaten each day cannot be more than 100%[60].

Nutrinform Battery is a reductive label, and its approach is relevant not only because it correctly takes into consideration the entirety of the diet, but also because it does not give a strict direction, an order that must be followed without explanation. It thus leaves the final choice with the customer.

Moreover, Italy is very invested in the topic: its Made-in-Italy food culture is based on the Mediterranean diet, and on a balanced consumption of ingredients and foods, even those that taken on their own are impaired by a Nutriscore evaluation that is believed to be unjustly negative. Unfortunately, the positive debate on the adoption of a common label with the main goal of promoting a healthy eating lifestyle has been twisted into a political matter, pitting France and Italy one against the other.

[57] https://www.politicheagricole.it/flex/cm/pages/ServeBLOB.php/L/IT/IDPagina/14933

[58] https://www.mise.gov.it/index.php/it/per-i-media/notizie/2040704-made-in-italy-notificato-alla-commissione-ue-il-sistema-di-etichettatura-nutrinform-battery

[59] http://www.aecosan.msssi.gob.es/AECOSAN/docs/documentos/seguridad_alimentaria/evaluacion_riesgos/informes_con SCORE.pdf

[60] https://www.agricolae.eu/wp-content/uploads/2020/02/Allegato-Dm-e-relazione-illustrativa.pdf

Since the label is so new and not yet used on any product, no comparative studies on its features or on its effectiveness exist, but its importance as a contestant in the role of official E.U. label is undeniable.

2.4.2 Labels in SEA

While South East Asia and the ASEAN countries are not affiliated in a way similar to, for example, the European Union, a huge part of trading occurs cross-border inside the region. The fact that nutritional information is expressed in various ways throughout the area, together with the existence of many national FOP labels, is a matter of concern when trading food.[61]

For this reason, the "Guiding Principles for Food Control Systems" have been established as guidelines for member countries, not only to help them define their labelling schemes but also to "allow freer movement of food products among countries" [Khalid, 2014] with the aim to open doors to new markets and opportunities for the food industry, benefiting customers, governments and industries.

Yet, the challenges that are intrinsic in defining and spreading a new standard, and the related costs, are worsened by the fact that many countries are still at early stages of development. Nevertheless, the advantages of improving people's health and facilitating commerce are much bigger than the difficulties, so the need for standardization is incredibly heightened[62]. We have selected Singapore as an example.

2.4.2.1 Singapore - Healthier Choice Symbol (HCS)

Since 2001, Singapore has supplemented the Nutrition Information Panel (NIP) with the Healthier Choice Symbol (HCS), a FoP label which highlights the healthier options within a specific product category [Finkelstein et al., 2019]. As much as 30 different labels exist.

Food producers have to submit an application to the Health Ministry to use the label, submit analyses of nutrient data of the product, sign a license agreement and agree to comply to the requirements. In case they lie on the composition of the product or they mislabel it, they lose the right to use the FOP indicator.

[61] https://www.slideshare.net/Adrienna/status-of-fops-in-the-asian-region2015?from_action=save

[62] Harmonisation of food labelling regulations in Southeast Asia: benefits, challenges and implications, William Kasapila MSc1 and Sharifudin MD Shaarani PhD2

Being a directive label, it is easy to read it to simplify the decision process, but it has some possible downsides. For starters, it is possible that consumers might overconsume products labelled with the HCS. Moreover, customers that purchase HCS might also consume more products with HCS, because they might think they're entitled to some less healthy food as a result of making "healthier" choices on other food.

Finally, as not many of the claims placed on the labels communicate the caloric intake that a customer would have by consuming the product, the result, as confirmed by some studies, is that while they affect the purchasing intentions and behavior, they do not limit caloric intake or improve overall diet quality.

Figure 17: Healthier Choice Symbol Singapore

2.4.3 Other Labels

Chile has been dealing with obesity and diseases that stem from bad diets for many years. One out of four school children and a third of adult population are obese, and this incidence is the primary cause of premature death and disability in the country.

In order to tackle this issue, a comprehensive and decisive regulation was introduced in 2016. It comprises elements such as FoP labeling, marketing restrictions, and school regulations, to promote healthier food environments in a 360-degree approach. [Corvalán et al., 2013].

The main target and beneficiary of these regulations are children, in an optic of prevention, and the channel through which they are reached and impacted is that of their mothers, who "in the Chilean society in particular are a key stakeholder of the new policy because they are primarily responsible for food purchase decisions." [Correa et al., 2019]

Figure 18: Example of Chilean Food Labels

The implementation of said policy is referred to products called HEFSS, those with high levels of energy, saturated fats, sodium and sugars. These products must include a FOP label in the form of a black stop sign that highlights the high critical nutrient that exceeds a certain threshold, such as "high in sugar" or "high in sodium". Multiple warning signs can be placed on a single products. Moreover, products containing these ingredients cannot be sold in schools, and cannot advertised by targeting child-specific media and age ranges [Corvalán et al., 2019].

These measures, together with the specific design of the labels, have led to some interesting results. Research has found that warning monochromatic FOP labels that flag products high in key critical nutrients improve consumers' abilities to identify unhealthy food compared to traffic-light systems, thus solidifying the notion that a simple, directive label is better. [Arrúa et al., 2017]

"Responses to the Chilean law of food labeling and advertising: exploring knowledge, perceptions and behaviors of mothers of young children", a 2019 study [Correa et al., 2019] on the impact of the Chilean measures, and specifically on the warning labels, on its population, had some interesting results. Most of participants "agreed that their children, particularly the youngest ones, had positive attitudes toward the regulation due to its high dissemination in schools and daycares. Many mothers also expressed that they perceived an important shift toward a healthier dietary pattern, which may lead to a change in eating social norms." Data also showed that the message was easy enough to be understandable, specifically that more labels meant an unhealthier product.

Yet, as these labels only provide a warning, without any explicit explanation of why they are placed on a food product or what the logic underneath is, they are simply asking the customers to blindly trust them. While this is an intended feature, as the purchasing process takes place in seconds and is thus fundamental for the label to be interpreted quickly, it penalizes the chance to actually learn about why a product is considered bad, and to subsequently improve other aspects of a person's diet.

Moreover, they help uncover some products that have historically been perceived as healthy, such as cookies or cereals. As they are mandatory, either manufacturers reformulate products, or their customers will avoid buying them when they discover they are not as healthy as common sense says. Finally, as it is always the case with food labels, not only FOP ones, the trust buyers put in a food product is always very relevant during the purchasing process. Specifically, the "presence of warning labels influenced their purchase decision mostly when deciding about new food products" [Correa et al., 2019], testifying the strength of habit and of trust in a brand or product.

The pros and cons of this type of label, and the real-world effect that have been highlighted by

the study are consistent with our interpretation of the characteristics of FOP labels. While extremely directive labels are very effective, they simply prevent people from buying something unhealthy, but they do not push towards learning how to improve a person's lifestyle. And yet, being mandatory, they might be one of the best alternatives.

2.5 On the Effectiveness of FOPLs

As we now know, FOP labels come in different shapes and and sizes. Their goals are also different, in respect to what they're trying to convey to the customers. Yet, the core objective is always to provide nutrition information in more understandable formats, but are we sure that this is and can be achieved? Are we sure that customers can change their perception of food and healthiness thanks to them? Can the fear of missing out intrinsic to having a negative label, or no label at all, be a factor of change for manufacturers to reformulate their products into a healthier version? Or, most importantly, are we sure that FOP Labels have a significant effect in bringing customers to buying more healthier choices?

The following section will provide an overview of some of the effectiveness issues of FOP labels, by looking at comparative analysis both of single labels and of the concept of labels as a whole.

2.5.1 Stealing attention away from NFPs

Let's begin by restating the fact that the goal of FOP labels is to guide customers towards evaluating their food purchases through the glass of healthy diet. They do so by complementing the nutritional information available on the NFP, simplifying it either through a reduction of data, or sometimes even giving directions on how to evaluate such scientific information.

Having understood that customers that are not particularly health-conscious rarely look at NFPs, it is important to understand the effect that FOP Labels have on the usage of said NFPs. In different words, is the fact that a simpler, faster alternative to reading through and understanding a multitude of nutritional data mean a reduction of attention and usage of NFPs?

Studies such as "Consumer effects of front-of-package nutrition labeling: an interdisciplinary meta-analysis" by Ikonen & Al have shown, as it is expected, that "the presence of FOP labels may reduce the attention consumers pay to the NFP, suggesting a strong reliance on the information presented on the front. As purchase decisions in the supermarket are typically made quickly, consumers will not have

the time to study the two sources of nutrition information and, as a result, often ignore the lengthier NFP when a FOP label is present"[63].

This especially seems to be the case with labels that do not offer the same information as the NFP: either claims focusing on individual nutrients or rating labels offering a summary of the overall healthfulness of the product. This can lead to customers simply trusting the FOP and overgeneralize the information to the overall healthfulness of the product.[64][65]

This finding critically underlines the importance of having a proper, accurate, and effective FOP label, that does not mislead customers. The label must be able to convey the essence of the NFP, and thus be fair and objective when rating the product.

2.5.2 Consumer Confusion

An attentive reader might find the title of this paragraph a little contradictory. If the goal of FOP labels is to make the fruition of nutritional information easier to customers, how can they generate confusion?

It all comes down to a problem that we've discussed thoroughly throughout the chapter: a lack of standardization. The fact that labels are not mandatory, combined with the absence of any kind of guideline that is followed by food manufacturer, has led to a proliferation of systems based on varying underlying criteria. Thus, not only a different styling, layout, or coloring, but also the employment of different algorithms and scoring systems.

Intuitively, the goal would be for customers to use FOP labels to compare products in a fast and simple way, to pick the healthier choice: for how things are right now, without a common standard and thus the usage of different labels, customers find themselves trying to contrast apples with oranges.

Many studies on the subject all around the world have confirmed the thesis that having multiple different labels with dissimilar designs and no common underlying logic or algorithm confuses the customer. Studies in New Zealand and Australia, such as [Mhurchu and Gorton, 2007], or in the UK,

[63]Watson, W. L., Kelly, B., Hector, D., Hughes, C., King, L., Crawford, J., et al. (2014). Can front-of-pack labelling schemes guide healthier food choices? Australian shoppers' responses to seven labelling for- mats. Appetite, 72, 90–97.

[64]Roe, B., Levy, A. S., & Derby, B. M. (1999). The impact of health claims on consumer search and product evaluation outcomes: Results from FDA experimental data. Journal of Public Policy & Marketing, 18(1), 89–105.

[65]Burton, S., Cook, L., Howlett E. & Newman, C. L. (2014). Broken halos and shattered horns: overcoming the biasing effects of prior expec- tations through objective information disclosure. Journal of the Academy of Marketing Science, 43(2), 240–256.

such as [Malam et al., 2009], combined with public interest groups in the U.S.A. have examined and reviewed a vast number of products employing FOP labels, and their effect on customer choice and behaviors, confirming that having such a wide variety of coexisting markers does little in terms of helping customers.

All these reports have made similar findings and have reached the same conclusion: there is a strong need for the development of a standard to ensure more consistency across FOP labelling systems, or, even better, the use of a unique standard system to enhance not only consumer comprehension of the labels, but also the usage of labels themselves. [66]

2.5.3 Halo Effect

Consumer effects of front-of-package nutrition labeling: an interdisciplinary meta-analysis, is a paper published in 2019 that generalizes the findings of 114 articles on the impact of FOP labels on outcomes such as consumers' ability to identify healthier options, product perceptions, purchase behavior, and consumption. [67]

While various FOP labeling systems have been developed through government policies, the implementation of most remains at the discretion of manufacturers and marketers[68]. As stated in many occasions throughout our analysis, before not having a common standard, FOP labels are not mandatory. The world of products available on, say, a shelf in a supermarket, is divided in products with a FOP labels, and in products without one.

This aspect has to be combined with the first significant result from the study: **the presence of FOP Labels may reduce the attention that consumers pay to the NFP tables**, the nutritional values usually placed on the back of the packs. This affirms the importance of having a properly designed label, that can convey all the important information, to avoid misleading the customer, or presenting him with an oversimplified version of the nutritional data. It also means that customers tend to make comparisons between products by only looking at FOP Labels.

This final aspect is what brings us to the topic of this section, the halo effect. First of all, to a sound

[66]BMRB (British Market Research Bureau). 2009. Comprehension and Use of UK Nutrition Signpost Labelling Schemes. London: British Market Research Bureau.

[67]https://link.springer.com/article/10.1007/s11747-019-00663-9

[68]Kanter, R., Vanderlee, L., & Vandevijvere, S. (2018). Front-of-package nutrition labelling policy: Global progress and future directions. Public Health Nutrition, 21(8), 1399–1408.

mind "it would sound obvious that FOP labels should ideally have a negative impact on the perceived healthfulness of vice products and a positive impact on that of healthy products"[69] Yet, the fact that labels are not only different, but are only applied to certain products at the discretion of the regulatory body, the manufacturer or the retailer, means that even negative labels have some sort of positive effect on the perceived healthiness of a product.

This is relevant when the "vice" product is compared with an unlabeled one. Specifically, this generates the potential for a halo effect: the simple existence of a health claim related to the product, even a negative one, wins over not having any kind of claim at all. Basically, customers are shown to infer on their own that unlabeled products are in some ways less healthy than labeled ones.

Moreover, as we know labels exist that show not only a single score of the product, but of some of its basic components. Results have shown that "consumers may perceive an interpretive nutrient-specific health claim as an indicator of overall healthfulness", extending the positive value of a specific indicator to the other attributes, and thus to the whole product [Roe et al., 1999]. For example, a product that is marked as "good" in the sugar area could be considered good as a whole.

In conclusion, it is possible that FOP labels may influence consumers' overall product attitudes, not only regarding the marked ones but also the ones that do not have a label. This can lead to positive effects, such as an increase in sales of positively-evaluated products over negatively-marked ones, or the reformulation of the recipe in order to provide something healthier at a different price point. The main negative effect is the health halo that can be found around unhealthy labeled products when compared to unlabeled ones, and this could be exploited by retailers and manufacturers.

Yet, not much research exists about what customers think of such entities abusing FOP Labels by halos to improve the perceived image of unhealthy products, thus tricking clients: brand reputation effects always have to be considered.

2.5.4 Brand Familiarity

In our analysis, we have never assumed any bias of the consumers towards a specific product or brand, and thus that the choice of a product was made by evaluating taste and, in some cases, health information.

[69] Talati, Z., Pettigrew, S., Dixon, H., Neal, B., Ball, K., & Hughes, C. (2016). Do health claims and front-of-pack labels lead to a positivity bias in unhealthy foods? Nutrients, 8(12), 787–805.

Evidence suggests that familiarity in general has an impact on the effectiveness of FOP labelling, and more so has brand familiarity. The question to ask is: if something told you there's a healthier alternative to a product from a brand you have been buying for ages, would you consider switching? What if that someone was a scientific label placed on that product?

Studies made in this sense indicate that FOP labels have limited impact on consumers who are familiar with the product and the brand, thus suggesting that the perception associated with a brand is stronger than health indications placed on labels[70]. In particular, labelling is thought to be less influential when consumers have already formed opinions about products, as they pay less attention to labels [71].

Nevertheless, they confirm themselves to still be extremely valuable when the evaluation is of a new product, when the customer is forming an opinion on the brand for the first time.

2.5.5 A Cognitive Approach - Do People Care?

Up to this point, we have discussed the effectiveness of FOP labels as a tool to encourage healthier food purchasing, and thus consuming, behaviours. We have always assumed, silently, that people are actually interested in improving their diet. What if this is not the case?

Strategies to have people eat healthier have been conceived by implementing what is called a "cognitive" approach [72], which assumes that a consumer actually wants to improve his diet and be healthy, and that would do so with the appropriate nutrition information. Thus the only obstacle is the difficulty of obtaining said information.

So, if people knew more about what they're eating, and what their food choices should be, they would surely pursue a more healthy diet. This is why labels such as the NFP have been made mandatory, to provide customers with scientific and precise details about the food they're considering to purchase.

When phrased like this, it obviously looks like a simplistic and reductive strategy. "Nutrition knowledge" is only one of the many environmental and individual variables that can affect an individual's

[70]Moon, W., Balasubramanian, S. K., & Rimal, A. (2011). Health claims and consumers' behavioral intentions: The case of soy-based food. Food Policy, 36(4), 480–489.

[71]Becker, M. W., Bello, N. M., Sundar, R. P., Peltier, C., & Bix, L. (2015). Front of pack labels enhance attention to nutrition information in novel and commercial brands. Food Policy, 56, 76–86.

[72]Petty, R. E., P. Briñol, and Z. L. Tormala. 2002. Thought confidence as a determinant of persuasion: The self-validation hypoth- esis. Journal of Personality & Social Psychology 82:722-741.

food choices [Worsley, 2002]. Taste, cost and convenience also have to be taken into consideration when assessing the situation, as it cannot be denied that they are also strong driver of consumer choices, together with being part of ethnic, cultural and even geographic groups.[73]

Taste, for example, is shown to be a stronger factor than health and nutrition: consumers prefer food they like, and try to avoid things the taste of which they dislike, no matter how healthy they might be [74]

Cost is also extremely significant, when looked at through the lens of wealth and access to a vast choice of food. When money or food availability is not a constraint, we can actively make the choice of eat healthy, but when we don't have much saying in what we can eat the choice is not driven by healthiness. When cost is a factor that has to be strongly taken into consideration, research shows that even customers that are knowledgeable about correlations between certain food and healthiness have to compromise, and choose cheaper, and maybe less healthy food instead of more expensive, better food.

In conclusion, it is clear that even the more knowledgeable customers will not always make what they know are the best purchases in terms of food healthiness, for various factors.

And yet, customers have to actively want to eat healthy to employ their knowledge of food healthiness when choosing what to buy. If they have the right health concerns, research shows "that nutrition information on food labels is more likely to be read by consumers, so the label may indeed assist this group in making healthier food choices" [Wartella et al., 2011].

In contrast, if the labels are found to be difficult to understand, no matter what the level of knowledge is, they are less likely to be used to make an evaluation. This is the group that might benefit more from the right kind of FOP label: NFPs are objectively too complex, and this is why there has to be the right kind of simplification. Even if they do not possess the right kind of knowledge to actively look at labels, they might use a tool as simple as a FOP label to influence their behaviour.

Nevertheless, when the constraints in terms of cost or food accessibility are strong, not even FOP labels can influence the customers.

[73]Glanz, K., M. Basil, E. Maibach, J. Goldberg, and D. Snyder. 1998. Why Americans eat what they do: Taste, nutrition, cost, convenience, and weight control concerns as influences on food consumption. Journal of the American Dietetic Association 98:1118-1126.

[74]Aikman, S. N, K. E. Min, and D. Graham. 2006. Food attitudes, eating behavior, and the information underlying food attitudes. Appetite 47:111-114.

2.5.6 Willingness to Pay

When measuring the impact of FOP Labels on consumer purchase decisions, price is a variable that must be taken into consideration. Are customers willing to pay more for a food that is comparatively healthier? If so, what is the impact of FOP Labels on this increase in the willingness to pay to receive a benefit in that direction? "The impact of interpretive and reductive front-of-pack labels on food choice and willingness to pay" is a study by Zenobia Talati & Al precisely about this topic[75].

The result of this study are quite clear: it all boils down to the type of label used on the product. First of all, the mere presence of any FOP label increases the willingness to pay compared to not having a label. That is, customers are more biased towards a product that is perceived as evaluated in terms of nutritional values, against a product that has not.

Moreover, research indicates that Interpretive, Directive FOP labels are more influential on customer purchase behaviours than reductive ones, thus making a stronger push towards healthy eating habits. Customers thus want and prefer indications that are more user friendly, compared to a simple reduction of nutritional values. This correlates with a stronger willingness to pay: if they can easily identify the "better" product, they are more willing to pay a premium for it.

This confirms the potential that simple, easily readable, directive FOP labels have to improve dietary and nutritional choices, not only by making healthier food choices more appealing in the eye of the customer, but also discouraging him to purchase less healthy food. Yet, as the goal is not only to direct customers but to educate them as well, these indicators must be complemented by a reductive component.

To conclude, the best type of label confirms to be a directive-reductive hybrid with multiple reading levels: this is the best way to increase willingness to pay for healthier alternatives in customers.

Will this be exploited by food manufacturers and retailers to orchestrate ad-hoc food compositions, and subsequently, appropriate labelling, to push customers to pay for (marginally) healthier products? This is a topic that will be better understood only with more data, once labels will be mandatory and thus widespread. In the meantime, let's look at the health goal and hope for the best.

[75]DOI 10.1186/s12966-017-0628-2

2.6 FOP Labels Best Practices

Throughout our analysis we have tried to give the reader an overview of how FOP labels have become the way they are. We have highlighted different styles and approaches, both to algorithms and designs, and defined the potential issues and pitfalls of a widespread labelling effort.

Yet, it is of paramount importance to synthesize the results of our efforts in order to derive some guidelines concerning best practices. We will base our exposition on *Front-of-Package Nutrition Rating Systems and Symbols Promoting Healthier Choices Committee on Examination of Front-of-Package Nutrition Rating Systems and Symbols (Phase II) Food and Nutrition Board Ellen A. Wartella, Alice H. Lichtenstein, Ann Yaktine, and Romy Nathan, Editors*, a comprehensive overview concerning FOP labels published in 2012.

In order:

- FOP Labels have to compete for the interest of the customer on the pack, against an array of advertisement messages that are designed to capture attention. They thus have to employ full-fledged marketing techniques to be visible and appealing.
- Standardization: it is fundamental to standardize the appearance of labels and the information that is present of them, to allow for easy product comparison and to encourage it, all with the final goal of promoting healthier food choices at the point of sale.
- Simpler is better: simple and easy to understand labels have better results in encouraging consumers to choose healthier products.
- Time: when making purchases, customers have little time to dedicate to thorough analysis of nutritional information, and have to consider a great amount of factors and stimuli when making their decisions. This contributes to the need for simplicity.
- Location: a consistent location for all the FOP labels would help customers when comparing products, as they would not have to search the pack for the information.

This is, in a gist, how a FOP label system should be. Let's delve deeper into those factors

2.6.1 Style

We believe the reader is now aware of how messy and varied the situation is concerning the different styles of FOP Labels. This poses an issue to consumers that have to compare products labelled with different kinds of FOP signs: how can they compare an directive one with a reductive one, side by side? They're either forced to use the NFP, and good luck with that, or they give up altogether and pick the one they like the most, thus nullifying all the efforts made in making the nutritional information easily available in the FOP label.

Moreover, customers at the point of sale "already face time pressure and struggle to understand the information presented on the NFP"[76], why should we make them face even more by making them compare apples with oranges?

Manufacturers and governments alike know this, even going as far as calling for one internationally agreed-upon format [77]. But what does research show to be the best format?

There is no agreement on that, either, but there are some general guidelines concerning the elements that labels should include. First of all, we have to keep in mind that the goal of FOP labels is to bring customers closer to a healthier diet: we don't necessarily want them to be more informed, we just want them to eat better.

Studies have thus shown that to meet a key goal of FOP labels to help consumers identify healthier options from product sets, reductive summary indicator labels are most helpful. These labels are useful not only because they reduce evaluation time when shopping at supermarkets, but also because they are beneficial for customers that lack the knowledge to read more detailed nutrition information, who may be more at risk for health issues related to an unhealthy diet. [78]

To expand on that, studies on consumer preference have shown that while they appreciate a quick direction about the food they're evaluating, customers still want to have access to nutritional data,

[76]Block, L. G.,& Peracchio, L. A. (2006). The calcium quandary: How consumers use nutrition labels. Journal of Public Policy & Marketing, 25(2), 188–196.

[77]Askew, K. (2018). To be or not to be? Battle lines dawn over nutritional labelling in Europe. Food Navigator. Retrieved January 15, 2019, included formats from https://www.foodnavigator.com/Article/2018/12/04/To-be-or-not-to-be-Battle-lines-dawn-over-nutritional-labelling-in-Europe.

[78]Ducrot, P., Méjean, C., Julia, C., Kesse-Guyot, E., Touvier, M., Fezeu, L., & Péneau, S. (2015). Effectiveness of front-of-pack nutrition labels in French adults: Results from the NutriNet-Sante cohort study. PLoS One, 10(10), e0140898.

even if in a reduced and more compact form. Thus, to provide them not only with this data, but also with a simple way to determine the healthiness of the indicators, labels that combine detailed nutrition information with an interpretative aspect should be considered [79].

2.6.2 Advertising Space Competition

FOP labels placed on products have to compete for customers' attention. Think about going to a supermarket or any other point of sale, and about all the elements that come into the picture when evaluating a product: to cite just a few, prices, position of the package on the shelf, colors, logos, brands, nutritional claims...

Nutritional claims are very common on food packages, and have to adhere to specific regulatory standards have to be truthful and conform to regulations. Yet, the way they are formulated and displayed could very possibly influence customers' purchase choices: they could tend to over-generalize and base their decisions only on the claims, for example.

This is one of the many reasons why FOP nutrition labels have to stand out and significantly impact customer choices. By taking some cues from Visual Design, for something to be noticed it has to be contrasting against its background, by changing, for example, size, color or shape.

It is clear that many things are made contrasting on a package, to make the product stand out among competing ones, but these attention-stealing factors must be taken into consideration when creating the label. In fact, "the salience of any one advertisement component is likely determined by not only its own attributes, but also its contrast with the other components around it" [Wartella et al., 2011]. So, it is fundamental for the FOP Label to be one of the main elements on the product.

Yet, we must thread lightly: It is possible that "as the amount of package information increases, some consumers will be overwhelmed and unable (or unwilling) to process it all", reverting to using only simpler elements such as branding or nutritional claims to judge and compare. [80].

[79] Temple, N. J., & Fraser, J. (2014). Food labels: A critical assessment. Nutrition, 30(3), 257–260.

[80] Woolverton, A., and C. Dimitri. 2010. Green marketing: Are environmental and social objectives compatible with profit maximization? Renewable Agriculture and Food Systems 25:90-98.

2.6.3 Location

As we have mentioned before, customers need to have a fast and easily understandable way of evaluating nutritional information when shopping. It is not only a matter of simplifying the label: the fact that customers process products in a cursory manner and scan shelves must also be taken into consideration. Customers usually don't want to take the time to turn a package around, not even mentioning reading the NFP table, so the evaluation of the FOP label must be quick and easy as well.

Thus, this brings us to the matter of where exactly the label is located in the front of the pack. In fact, studies have shown that humans establish saliency paths, and base their behaviours on, essentially, knowing where to look. Just as they know where to find price labels when looking at a shelf, it would be important to establish a path for FOP labels as well. Were FOP labels put in the same place on the pack, customers would be able to identify them immediately, as they would know exactly where to look for the nutrition information they need.

Thus, by having a constant location for FOP labels, they would be more easily taken into consideration when evaluating a product. The proof for this statement comes from "What determines consumer attention to nutrition labels? Food Quality and Preference"[81], a comparative study on consumer attention towards FOP Labels.

In the study, participants were shown 194 packages with varying types of FOP Labels displayed in various locations. They were timed when asked to point out whether there was a label on the pack, thus simulating a fast-paced shopping behaviour in which customers have to easily locate the FOP sign and evaluate the product based on it.

Its findings confirmed that "label characteristics (e.g., display size, position of the label on FOP, colour scheme); and familiarity with the type of the logo and the location it appears in are key determinants of attention to labels". This familiarity effect has to be taken into consideration when deciding placement and styling of labels. In particular, reaction times were faster when labels were placed in the top right corner.

Moreover, the comparative effort made by the authors also provides some indicators on the complexity of the label: as we have mentioned, one of the main problems with NFP tables is that they're as insightful and complete as they are complex, not only to read but also to understand. The subjects that

[81] Bialkova, S., and H. van Trijp. 2010. What determines consumer attention to nutrition labels? Food Quality and Preference 21:1042-1051.

took part in the test were able to identify (and thus actually use) simpler labels, over more complex, showing a big advantage to the former. Physical features of a label are thus fundamental factors in determining the level of attention a customer pays to it.

In conclusion, the key outcome of this test is that it is of paramount importance to have the labels printed on a consistent location on the front of the box: moreover, the simpler the label, the better.

2.6.4 Integration with the NFP

FOP Labels are a synthesis, a simplification of the NFP label. They are not supposed to replace it, but to be integrated with it so that there is a mutual reinforcement.

In a way, they can be helpful both to people that don't care about NFPs and nutritional data, or simply don't know how to read them, and also to people that have the necessary knowledge but don't have the time to carefully evaluate every single detail.

Moreover, customers that wish to better understand and study why a specific nutritional aspect of the food they're looking at is rated the way it is, could be incentivized to refer to the NFP.

2.7 Product Reformulation

Up to this point, the point of view that we have embraced when discussing Front of Pack labels has been that of the customer. We, until now, have evaluated the effectiveness of labelling styles in helping purchase decisions and dietary choices, to have shoppers buy healthier products, and discard less healthy alternatives.

As we know, there is another side of the coin, that of product reformulation.

Specifically, reformulation of food products with the aim of improving their nutritional quality is an extremely cost-effective policy[82] to improve general population health. Regulatory bodies don't have to spend money educating customers or on, say, obesity prevention and treatment, when they can simply have manufacturers sell healthier food. Moreover, by increasing the number of available healthy products in the marketplace, it can encourage customers to move away from unhealthy products [83].

[82]Dobbs, R., Sawers, C., Thompson, F., Manyika, J., Woetzel, J., Child, P., et al. (2014). Overcoming obesity: An initial economic analysis. London: McKinsey Global Institute

[83]Lehmann, U., Charles, V.R., Vlassopoulos, A., Masset, G., & Spieldenner, J. (2017). Nutrient profiling for product

An usually overlooked factor concerning product reformulation is that it can influence nutrient intake even if customers do not change their purchase decisions: they can continue eating essentially the same product, with the same packaging and the same brand, but with a different, healthier formula [84].

Different initiatives have been put into motion worldwide, both concerning education of consumers and mandatory reformulation products, direct or indirect, such as the Italian Sugar Tax. Voluntary programs are the most common and more appreciated by the industry, but have been proven to be not effective enough at the scale required to meaningfully impact the nutritional quality of products[85]. Governments and regulatory bodies were thus forced to find an indirect way to force manufacturers to change their products.

FOP labels do have an impact on customers' purchase decisions: when faced with two options, one healthier and one less healthy, they will, in a very simplistic scenario that ignores factors such as price, brand reputation and personal taste, go for the former. A manufacturers will never want to find itself in a position in which another product is preferred to its own, and if the healthiness measure comes from a scientifically accurate, independent nutritional label, its only way to become competitive again is to change the product to make it healthier. This will lead to a better score and a better FOP label, and thus to being back in the game.

The difference in FOP labels translates to a difference in the effectiveness with which they encourage customers to choose the healthier option; it can inferred that the best at affecting customers' behaviours are also the one that incentivize product reformulation the most. [86]

Health logos, for example, are extremely effective at highlighting the most healthy products within a category, with evident consequences in terms of purchasing behaviours, but they also have their downsides. In particular, they may encourage reformulation only of products that the industry actively decides to differentiate as less healthy, instead of pushing for a wider reformulation effort concerning other products. In this regard, labels that not only identify positive factors, but that define less healthy products, should be employed.

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reformulation: public health impact and benefits for the consumer. Proceedings of the Nutrition Society, 76, 255-264.

[84]van Raaij, J., Hendriksen, M., Verhagen, H. (2008). Potential for improvement of population diet through reformulation of commonly eaten foods. Public Health Nutrition, 12, 325- 330.

[85]Henney, J.E., Taylor, C.L., Boon, C.D. (2010). Strategies to reduce sodium intake in the United States. Washington, DC: Institute of Medicine.

[86]Hawkes, C., Smith, T.G., Jewell, J., Wardle, J., Hammond, R.A., Friel, S., et al. (2015). Smart policies for obesity prevention. The Lancet, 385, 2410-2421.

Reformulation, nevertheless, is only a step: customers have to actually like, and buy, reformulated products. Consumers cannot be expected to accept healthful product alternatives if they do not meet their sensory and hedonic expectations [87]. It is clear that changing the quantities of sugar, salt and fat, the elements that are most touched, alters flavours significantly. Reformulations thus have to take that into account, so that all the efforts made to create healthier products actually translate in people improving their diets.

Consumer acceptance is very dependent on taste, as it would be expected, but is also strongly related to other elements. For example, the brand of the product is one of the strongest factors in influencing consumer perception of food. [88]. A brand, in the eye of the customer, means many things: quality and safety features are usually associated with it, not only at the time of purchase, but also when consuming food. [89]. It thus sometime can have a bigger impact than nutritional qualities, and scores. Two are the main impacts that a strong brand can have on the use of FOP Labels and subsequently on inciting product reformulation.

Customers can assign more importance to the trust and loyalty they have towards a product of a specific brand than to health suggestions. If a Nutritional label gives them a warning of some kind, advising against the unhealthy features of the product, they simply ignore it and keep buying the food. [90]

On the other hand, when a product of a brand that is trusted and known as safe is reformulated, customers can maintain or even increase their purchase intentions, something that would not happen to less known and less strong brands. [91]

Studies on the topic have confirmed the potential of FOP labels and the related nutritional warnings to reduce consumption of products that contain nutrients associated with non-communicable diseases, or even sugar sweetened beverages. Moreover, results indicate that reformulation is a good strategy to comply with nutritional warnings, and thus keep selling products while making them healthier. In fact,

[87] Civille, C. V., & Oftedal, K. N. (2012). Sensory evaluation techniques — Make "good for you" taste "good". Physiology & Behavior, 107, 598–605.

[88] Grunert, K. G. (2006). Marketing parameters and their influence on consumer food choice: In: Shepherd, R., & Raats, M. (Eds.), The Psychology of Food choice (pp. 161-177). Wallingford: CABI.

[89] Manning, L. (2007). Food safety and brand equity. British Food Journal, 109 (1), 43–67.

[90] Ling, E. S. (2013). The mediating effects of brand association, brand loyalty, brand image and perceived quality on brand equity. Asian Social Science, 9 (3), 125–134.

[91] Sichtmann, C. (2007). An analysis of antecedents and consequences of trust in a corporate brand. European Journal of Marketing, 41, 999–1015

if consumer prefer reformulated products without nutritional warnings, the industry may face the risk of losing market share if they do not reformulate their products.

One of the most comprehensive long-term studies on the positive impact of Front of Pack labelling schemes on actual product reformulation, by looking at raw nutritional data, has been completed in 2020 [van der Bend et al., 2020].

Nutrient contents of 4,343 products labelled with the Dutch Choices Logo were analysed between 2006 and 2016, comparing the over-time changes in nutritional values and in product compositions. The study, while only focused on nutritional data and not on sales or consumption, showed that the number of labelled products increased over time. Moreover, they had healthier compositions and more favourable trends in nutrient content compared with products generally on the Dutch market. In addition to that, reformulation of such products towards healthier nutrient compositions may have stimulated manufacturers to reformulate comparable non-labelled product categories.

A key takeaway from all of this is that the effort of bodies promoting healthier eating habits should be two fold. On one hand, it should promote a widespread adoption of FOP labels to educate customers on what they're eating, to pick the healthier option. On the other hand, by accompanying the introduction of labels with a push towards reformulation, they could make a real difference in consumers' health.

2.8 The importance of Clearness and Readability in the time of COVID-19

The ongoing COVID-19 pandemic has forever changed the way we live our lives.

The way the virus spreads so rapidly has forced humanity as a whole to enact strict quarantine and social distancing policies among many strategies in order to reduce contagion. Time spent outside, or inside shops, has thus been reduced, and people are, justly, afraid to touch things that could transmit them the virus.

According to the World Health Organization, studies have shown that the COVID-19 virus can survive for up to 72 hours on plastic and less than 24 hours on cardboard[92]. Because of this, even touching food packaging in supermarkets becomes dangerous.

As a consequence, consumer patterns have changed drastically, and the food and grocery retail

[92]https://www.who.int/emergencies/diseases/novel-coronavirus-2019/question-and-answers-hub/q-a-detail/q-a-coronaviruses

industries have been affected significantly.

A report by McKinsey titled "How Chinese consumers are changing shopping habits in response to COVID-19"[93] authored in May 2020 helps us shed some light on these new patterns.

There has been a huge rise in online shopping. While that was always a large prerogative of categories such as, well, everything but food, the trend has changed significantly. Services such as Glovo, Deliveroo, JustEat and supermarket chains with their own apps have seen a huge spike in that area, as customers can pick the exact products they want and get them delivered on their doorstep.

From the comfort of their own couch and using only their mobile phones, they have access to enormous varieties of products, and can thus compare and evaluate many more alternatives than they would do in a supermarket.

At first, it would look like a great opportunity to make customers more aware of the effects of what they're eating or purchasing on their health. And yet, it has been proven that people have a much shorter attention span when using mobile phones and technology in general, so this additional health information must be provided in a clear and concise way.[94]

Studies have also shown that given the physical constraints of the crisis, customers have been more willing to try new stores and new brands.

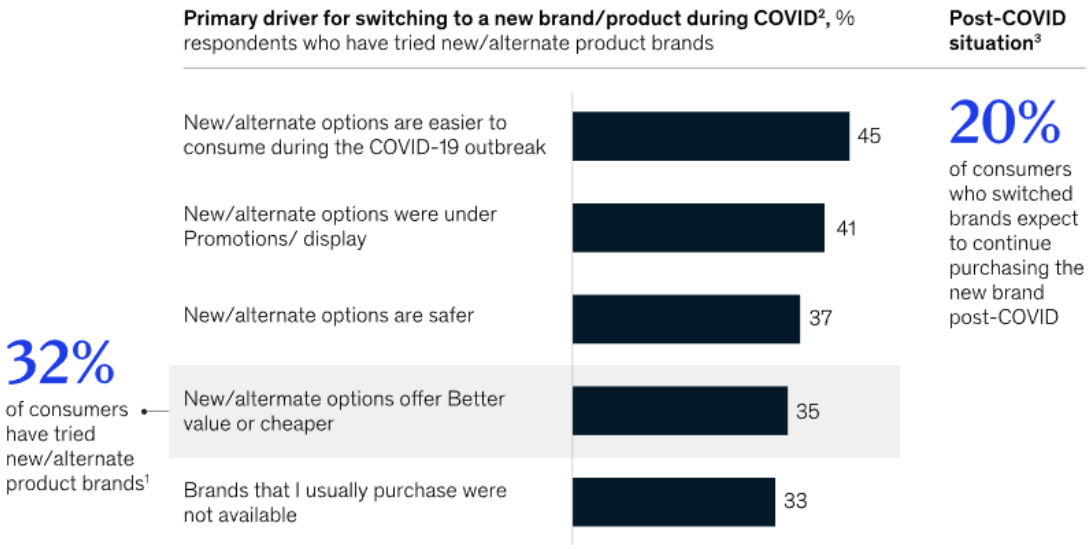

Figure 19: Driver for switching to a new brand/product in the COVID-19 Pandemic - McKinsey

[93]https://www.mckinsey.com/featured-insights/asia-pacific/how-chinese-consumers-are-changing-shopping-habits-in-response-to-covid-19

[94]"Constant, constant, multi-tasking craziness": Managing multiple working spheres https://www.ics.uci.edu/ gmark/CHI2004.pdf

This can counteract the familiarity effect that well-known and tested products and brands have on customers, and that leads them to give less importance to nutritional and health information when picking the right alternative. If customers are willing to change what they eat, this has to be exploited to help them choose.

But where could this happen? Hyper and supermarkets saw enormous spikes in demand as more people cooked at home. Moreover, during the outbreak basket sizes in non-discretionary categories increased, "reflecting consumer aversion to shopping trips and willingness to spend more per visit to reduce travel frequency".

And yet, a longer visit to a supermarket to stock up for enough food for the entire family to actually last for a week does not mean that a customer has more time to spend to evaluate different product choices. In fact, having to buy many products but having to limit the amount of time spent outside leads to less time to physically compare food from different manufacturers: customers simply leave their homes knowing exactly what to get.

This translates into less time to catch consumers' attention, both generally concerning products, and when trying to communicate important nutritional information. It is clear why the search for efficiency penalizes in-store comparisons between products: consumers want to spend as little time as it is humanly possible inside the store, but they have many things to buy as they're stocking up, say, once per week. They will thus dedicate even less time to choosing the healthiest alternative.

In addition to that, the fact that citizens are advised to go grocery shopping as rarely as possible. Flour, sugar, canned soups[95] and alcohol have all surged in U.S. sales during the pandemic, for example. People are buying more canned and highly processed, packaged foods, that last longer but contain high quantities of sugar, fat and salt and linked to a higher risk of cancer and obesity. The stress of the pandemic may also make people want to bake batches of cookies and load up on processed snacks, since foods like these can comfort people in scary times.

So, how does any of this relate to FOP Labels? Once again, it is important to remind the reader what the ultimate goal of simplified product labeling is: improving food consumption, dietary choices and consumer health.

Trends are showing that the market of organic products has seen an incredible boost, growing much more than traditional products. (source: Nielsen ScanTrack).

[95]https://www.iriworldwide.com/IRI/media/Library/COVID-19-Thought-Leadership-4-17-2020.pdf

Customers are actively trying to eat better, healthier and safer, as shown by their purchasing trends. Thanks in part to the simplicity and comfort of on-line shopping and grocery deliveries, they are willing to try different, new brands and products. Yet, the time they can dedicate to selecting the healthier alternatives when looking at many products in the shelves of a supermarket has been reduced because they're afraid of contagion. A worse lifestyle and inclination towards long-lasting, unhealthy prepackaged food are the final nails in the coffin.[96]

Moreover, people are afraid to go to the hospital for normal checkups, so instead of being diagnosed and treated they stay home to avoid contagion. Studies on the topic show that the number of severe heart attacks being treated in hospital has decreased significantly. [97]. And the job losses caused by the pandemic only hamper citizens' access to healthcare. As we know, these illnesses are precisely the ones that require the efforts towards better nutrition choices that are the main goal of FOP labelling.

The solution to all of this is clear. Now more than ever, people must improve what they eat, and must be given the tools to do so. FOP labels can and will respond to the challenge.

In particular, easily readable, simple and useful indicators placed on the front of packs will allow customers to rapidly find the better nutritional alternative, counterbalancing the reduced time they can put into selecting food products when shopping.

[96]https://time.com/5827315/coronavirus-diet/

[97]http://www.onlinejacc.org/content/accj/early/2020/04/07/j.jacc.2020.04.011.full.pdf

3 Social Media Analysis

Up to now, we have provided the reader with a comprehensive overview of why FOP Labels exist, how they're created, and their strengths and weaknesses. We have also analyzed customers' response to them, and specifically the measure in which they affect food purchasing behaviors.

On paper, this should be enough to create the perfect label. Specifically, a label that is well-evaluated in surveys, well-received by customers and that is scientifically proven to positively impact purchase and dietary choices. A label that can thus be correlated with an increase in health in the population.

Yet, all the surveys on existing FOP Labels that specifically ask respondents what they think about said labels are actually asking for customers to focus on them. They subsequently might show a bias that cannot easily be adjusted for.

In order to correctly estimate customer's perception of FOP labels, and the response that they generate, it is imperative to employ a different kind of approach. Specifically, by leveraging the power of Social Media, it will be interesting to analyze what the online chatter about labels is, and to correlate this data in order to assess their effectiveness and the interest that there is towards the topic. The growth of social media represents an opportunity in this regard by providing access to spontaneous consumer information elicited in real-life situations

This indirect approach could prove to be more genuine and unbiased, and will hopefully give meaningful insight on how to reshape food labels.

Specifically, by analyzing online chatter about labels and correlating it with the geography in which these labels were mentioned positively, we aim to understand whether a strong interest in FOP labels as a tool to improve health does actually have positive consequences. Moreover, we want to determine whether Social Media can be employed as a tool to inform people, especially young adults, on how to correctly read and use FoP labels to improve their diets.

The final goal of this work is to create a working, actionable framework to gauge interest and effectiveness of Front of Pack labelling schemes on Social Media. Of course, this has to be inserted in a wider, more comprehensive information, education and knowledge sharing initiative: we know that labels work best when accompanied by education, by knowing what they mean and most importantly how to properly use them. As Social media is so ubiquitous and has the tools to deliver a tailored, targeted message, it could be the right tool. This work proposes a tool to verify the effectiveness of

said strategy.

3.1 What are Social Network Sites

Social network Sites "are a collection of web-based services that allow users to build a profile within the system and define a list of other users with whom they have some kind of connection" [boyd and Ellison, 2007]. The architecture of social networking platforms is very differentiated.

Moreover, Social media "can be defined as any web-based communication channel dedicated to community-based input, interaction, content-sharing and/or collaboration i.e. used for online social networking[98]. This can include social network channels, such as well-known, publicly available platforms (e.g. Facebook, YouTube, Snapchat), or purpose-built, private discussion forums for 'closed' groups."

3.2 Methodology

In order to perform a correct, purposeful and effective analysis of what's said online about FOP labels and their effects, the following methodology will be employed. It has been devised by studying similar research projects such as "Social media use for nutrition outcomes in young adults: a mixed-methods systematic review" by Karen M. Klassen , Caitlin H. Douglass , Linda Brennan , Helen Truby and Megan S. C. Lim and "Using Twitter data for food-related consumer research: A case study on ''what people say when tweeting about different eating situations"" by Leticia Vidal, Gastón Ares, Leandro Machín, Sara R. Jaeger

1. Define a list of possible **information sources**, complete with their intrinsic features and pros and cons related to their use.
2. Define the **criteria** that will be employed to select the source/sources.
3. Apply criteria to **choose** the source/sources.
4. Define the kind of **analyses** that will be performed on the datasets.
5. Select the **Keywords** that will be used to search the text samples.
6. Define the **tools** that will be used to analyze the dataset.

[98]Definition: social media [http://whatis.techtarget.com/definition/social-media]. Accessed 6 July 2018.

7. Perform Analyses.

8. Interpret and discuss the data.

3.2.1 Where to look?

The internet is vast. Googling FOP labels, a more scientific term, returns 638'000 results, while Nutriscore returns 3'710'000. It is mandatory to find a way to reduce and focus the scope of the information we're looking at. Many are the sources of information available for our research, and differ in specificity, language, style and lexicon. Moreover, different locations attract a different public, and thus a different education level or simply interest towards the topic. Geography is also an interesting factor, as it can be easily correlated with demographic data.

Possible information and discussion sources include

- Social Media posts, such as Facebook, Twitter, Instagram.
- Scientific Papers and Literature
- News Articles and comments under them
- Documents and transcripts from conferences
- Forums, both specific on Nutrition and more generalistic

While there is no shortage of discussion on FOP labels, and thus of potential material for analysis, this analysis standpoint is precisely what we must evaluate next.

It is important to find a source of information that can be easily crawled through, to acquire a sizable quantity of data on the topic, to precisely estimate the feelings of whoever is commenting. Ease of access has to be taken into account as well: data can't be hidden behind a password screen, or posts restricted to only friends.

Moreover, the more standardized the data we obtain is, the easier it is to extract specific information, such as location, and compare it or employ to divide comments into buckets. APIs are of paramount importance to this regard, as the difference between scraping a multitude of different websites and obtaining structured data from an endpoint means simplifying the acquiring process massively.

Spontaneity of the discussion is also an important factor: usually, people that take time to comment on a food-related forum are more educated on the topic of health, diet and food labels. This means their point of view is somewhat different from that of the general population, which we're trying to understand and influence.

Finally, the elements we obtain need to be textual. In order to perform measures, comparisons, and analysis of opinions, we cannot have a dataset of images.

	Ease of access (API)	Standardized Information	No Access Restrictions	Spontaneity	Extra Information (Geography...)	Textual Information
Social Media: Twitter	X	X	X	X	X	X
Social Media: Facebook	X	X		X	X	X
Social Media: Instagram	X	X	X	X	X	
Scientific Literature					X	X
News Articles and related Comments			X	X		X
Documents and Transcripts from Conferences			X		X	X
Generalistic Forums			X	X		X
Specific Forums						X

These factors, most importantly the need for standardized data, and access to a more spontaneous, generalist discussion arena, direct us towards Social Media. The fact that we need to obtain access to a large dataset with ease, together with the requirement that this dataset is readily and publicly available, and also complete with corollary information such as geolocation, subsequently brings us to selecting Twitter as the source of data for our analysis.

3.2.2 Twitter

Twitter, as a social media platform, ticks all the important boxes in regard to the requirements that we have established. Yet, before we employ it as our single source of information, we have to clarify how

it works and why it is so useful.

Twitter is a 'microblogging' system that allows you to send and receive short posts called *tweets*. Tweets can be up to 280 characters long and can include links to relevant websites and resources.

Its architecture as a platform is simple: it is structured as a directed graph: the nodes are the users, and the relationships between nodes, the edges, are established by a "follow" structure. Each user can decide to follow a number of other users, and can be similarly followed by other users. This is why the graph is directed: the relationship can be asymmetrical. A user can follow another one and read their messages without being reciprocated.

Users can create their own tweets or can retweet other people's tweets, sharing their content on their profile, usually as a form of endorsement. [99]

One of the peculiar features that Twitter offers is that users can group posts together by topic or type by use of *hashtags* – words or phrases prefixed with a "#" sign. Similarly, the "@" sign followed by a username is used for mentioning or replying to other users. [100]

As of 2019, Twitter had more than 500 million monthly active users, spread on all the continents, tweeting in multiple languages.

All of this is accessible through APIs, computing interfaces which define interactions between multiple software intermediaries [Wikipedia, 2020a] [101]. By making an appropriate request to the system, a single tweet, or a list of tweets, is returned.

A tweet object, which is how a single tweet is called, is a standardized JSON object that contains information already divided into fields. They include data such as username of the person tweeting, timezone, language, location coordinates (if enabled), hashtags, and whether the tweet is standalone or a reply, meaning it's part of a conversation.

This particular aspect is what really simplifies dividing tweets into buckets, even before performing a textual analysis of what is said in the actual tweet content.

Twitter's API in its freely accessible version only provides tweets in two different ways. The first option is a streaming fashion, which means that instead of retrieving tweets in batches through repeated

[99] https://esrc.ukri.org/research/impact-toolkit/social-media/twitter/what-is-twitter/
[100] https://en.wikipedia.org/wiki/Twitter
[101] https://en.wikipedia.org/wiki/Application_programming_interface

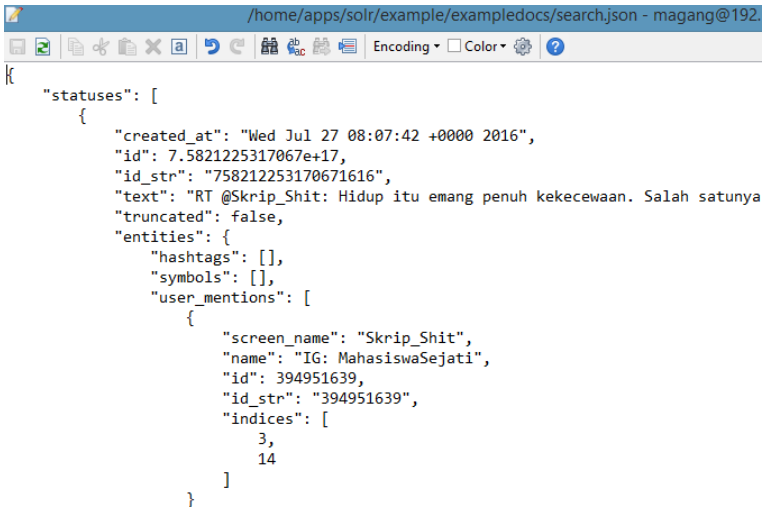

Figure 20: Example of the contents of a Tweet object.

requests by a client app, a single connection is opened to retrieve all new tweets that satisfy a certain query when new matches occur.

The second option allows the retrieval of old, historical tweets, based on a search query as well. Unfortunately, aside from a limit in the number of tweets that can be obtained per hour, which is expected, the free version only allows retrieval of tweets that are up to one week old.

Discussion on FOP labels is a very specific topic, and restricting the time frame to either ”future” or ”up to a week old” would not give us access to a large enough dataset to be meaningful.

Luckily for us, Twitter provides a premium, paid, API platform named Twitter Premium. The exploitation of the Premium Search API is important since it allows us to build a complete dataset. In fact, the Standard Search API used in the majority of previous works, does not guarantee completeness, meaning that not all tweets matching the query criteria are returned.

This is particularly true specifically for the time aspect: Twitter Premium allows developers to retrieve tweets posted since the foundation of the Social Network in 2006. The only limit is how much we pay: with enough funds, the entirety of tweets ever posted that contain our query could be retrieved.

3.2.3 Choice of Keywords

The way Twitter APIs work is the following: a list of search keywords is passed onto them, and the system returns a large number of tweets in which said keywords were mentioned.

The less specific the keywords, the bigger the dataset, which can be an advantage. Yet, as we have no way of having the software distinguish the actual meaning of the sentence, there is a requirement

of specificity. The selection of appropriate keywords, related to the topic of our analysis, is thus fundamental in order to acquire a correct dataset.

The comprehensive literature review we have performed in Chapter 1 and 2 is the source of the majority of said elements, as it comprises a vast number of specific terms related not only strictly to labels, but also to the health concepts that labels target.

The first step is to include in this list the names of the most important Front of Pack labels, as we can be confident that tweets mentioning said words will be highly related to the topic at hand.

```
Nutriscore OR Keyhole OR Multiple Traffic Light OR Healthier Choice Symbol
```

False positives and unrelated tweets are a great issue in this regard. Usually, the less ambiguous the words are, the easier it is to obtain tweets that are related to the topic. For example, a search for Nutriscore is 100% certain to give results that are related to the label.

On the other hand, if `Multiple Traffic Lights` is researched on its own, many results will be related to traffic. The usual approach to counter this issue and to get content that has the desired meaning consists in defining a list of stop words, that will make the system discard the tweet. A `NOT` query, in a sense. For example, `Multiple Traffic Lights NOT driving NOT traffic` should be helpful in restricting the scope of the search.

In addition to that, as the goal of the analysis is to assess where and how much food is discussed relatively to these words, the following search terms are added.

```
nutrition OR labelling OR fop label OR front of pack OR nutrients
```

The final search query is thus defined as

```
Nutriscore OR Keyhole OR Multiple Traffic Lights OR Healthier Choice Symbol
OR nutrition OR labelling OR fop label OR front of pack OR nutrients
```

Moreover, an iterative approach is employed: the search query has been adjusted by looking at the results of the initial one, in order to filter out unwanted or unnecessary elements.

Finally, the query has the `has:profile_geo`, in order to retrieve only tweets with the physical location of the poster set in the profile. This is done to have access to meaningful data that can easily be correlated with geographical parameters.

3.2.4 Tools

Python-based environments are usually employed in order to crawl Twitter data, and big data in general, comb through it and visualize the results of the analyses. Python is chosen because of its completeness, flexibility and easiness to use. Moreover, many researches and social media analyses have been done using Python, so there is a great amount of available packages and tools to perform these tasks.

- Python 3 - Main programming language
- Anaconda - open-source distribution of Python for scientific computing, that aims to simplify package management and deployment.
- Jupyter Notebooks - open-source web application to create and share documents that contain live code, equations, visualizations and narrative text, which serves as the main programming environment [102]
- Python packages
  - Searchtweets - Interface with the Twitter APIs, that allows the retrieval of tweets that satisfy a certain query, both textual and/or geographical, posted in a specific time frame
  - Pandas - Software library for data manipulation and analysis, that offers data structures and operations for manipulating numerical tables and time series.[103] Employed to filter data and analyze it.
  - NLTK - Leading platform for building programs to work with human language data. It provides easy-to-use interfaces to over 50 corpora and lexical resources such as WordNet, along with a suite of text processing libraries for classification, tokenization, stemming, tagging, parsing, and semantic reasoning, wrappers for industrial-strength NLP libraries. [104]
  - LangDetect - A language detection library [Nakatani, 2010] that returns the language of a string, used to determine the language of the tweet. It has been trained on text coming from Wikipedia in 55 different languages, and returns the correct language with 99% precision.
  - VaderSentiment - lexicon and rule-based sentiment analysis tool that is specifically attuned to sentiments expressed in social media [Gilbert, 2014], that returns a polarity score scaled in $[-1; +1]$ defining whether the text can be considered positive, neutral or negative

[102] https://jupyter.org/
[103] https://pandas.pydata.org/
[104] https://www.nltk.org/

- Seaborn - Data visualization library that provides a high-level interface for drawing attractive and informative statistical graphics[105]

3.2.5 Analyses

For each tweet obtained, the following steps are performed, to extract data that and elements that will subsequently be analyzed

1) **Elimination of Duplicates** Sometimes, tweets are just copied and pasted from one another, and if so they will pollute our dataset. So, duplicates are removed by looking at both the `Tweet ID` and the textual content

2) **Elimination of Retweets** for the same reason, retweets will wrongly shift the bias of our dataset. Only original tweets are kept.

3) **Language Detection** Assignment of the language in which the tweet has been written. The language of the Twitter profile can be inferred from the data associated with the profile, but many users use the website in English while tweeting in other languages. The algorithm assigns a probability to each possible language, and then selects the higher one.

4) **Extraction of the Screen Name** for easier manipulation and detection of most frequent tweeters

5) **Extraction of Country** Tweets can have a precise location attached to the tweet itself, or a fixed location attached to the profile of the person tweeting. This is not mandatory, and users can choose every time whether to include a location, and with which precision. Not all tweets contain a valid location, as places like "Wonderland" can be set.
When the location is present at a profile level, and is valid, the country is extracted.

6) **Identification of Retweets** A retweet is a repost of a tweet made by another user on someone's own profile, to get shared with the reposter's own followers. They can represent endorsement, or just a simple share with no strings attached. They are usually preceded by the letters RT for Retweet. It is important to determine which tweets are original, and which are simply a share of someone else's content. This is also useful to determine influencers, as their tweets, and thus their opinions, are those that circulate the most.

[105]https://seaborn.pydata.org/

7) **Removal of Punctuation** Punctuation is removed by a specific tool in order to have only the words forming the tweets.

8) **Tokenization** In order to find the words that are most used, and to determine the main topics that are being tweetet about, it is important to divide the tweets into tokens.

- "Tokenization is the process of demarcating and possibly classifying sections of a string of input characters."[106].
- Each tweet has thus to be divided into words. Yet, as conjunctions and articles would represent the most frequent words, analyzing those would not be meaningful.
- In that regard, stop words have to be used[Saif et al., 2014]. These are common terms which rarely add to the meaning of a sentence for the purposes of NLP and information retrieval. These particles are ignored during the tokenization process and are thus excluded from it, such as articles, conjunctions, punctuation...
- Stop words are different based on the language of the tweet, and the information on it that was previously detected is used.
- By analyzing the tokens and most frequent words produced by the algorithm, further stop words have been added, such as `[RT, et, a, ...]`

9) **Sentiment Classification** Aa Sentiment Polarity Score is determined through `VADER`. The algorithm detects the presence of words, punctuation and emojis the presence of which is clearly related to a sentiment, an interpretation of the emotions and connotations expressed in the tweets.[107] No thresholding is done. The algorithm requires a corpus that allows it to identify the meaning of words and derive the associated sentiments: English corpora are widely available, but it is not the case with other languages. Thus, this proof-of-concept analysis will be focused only on English content.

After these steps, the data is combined and evaluated, in order to determine:

- Conversational Topics - what are the topics that involve Front of Pack Labelling and Nutriscore? Why is the conversation happening?
  - Most Frequent Keywords

[106]https://en.wikipedia.org/wiki/Lexical_analysis#Tokenization

[107]https://monkeylearn.com/sentiment-analysis/#: :text=Sentiment%20analysis%20is%20the%20interpretation,in%20online%

  - Most Frequent Hashtahgs
  - Word Cloud

- Country Share of the conversation - Which countries participate the most to the debate? Geographical data and shares of discourse will be correlated with healthiness parameters.
- Language Share - In which languages does the debate happen? Both in absolute terms, and per country
- Overall Sentiment - What is the overall opinion of the topic? Average, Median and Standard Deviations of the Polarity Scores attributed to English Tweets are computed.

3.2.6 Correlation

The goal of the whole analysis is to determine whether some sort of relationship exists between interest in Front of Pack labelling schemes, and participation in the ongoing debate, and interest in health in general.

Such relationship can be determined by computing the Pearson Correlation Coefficient between the Language Share of tweets (net of retweets and duplicates) posted in EU Countries between January 2020 and June 2020 and Mindfulness Indicators such as

- **Eurostat Statistics on Sport Participation**: statistics compendium computed in 2018 related to participation in sports, both active and passive, surveyed in 2014, across European Union member states. [Eurostat, 2018a]
  Participation in sport is determined by the European Health Interview Survey, that gathered data on work- and non-work related physical activity, asking people whether they engage in sport, fitness or recreational activities (e.g. Nordic walking, brisk walking, ball games, jogging, cycling, swimming, aerobics, rowing, badminton, etc.).
  The reference period is a typical seven-day week and the target population consists of people aged 15 and over.
- **Percentage of Obese Adults in the Country's Population** As we know, one of the reasons why FoP labels exist is to offer an actionable tool to prevent and reduce the impact of non-communicable diseases such as obesity.[Eurostat, 2018b] With this aim, data concerning "Overweight and obesity - BMI statistics", gathered once again in 2014 by Eurostat through the

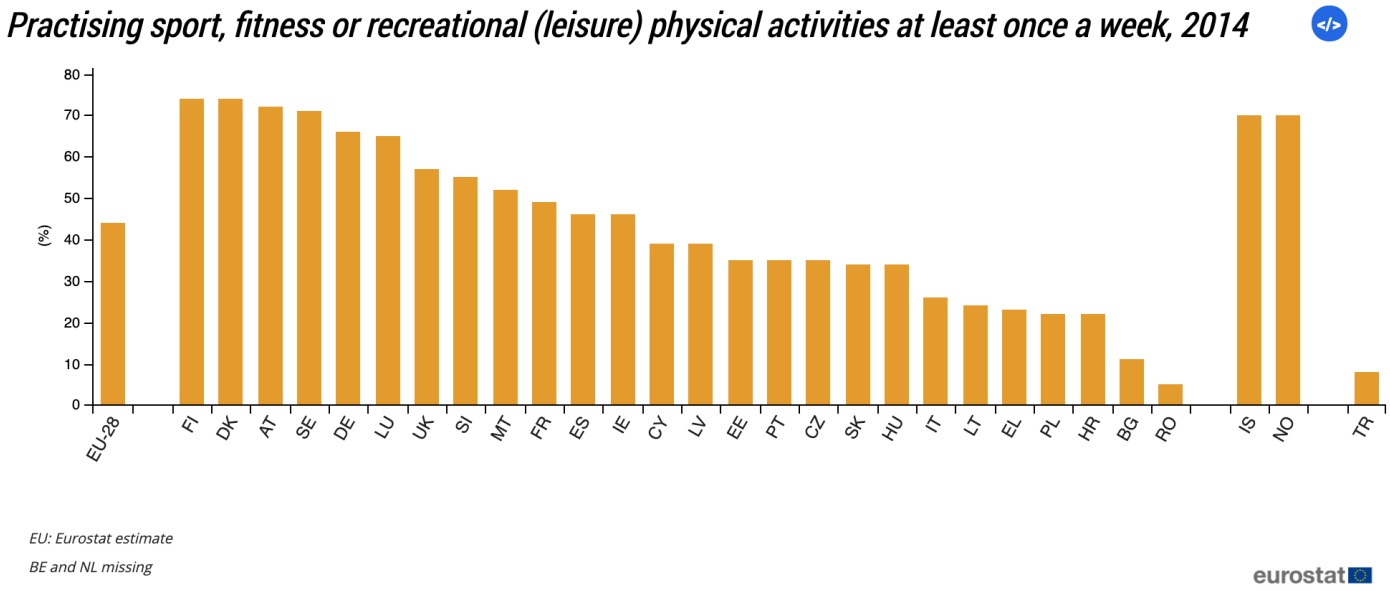

Figure 21: EHIS Survey on Sport Participation - Details per Country

EHIS survey, is employed. Data in the survey is divided by age group, gender differences, and education level.

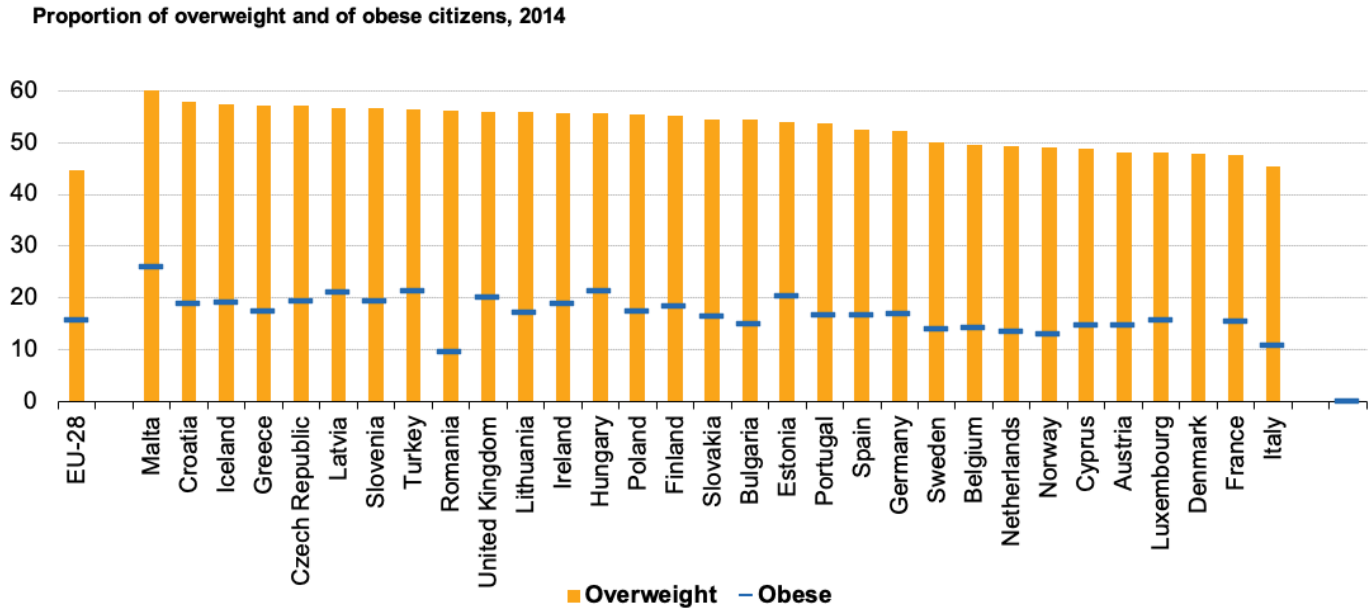

Figure 22: EHIS Survey on Obesity and Overweightness - Details per Country

Correlation is a statistical technique that can show whether and how strongly pairs of variables are related. The result of this mathematical operation, when applied of a set of two variables, is a single value named the "Pearson's product-moment" r or r coefficient. [Benesty et al., 2009]

r is characterized by both a magnitude, and a direction, that can be positive or negative. The magnitude is a continuous value that exists on the normalized range between -1 and +1; these values are absolute and non-dimensional. A correlation of 0 indicates that no association whatsoever exists between

the variables. When r approaches -1 or $+1$, it shows a strong association between the two variables, that becomes linear in the edge cases. A positive correlation coefficient indicates that an increase in the first variable would correspond to an increase in the second variable. A negative correlation indicates an inverse relationship between them, such that whereas one increases, the other decreases in the same measure.

$$r(a,b) = \frac{E(ab)}{\sigma_a \sigma_b}$$

$E(ab)$ is the cross-correlation between a and b and $\sigma_a^2 = E(a^2)$ and $\sigma_b^2 = E(b^2)$ are the variances of the signals a and b, respectively.

The correlation coefficient has to be interpreted, and its meaning adjusted to the scale at hand. Usually, a correlation coefficient $\|r\| \leq 0.35$ expresses low or or weak correlation, $0.36 \leq \|r\| \leq 0.67$ signifies modest or moderate correlations, and $0.68 \leq \|r\| \leq 1$ strong or high correlation. As these ranges are in absolute values, a negative value falling in the $[-0.67; 0.36]$ obviously means a moderate negative correlation. [Taylor, 1990]

An important element when assessing the strength associated with the computed correlation coefficient is the size of the sample n. In order to better evaluate the meaning of r, the coefficient of determination r^2 is more meaningful. It is defined as "the percent of the variation in the values of the dependent variable that can be explained by variations in the value of the independent value", thus showing how well our hypothesis works.

Moreover, as we don't know whether our data is linearly related, we are going to also compute Spearman's correlation between the variables, which is a statistical measure of the strength of a monotonic relationship between paired data. Spearman's correlation works by calculating Pearson's correlation on the ranked values of this data. Ranking (from low to high) is obtained by assigning a rank of 1 to the lowest value, 2 to the next lowest and so on. [108]

$$r_s = \rho = 1 - \frac{6 \sum d_i^2}{n(n^2 - 1)}$$

having defined how we're going to gather the data, how we're going to analyse it, and with what we're going to correlate it, it's now time to proceed with our analysis.

[108] http://www.statstutor.ac.uk/resources/uploaded/spearmans.pdf

3.3 Analysis

By performing preliminary searches, in order to refine the keywords employed, it is clear that most of the chatter with the meaning we need occurs around Nutriscore. The reasons for this are various. First of all, as it is a strong brand with a specific, identifiable name, it is easy for users to talk about it using the specific, correct term. Moreover, in recent years and months much debate has sparked concerning Nutriscore and its adoption at an EU-wide level, so it is wildly used.

In addition to that, enormous pollution occurs by other keywords. Mentions of *Multiple traffic lights*, when retrieving 20000 results of our query are non-existent, and a search with only those three words retrieves 29 results in the last six months. `Food`, for example, takes up the majority of the results, but it is too wide a keyword, and is not relevant to what we're trying to determine.

Moreover, the time frame in which we are searching is relevant. There presently is an enormous multi-national debate at the EU-level on the adoption of Nutriscore as a EU-wide FoP label to complement other nutritional information on the box. Analysing this traffic in particular will therefore be particularly significant.

By following our model the research query is thus simplified to follow the Nutriscore debate, while still maintaining the restriction to retrieve only tweets posted by users that have set their profile location. The time span under analysis is between `01-01-2020` and `01-06-2020`.

15832 tweets with the required characteristics have been retrieved. Out of these, duplicates are excluded, leaving us with 7168 original tweets.

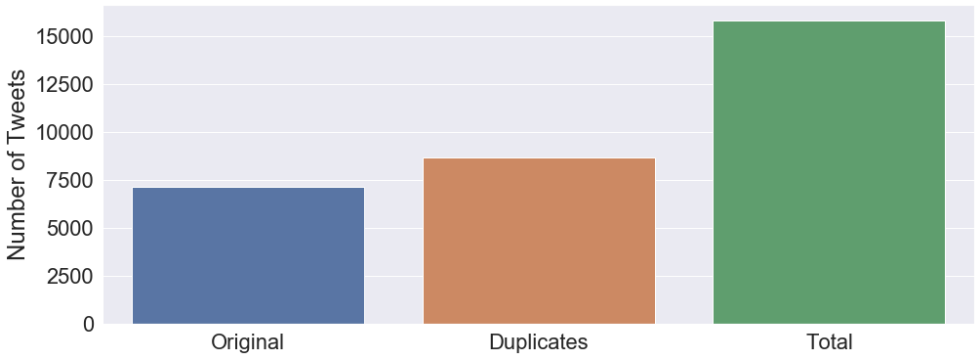

Figure 23: Composition of tweets retrieved

Our working dataset will only include the 7168 original ones. The next step is to determine how many are retweets, and to exclude them to avoid polluting our dataset.

We then proceed to reduce our dataset by eliminating the 28.32% of retweets that are in it, leaving

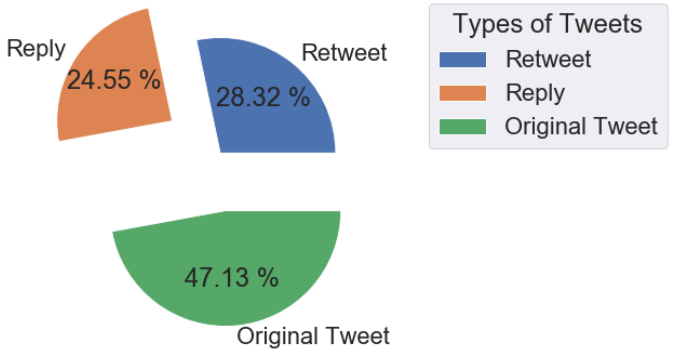

Figure 24: Composition of Original Tweets

us with 5138 tweets that we will proceed to analyze.

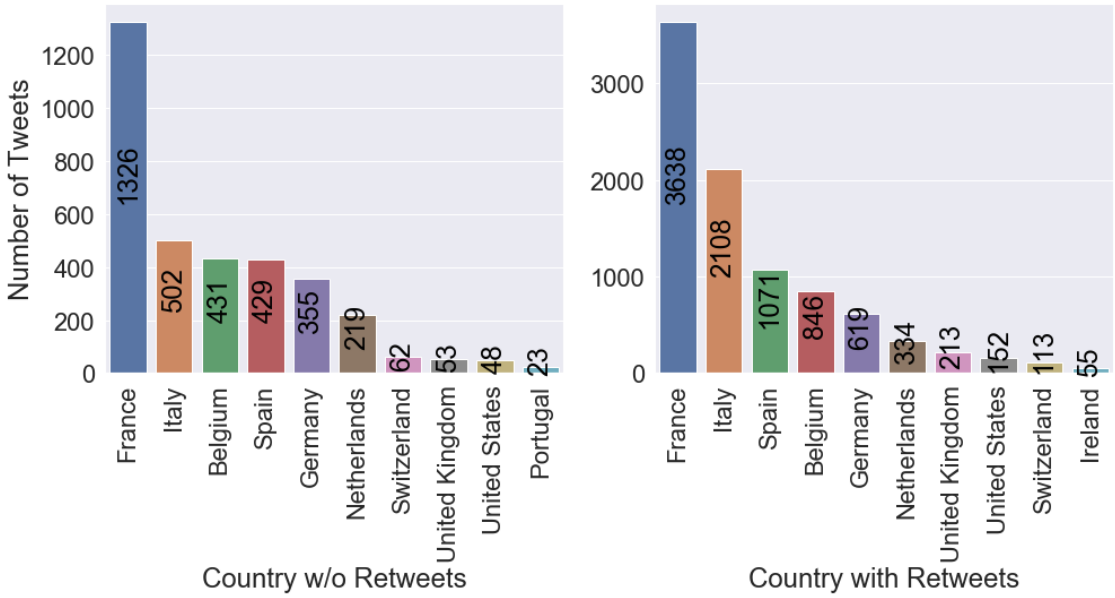

Figure 25: Locations of Original Tweets

Subsequently, we extract the tweets that have a valid profile geolocation and thus a country, by filtering on the `Country` field of the `user` object associated with each tweet. Out of these, the ten most-tweeting countries are selected.

Side by side are shown the country buckets with and without retweets, highlighting the bias that including them has on the discussion.

Removing retweets and duplicates is also important in the analyzed time frame because many tweets are being republished under the direction of political leaders, both by people and by bots, to influence the perception of the debate. Such is the case for Italy, for example, in which the majority of retweets are political.

As can be seen in the chart, the most active countries in the debate are as follows

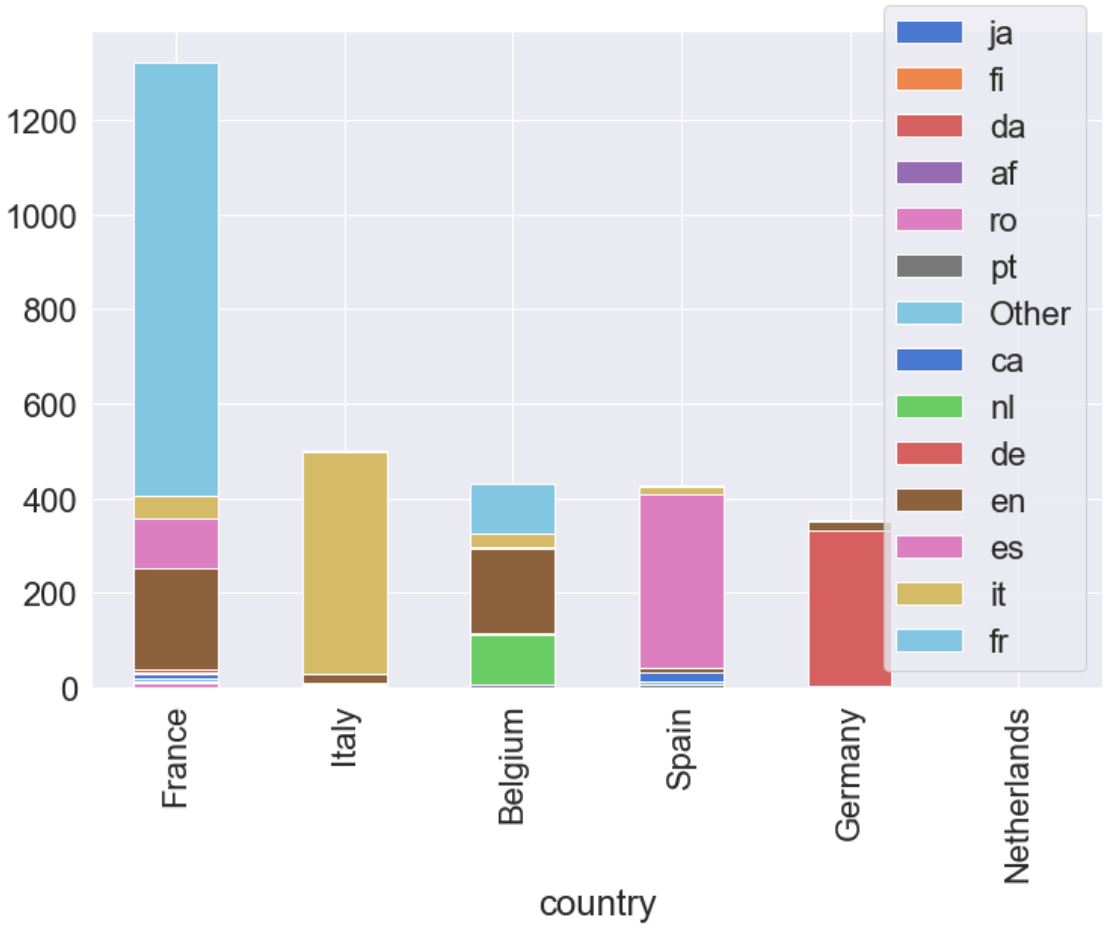

Figure 26: Division of Tweets Languages from a country

Country	Count	Share
France	1326	38.45%
Italy	502	14.55%
Belgium	431	12.5%
Spain	429	12.44%
Germany	355	10.29%
Netherlands	219	6.35%
Switzerland	62	1.79%
United Kingdom	53	1.53%
Other		2,1%

Table 4: Country Shares of the conversation

A less significant but still interesting element is the **language share** of the tweets across the total, as it still follows the Country trend.

Before we analyze the correlation with a specific set of healthiness and mindfulness variables of the data that we have gathered, it is important to understand the general meaning of what is being

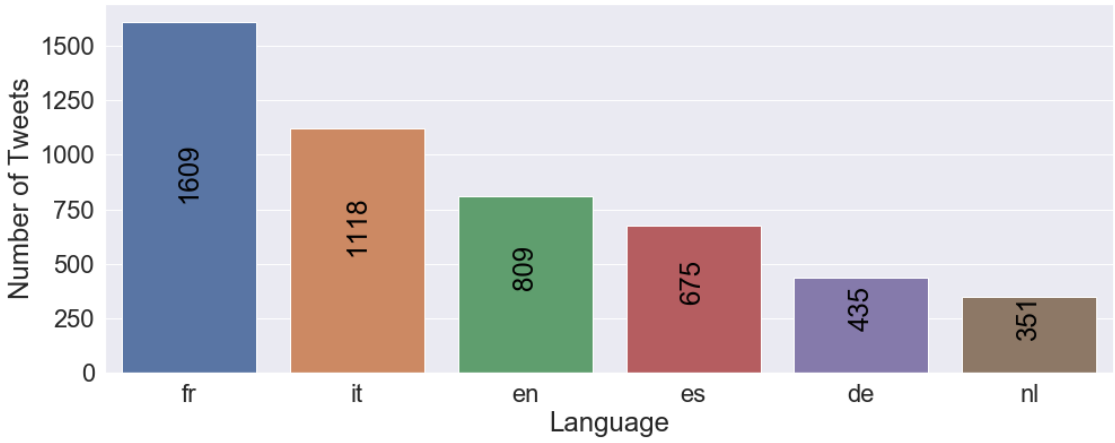

Figure 27: Languages of Original Tweets

discussed.

First of all, **Hashtags** are extracted, once again by only looking at original tweets and excluding the pollution by duplicates and retweets. It is clear that the majority of the conversation rotates around `Nutriscore`, because of the international debate at an EU wide level that dwarfs anything else. This is also made evident from `eu` and `ue`. Other notable elements are the mentioning of `nutrinform`, the italian alternative for a EU-sanctioned label, albeit with a much limited scope.

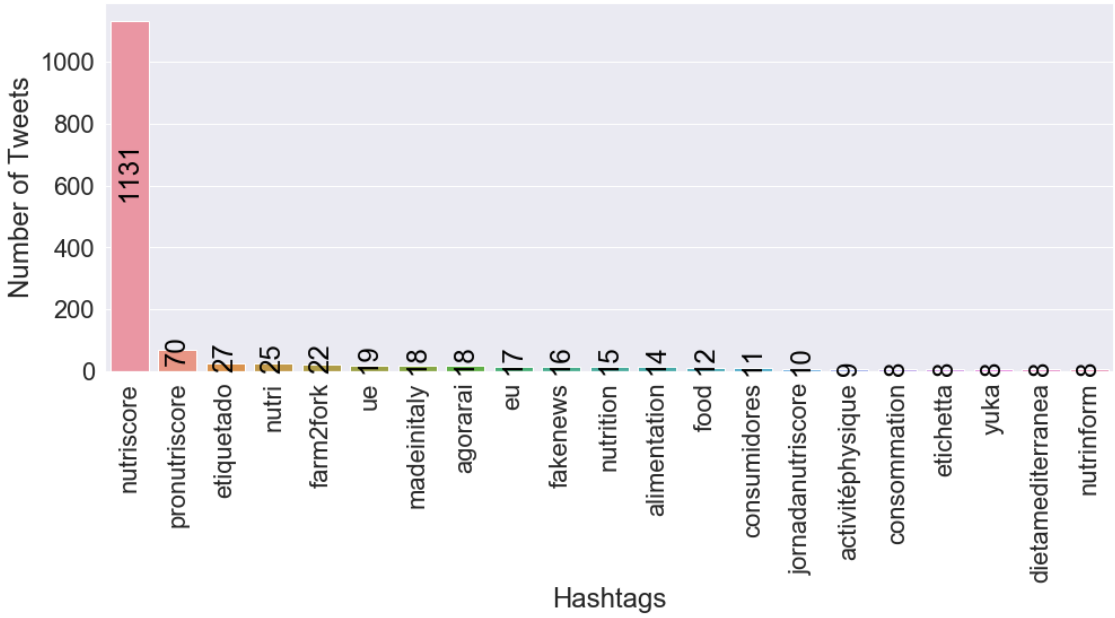

Figure 28: Hashtag Distribution

Relevant in the framing of the discussion is also the mention to `Farm2Fork`, EU's new Food Policy, via the hashtags `eu` and `ue`, as the debate became more intense. [109] The regulation was expected to institute guidelines for the EU-Wide adoption of a FoP Label, and even to crown NutriScore as the

[109]https://www.foodnavigator.com/Article/2020/05/22/What-does-the-farm-to-fork-strategy-mean-for-the-future-of-food-in-Europe

chosen one. Yet, no decision was made, as the document simply stated a strong necessity for a shared, unique label.

The next step in terms of content analysis is to determine the most frequent words that are used. Words have thus been tokenized according to the language of the tweet that we have previously automatically determined through an algorithm.

In addition to the language-specific stop words, by looking at the intermediate results of the tokenization process, the list has been improved and increased to leave us only with the more meaningful words.

After that, words have been counted and divided into buckets, leaving us with the most recurring words and concepts in multiple languages. The following word-cloud has been generated, and the bigger the font size of the word, the higher the frequency of a word in our selected dataset.

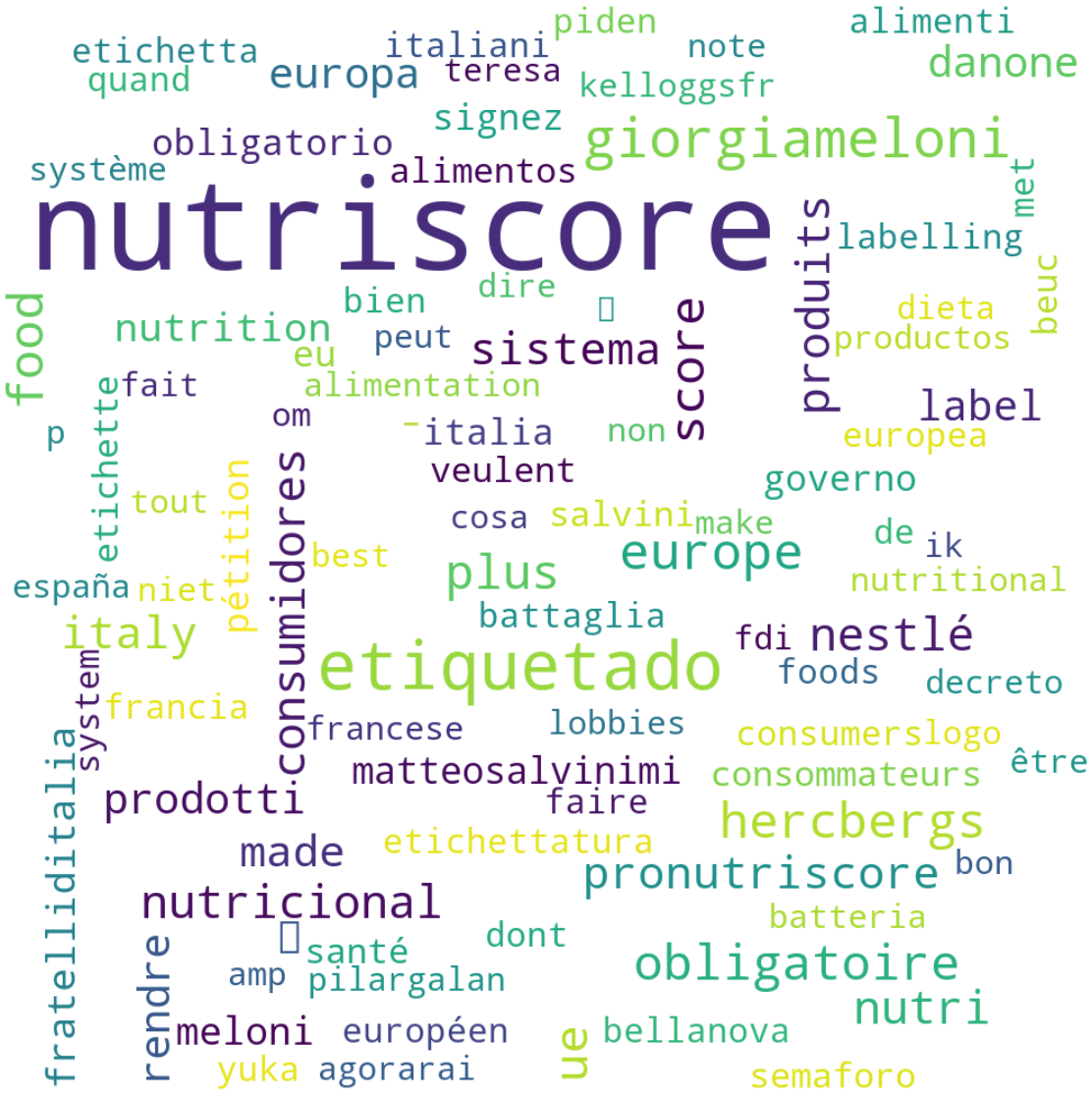

Figure 29: Word Cloud

Once again, `Nutriscore` takes up the majority of the discussion space, alongside words such as `debat` and `pronutriscore` that highlight the contrast at an European level. Contrast that is evident also from the usage of French terms.

Interesting is also the appearance of brand names such as `Danone`, `Nestlé` and `Coca Cola`. The Coca Cola vs Parmesan example is usually, and sometimes superficially, used by Nutriscore detractors in order to exemplify the alleged inferiority of the label. Specifically, they say that the Nutriscore model has a fallacy because it rates Coke higher, and thus healthier, than Parmesan. While this is true, it depends on the fact that, by design, the label should not be used to compare different product categories. The other two are brands that are in favour of using Nutriscore, and that are actually employing it voluntarily on their packages.

The presence of this rhetorical statement highlights how politicized the discussion around FoP labels, and Nutriscore in general, is. And what is more politicized than the presence of `fratelliditalia`, `giorgiameloni` and `matteosalvinimi`, respectively the name of a Italian party and of an Italian politician that are strongly opposing the label and promoting `batteria`, the Italian Nutrinform Battery?

Nevertheless, the discussion appears to forget what the labels should do. No mentions to the purpose of labels, with words such as *obesity, overweight, activity, fitness* are made, thus reducing the debate only to something related to the labels themselves.

Looking at the temporal distribution of the tweets is also interesting, as per the below chart. Let's go through the peak dates.

- 20200116 Danone, one of the world's largest food manufacturers, voluntarily adopts Nutriscore, starting with products for children.
- 20200121 Italy officially announces its Nutriscore Alternative, Nutrinform Battery
- 20200122 Kellogs France voluntarily adopts Nutriscore for on its Cereals
- 20200212 PepsiCo voluntarily adopts Nutriscore in a progressive way
- 20200428 Nestlé products equipped with Nutriscore begin appearing in Switzerland
- 2020 May the debate concerning Farm2Fork increases

The final element is Sentiment Analysis. As explained in the Methodology, Sentiment Analysis requires the software to "understand" the meaning of the words, and thus needs training. For the scope

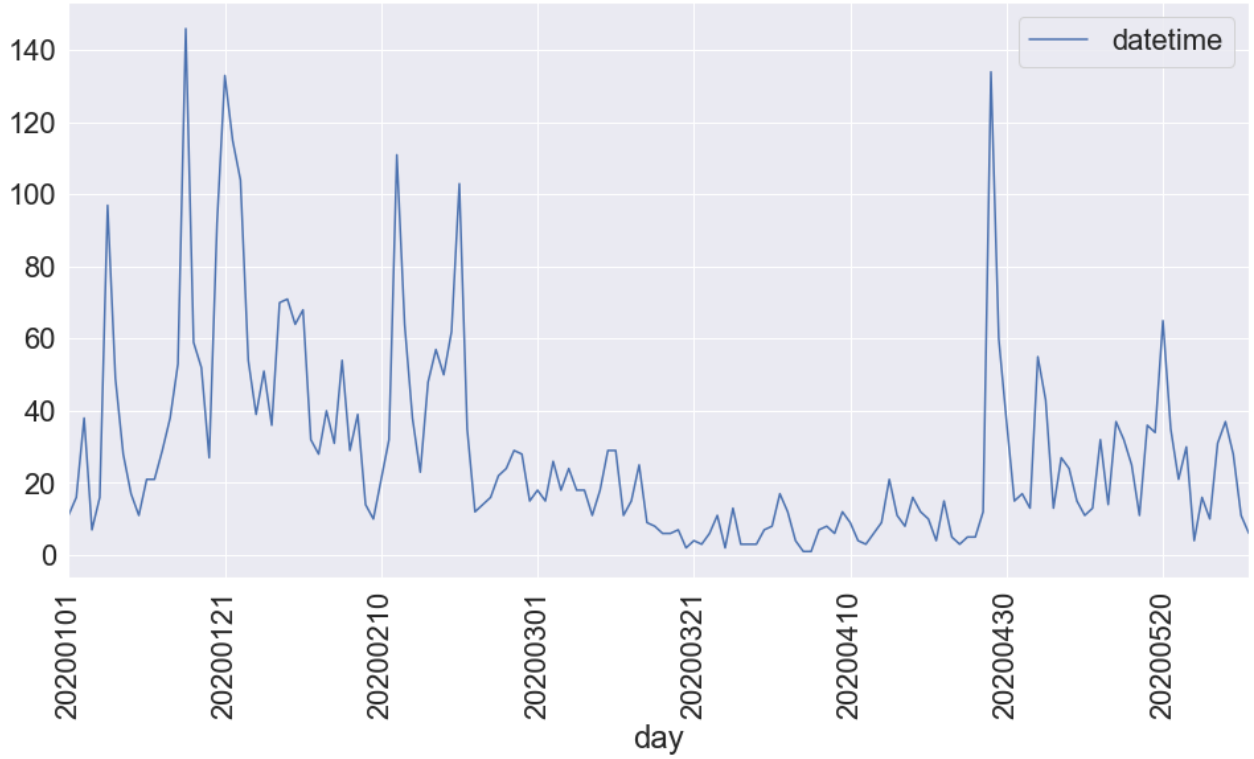

Figure 30: Temporal Distribution of tweets

of this analysis, only a partial training set has been used, and thus only tweets in English have been assessed. Polarity scores p have been computed through NLTK's Vader over a grand total of $n = 666$ tweets in English, as usual excluding duplicates and retweets.

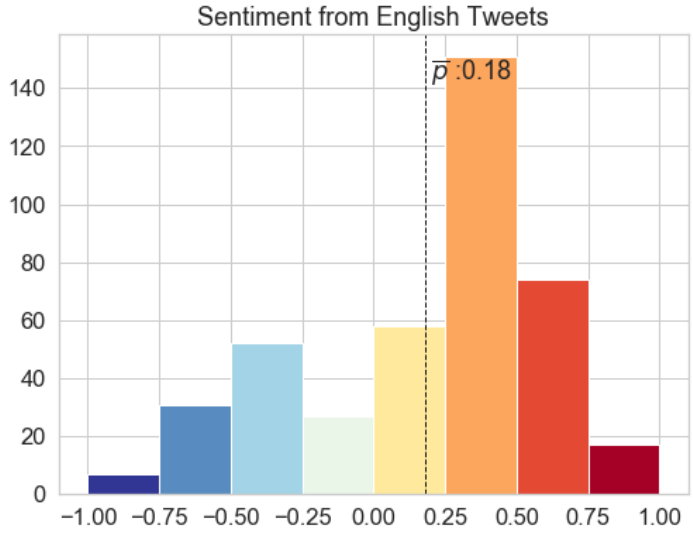

Figure 31: Sentiment Distribution

As it's clear from the chart, the majority of the tweets are positive, specifically 72% of the dataset, with a polarity score $p > 0$. The mean score is $\overline{p} = 0.182$, and the median is $\underline{\underline{p}} = 0.312$. Standard deviation is computed as $\sigma = 0.428$.

Our calculations, albeit limited the tweets in English, thus indicate that Nutriscore is generally well

perceived by tweeters, and that in the eye of a debate occurring on the topic, the majority tweets about it can be seen as promoting it and the concept of Front of Pack labelling instead of opposing it.

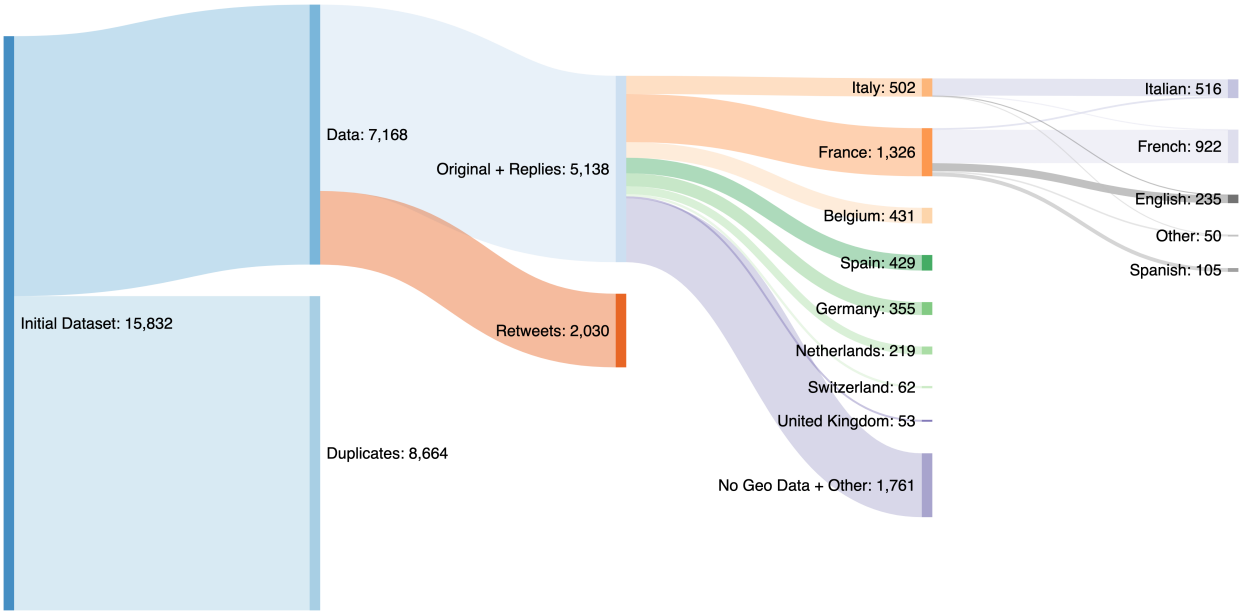

Figure 32: Sankey Diagram of the Dataset

3.3.1 Correlation Analysis

We now know that the conversations around FoP labels occur around Nutriscore, and we know precisely the countries where these conversations happen, and in which language.

Nevertheless, the goal of our analysis is to determine whether a relationship exists between a few selected healthiness and mindfulness indicators, and interest towards the ongoing debate on Front of Pack labels.

As highlighted in the methodology part, the variables that will be compared with our share of discourse are

- Share Percentage of Overweight People in the country
- Share Percentage of Obese People in the country
- Share Percentage of People that do physical activity at least once every seven days

For each, the correlation coefficient r will be computed, together with its r^2 and ρ.

The countries for which we have a meaningful share of discourse percentage, determined over 15832 tweets, and that we will correlate with the aforementioned parameters, are: France, Italy, Belgium, Spain, Germany, Netherlands, United Kingdom, Portugal.

3.3.2 Share Percentage of Overweight People in the Country vs. % of Discourse

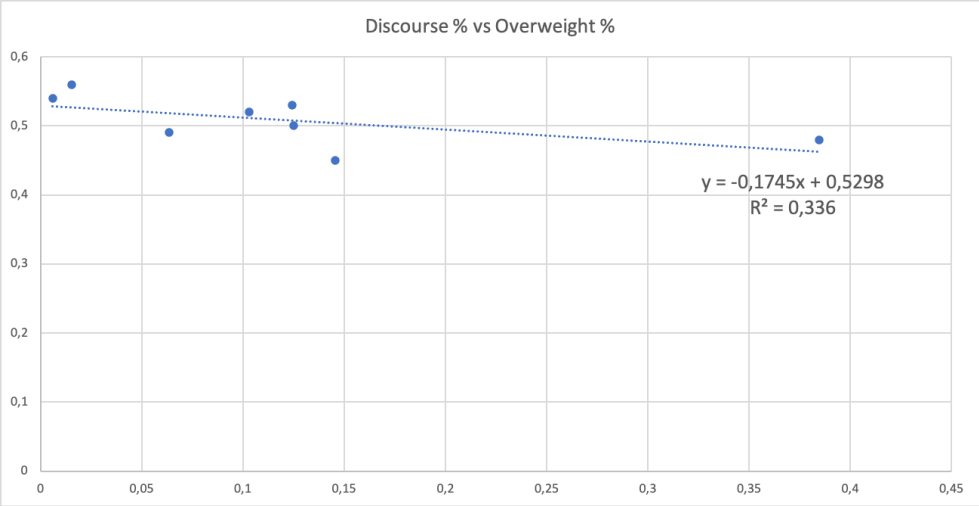

Figure 33: Correlation with Overweight Share of Population

Pearson Correlation Coefficient	-0,579
Spearman Correlation Coefficient	-0,785
R^2	0,336

Table 5: Discourse % vs Overweight % Correlation

By correlating, country by country, the percentage of original tweets concerning the Nutriscore debate and the share of obese adults in said country, we reach a r of -0,579 and a ρ of -0,785 This is a negative, medium correlation, meaning that there is a meaningful inverse relationship between the interest in the debate in the country and the number of overweight people. In different words, The more overweight is the population of the country, the less interest in the EU-wide debate.

The EU countries with the largest share of nationals that are overweight, such as Malta, Croatia, Slovenia and United Kingdom, have little or no conversation concerning the topic.

This is an understandable, yet undesired outcome, as the labels should be seen as a tool to help reduce obesity, so it's in the interest of overweight people that eat unhealthily to implement them. This could be seen as happening because less interest, or simply less push by institutions towards nutritional topics, not only related to Front of Pack labels, leads to weight issues and bad nutrition.

3.3.3 Share Percentage of Obese People in the Country vs. % of Discourse

Figure 34: Correlation with Obese Share of Population

Pearson Correlation Coefficient	-0,297
Spearman Correlation Coefficient	-0,47
R^2	0,0886

Table 6: Discourse % vs Obese % Correlation

The country by country correlation between the percentage of original tweets and the share of Obese people per each country has an r of -0,297 and a ρ of -0,47. Once again, this a negative correlation, and similarly to the previously computed one with the overweight share of the population. This is expected, as obese people are a subset of those identified as overweight. Yet, a lower, albeit negative and still present correlation can be interpreted as a more neutral approach of nationals of countries with a higher share obese citizens towards FoP labels, and the debate in general. While it is better than a stronger inverse relation, it still poses a great threat to their implementation.

3.3.4 Share Percentage of People that practice sports frequently in the Country vs. % of Discourse

Pearson Correlation Coefficient	-0,002
Spearman Correlation Coefficient	0
R^2	$4,49 \times 10^{-6}$

Table 7: Discourse % vs Active % Correlation

The country by country correlation between the percentage of original tweets and the percentage of people that practice sports at least weekly in their respective country has an r of -0,002 and a ρ of

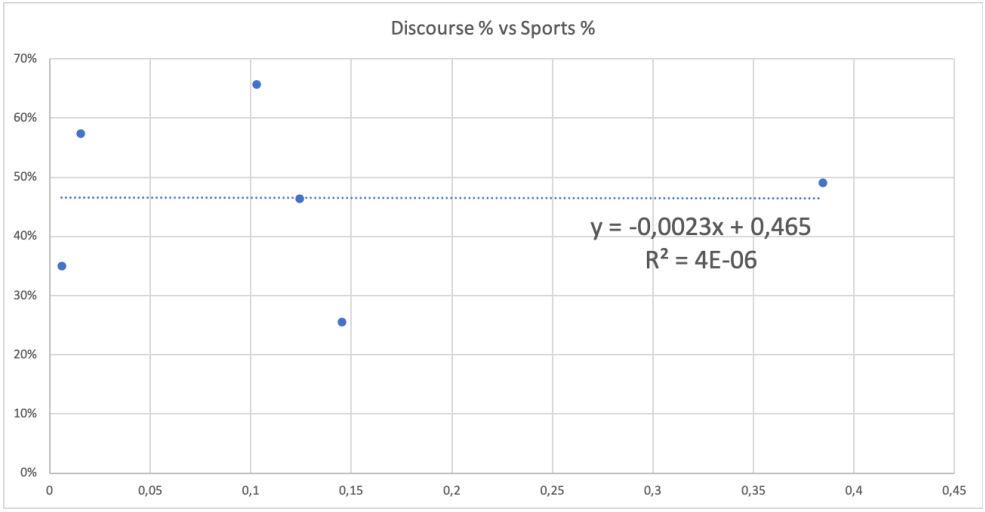

Figure 35: Correlation with Sport-active Share of Population

0. We can thus conclude that, based on our data, no correlation, Pearson or Spearman, exists between sportiness and the interest of people in a healthy and active lifestyle, and their interest or knowledge concerning the Front of Pack labelling schemes.

This is an important, even if negative result, as an active and healthy lifestyle is one of the goals shared by all the healthiness initiatives that work on improving people's lives, and that definitely needs work on.

In the following table we can see a synthesis of the Pearson correlation metrics that we have computed. Aside from the ones that we have already commented, the auto-correlation of the variables is obviously 1. High is also, as expected, the correlation between the share of obesity-affected in the population and that of overweight people.

An interesting element concerns the sports metric. There is a strong, negative correlation between the percentage of overweight nationals and the country's interest in doing sports, meaning that more sport means less overweight people. Yet, the opposite happens when correlating Sports and Obesity, meaning that the Sports variable is not dependent on the physical shape of citizens, and that thus obesity depends on different factors. A more active country as a whole, the positive messages that derive from it, and the peer pressure that comes from it, could be not enough to contrast obesity.

	% of Discourse	% Overweight	% Obesity	% Sports
% of Discourse	1	-0,579	-0,297	-0,002
% Overweight		1	0,928	-0,526
% Obesity			1	0,732
% Sports				1

Table 8: Correlation Summary

In conclusion, the discourse on the topics of Nutrition, and the interest in obtaining an EU-Wide label, are extremely polarized and led by a debate that is first and foremost political, and only after with the interest of citizens in mind. It's become more of a battle between National forces, mainly France and Italy, but it looks like it's more of a matter of national pride and a way to destabilize the European Union than actually an interest in health, and in actually providing the best complementary label.

Even accounting for this bias towards France and Italy leaves a huge imbalance, as EU countries that have the largest shares of overweight population such as Malta or the U.K. do not even take part in the debate, or do so in a very limited form. Let's try to understand why.

61% of the population of **Malta** is overweight, the largest percentage in the entire Union. Some of the contributing factors, not only to obesity, but to a lower interest concerning healthiness and well-being are a huge motorization rate[110], an economy based mostly on seasonal tourism and services and thus a high number of sedentary people, a low GDP per inhabitant and a low general education level[111]. Malta's government has tried to tackle this issue with the "Food and Nutrition Policy and Action Plan for Malta 2015-2020"[112]. Yet, the approach is more focused on educating the population on healthy diets, artificially altering prices to promote good food and to discourage unhealthy nutrients, and to discourage usage of sugary drinks[113]
While the situation seems to tick all the boxes that would make a Front of Pack labelling scheme a very effective tool, the plan briefly names a generic 'better labelling", no specific mention is made to FoP labelling strategies, and no effort whatsoever has been made in that direction.

The **U.K.**, another large offender with 56%, has a very low share of discourse, albeit present in our correlation analysis. The reasons behind it are multiple: first and foremost, the U.K. has already its

[110]http://ec.europa.eu/eurostat/statistics-explained/index.php/Transport
[111]https://www.destatis.de/Europa/EN/Country/Comparison/GER_EU_Compared.html
[112]https://extranet.who.int/nutrition/gina/en/node/23606
[113]https://www.pwc.com/mt/en/publications/assets/weighing-the-cost-of-obesity.pdf

non-mandatory labelling scheme, multiple traffic lights, and a set of guidelines that promote it wildly. As we have said, the debate on these labels is becoming more and more political, so having a proprietary standard could be seen as a matter of national pride. Moreover, the fact that they are in the process of leaving the European Union means there is no leverage, political or whatsoever, in fuelling this debate. So, the reason behind it might be that the country is not interested and that is satisfied by its existing labelling scheme. Nevertheless, by looking at the size of the obese and overweight population, it looks like the label already in place is not successful in its task.

Our correlation analysis shows that the healthier the country the more conversation about the topics happens, thus certifying via a strong inverse correlation that healthier nations are interested in ways to stay healthy, and in new tools they can use. On the other hand, countries with a high share of overweight citizens are not taking part in the conversation. This can be explained by looking at the policies they have enacted to curb Non-Communicable Diseases, that revolve more around either promoting food education and increased taxation or the application of different nutritional labels that are already ingrained in the citizen's minds. Labels that are apparently, not working in the way they should. The communal, choral role of coordination of the European Union is evidently not felt as useful in this area.

This trend has to be inverted: all nations, especially the ones with higher obesity and overweight rates have to be interested, and need to want as many working tools as possible as to fight the non-communicable disease they will incur into. This is not a fight that can be won alone, and governments have to understand it.

3.4 Limitations of the Study & Future Steps

3.4.1 Language and Translation Issues

One of the peculiarities of the debate on FoP Labelling is that is cross-border, and that thus occurs all around the world in different languages. For the scope of our analysis, the important element is understanding *where* the conversation happens. The contents of the conversation, the sentiment or the topics are not the main subjects. Yet, in the optic of a more advanced, targeted approach to employ social media in order to communicate and educate about FoPL, it is important to look at this elements as well.

Yet, these analyses require algorithms to *understand* the meanings of the words, to determine con-

texts, emotions. This can only be done through a training set, specific for each language. Our study has only focused on tweets in English because of the widespread availability of corpora in that language. A future step could be to gain access to commercial-grade training sets to specifically analyze topics and sentiments in a targeted manner.

3.4.2 Politicization & Pollution by Bots

As highlighted by the keywords and topics identified by the textual analysis performed, the debate on Front of Pack Labelling is extremely politicized, and polarized towards a nationalistic stance instead of revolving around healthiness and a better physical conditions for citizens. This also means that the content that we have scraped to is not only published by individuals interested in the labels, but also by citizens that are simply pushing for the political, even populist stance of their parties.

Moreover, a lot of what is said on Twitter is published by bots, "computer-generated programs that post, tweet, or message of their own accord". Political actors employ them manipulate and polarize public opinion, choke off debate, and muddy political issues [Kollanyi et al., 2016].

As identified by our analysis, that on NutriScore and on FoP Labelling in general is a debate that is extremely politicized, and much of it is formed by retweets and duplicates. While removing retweets altogether is a good solution, it is like squatting a fly with a cannon: it not only removes machine-reposted messages but also eliminates messages that do not bring a positive, diverse element to the conversation. The best way to proceed is to employ specific checks, algorithms and studies on the profiles to accurately identify bots and exclude their posts. Specifically, tools and processes developed by [Dickerson et al., 2014] and [Chavoshi et al., 2016] could be employed.

Finally, with the aim of evaluating the relevance of the debate on the topic, and to gauge future educational and knowledge-spreading efforts, the methodology described in this work could be applied to other Social Media platforms as per the defining framework.

3.5 Social Media as a tool to inform on nutrition

Up to now, we have tried to understand whether there is enough online discussion concerning Front of Pack labelling issues, their reception and on how they're used. Let's now try to understand how the opposite can be done: how Social Media can be leveraged to generate online discussions and educate people on the importance not only of said labels, but also of better dietary and lifestyle habits in general.

As we have mentioned multiple times throughout this work, one of the most effective ways to curb the threat that obesity poses not only to individuals but to society as a whole is prevention. If it can be intercepted in children and young adults, by educating them on good nutritional choices and on how to use tools such as Front of Pack labels to make an informed decision on what they're eating, it does not need to be treated when they're older and badly affected by it.

Today, in addition to being influenced by peers, family and traditional media, young adults, which are the main target of obesity prevention campaigns, are continuously exposed to information via social media, which may influence social norms and their behavior[Klassen et al., 2018]. Health, nutrition and food are all common topics posted on social media by food and wellness bloggers, influencers, health organizations and regular users of social media.

Nevertheless, not all social media posts are a form of discussion, or just simple sharing of opinions and information. Advertising, in this instance of food products, increasingly targeted to their specific demographic and tailored to their interests by using powerful analytics tools, is omnipresent on social media. The enormous data profiles that social networks have on us, ranging from age and location to our interests, to what makes us tick, makes these ads very on point and effective.

Yet, this powerful targeting can be used to do good. It is a common opinion that social media provides a great opportunity to directly reach young adults, and help them learn about nutrition and better dietary choices. Specifically, social media platforms can be used as a tool to deliver interventions and health promotion campaigns, increase exposure to evidence-based health messages and encourage young adults to participate and engage with interventions. [Klassen et al., 2018].

Tailoring is an effective method for increasing the relevance of health communication programs, in that it adapts messages to audiences' knowledge, beliefs, circumstances and prior experiences on specific health issues.

Social networking platforms such as Instagram, Twitter, Facebook and even YouTube are full of

influencers, that represent a new type of independent third party endorser who shape audience attitudes through blogs, tweets, and the use of other social media, that have a huge follower-base[Freberg et al., 2011] and that can thus be considered a means to convey this messages.

Content-creating audience members have become particularly influential and act as opinion leaders, introducing new information and ideas to their social circles and setting the agenda for conversations. In particular, a lot of these revolve people around the fitness and food sectors: collaboration with these influencers offers new opportunities to engage with audiences, for example in modeling health behaviors, breaking taboos and initiating conversations.[Lutkenhaus et al., 2019]

A systematic review titled "Social media use for nutrition outcomes in young adults: a mixed-methods systematic review" by [Klassen et al., 2018] has determined that there is a potential to use social media for its social networking and support capabilities by inspiring and soliciting positive feedback from social networking friends, however, for health professionals, this must be managed carefully as professionals may not be able to manage organically created social interactions. In other words, it is complicated to do an influencer's job.

The viability of Social Media as a tool to interact on these topics is still being debated, mostly because of health and overweightness being matters so sensitive and stigmatizing that they require a lot of privacy. Yet social media is renowned for being a great tool for delivering information, and to promote learning.

As it is now clear by the analysis contained in this work, directive labels on their own are not enough. Or better, simply telling customers what to buy and not to buy, and expecting them to blindly follow the directions and ignore any preconception or brand loyalty does not work. A more holistic approach is required, in which people not only are encouraged to avoid unhealthy products, but also to learn why they are supposed to do so. They have to improve not only their eating habits, but their lifestyle as well.

Studies on purely directive labels such as Nutriscore and the Chilean FOP label have shown that while they are easily understandable, people are not satisfied by not knowing what the logic behind a specific rating is. That is even more apparent when talking about reductive labels, because as much as they try to simplify and reduce the information presented to customers, they still require some sort of previous knowledge to be interpreted. It does not need to be much, but it needs to be there.

So, what's best to communicate all these notions than a channel that is already talking about health

and food matters? And not only that, but also that is used primarily by the demographic that every obesity prevention is trying to target?

It is not impossible to envision a worldwide program sponsored by health institutions that works on social media channels to inform and educate citizens, with a particular focus on young adults. Influencers that treat topics related to healthiness, mindfulness and food in general would be a great partner in this endeavor. By partnering with those who seek to raise awareness; promote conversations and/or educate online audiences on specific health issues; and are open to experimenting with collaborative partnerships, health institutions would be able to provide the info that is needed in order to effectively stop obesity and other non-communicable diseases when they can be treated the most. [Lutkenhaus et al., 2019]

Instruments such as community detection and algorithms that allow to identify influencers and opinion leaders, nodes with high centrality in social networks, for example the strategy proposed by "Tailoring in the digital era: Stimulating dialogues on health topics in collaboration with social media influencers" [Lutkenhaus et al., 2019] can make the effort of finding who is best to talk to specific groups easy.

And when if not now? Cloudflare, a network company that powers a huge portion of the Internet, confirms that, during the lockdown phase of the ongoing pandemic worldwide, Internet usage has increased significantly, ranging from + 20% to + 70%[114]. People are locked inside their apartments, and are not only video-conferencing and watching streaming media. They're also consuming a lot of Social Media content, and making more and more online purchases.

For what concerns the former, we have identified a strategy to employ social networks, in which we have determined the discussion in terms of FoP Labels is still limited, to focus and convey targeted information about healthiness.

People, as highlighted in a previous section, need a short and speedily readable way to compare and select healthy food, to spend less time outside and to compensate the unhealthy effects that the sedentary lifestyle that we were forced to adopt has had on everyone. A widespread adoption of Front of Pack labels is a solution, combined with the necessary tools to read and understand them. These tools can be provided by using social media as a learning platform.

Regarding the latter, the increase in purchases made from home are not only related to non-essential

[114]https://thenewstack.io/the-network-impact-of-the-global-covid-19-pandemic/

goods. People have also been getting more food delivered, and are buying more groceries online. This substitutes the physical act of staring at a shelf in a supermarket, looking for the right, and hopefully healthier, product, and provides a great opportunity to shape consumption towards better dietary choices.

Simplified nutritional information can be displayed alongside product listings on a supermarket website: for example, we can begin with a clear, simple and speedily readable FoP label, but can be expanded by clicking and looking at the specific nutritional values. Moreover, comparison can be incentivized, and and unhealthy products can be highlighted while promoting healthier versions in the same way an upsell suggestion is made.

4 Conclusion

For a tool that is supposed to reduce the complexity for customers when choosing what to buy and eat, the state of Front of Pack labelling is undoubtedly quite complicated, not only in Europe, but also all around the world.

The only real agreement is on the fact that there is a dire, urgent need for a revolution in the way customers consume information on the food they buy and eat. There is also agreement on the issues that Front of Pack labels have to solve, and also on the more well-rounded approach that has to be taken in order to educate people on the way they must reshape their lifestyle.

Everything else is still under discussion, and the debate has only increased in the past few years. It has also been embraced strongly by supra-national organizations such as EU and ASEAN, but no end is in sight.

The main discussion is between directive and reductive labels: we argued through our literature review and the best practices that we defined that a hybrid approach is the right way to go. It is important to find the right balance between a simple, readable and quick to consume label that directly provides customers with the means to evaluate a product, and enough information so that they are not overwhelmed but can still make an informed, well-thought decision. And still, there is no agreement on how much simple is too simple, or when too neutral and informative is too much.

In general, there is no agreement on where exactly the perfect label is on the spectrum. What is certain, not only by reviewing the literature, but also in our opinion, is that using a purely directive label to tell customers what to buy and what to avoid is not the right approach, as it only solves the immediate problem. The bigger issue, that is pushing of a societal change in lifestyle, is simply postponed. Moreover, the debate on it seems just an excuse for politics, and not actually health.

And yet, obesity, heart diseases, diabetes and all the other non-communicable disease cannot wait any longer. Health Systems worldwide are already overworked by something that is easily preventable, and that does not require advanced education or specific knowledge for the common citizen to intervene.

Our research has shown, via a Social Media Analytics framework that we have developed, that there is not enough interest in the population that really needs to know and have Front of Pack labelling schemes.

Nevertheless, in the optic of not only guiding customers, but also educating them, especially young

adults that are the ones in which these diseases are most preventable, Social Media is the right tool to intervene. In the current situation of sanitary emergency, in which computer usage has skyrocketed, together with online shopping, these categories of people could have access to much more information on the topics through Social Media: a strategy of partnership between institutions and food-oriented influencers could be a viable means to educate people on the correct usage of labels, and on how to improve their lifestyle in general. All in an accurately targeted effort, that would really have lasting benefits on the health of the population

The framework we have developed can thus be used to target these campaigns on the countries that need it most, and to track their effectiveness in the medium-long term while continuously adjusting and retargeting them.

In conclusion, we have the tools, we are in the right time, and we are the verge of a silent epidemic that we cannot wait to treat any more. So, why wait?

5 Appendix

5.1 Analysis of shopper behaviour in supermarkets pre and post COVID-19

A study by Amobii, a Belgian startup that specializes in the analysis of shopper behavior through modern techniques such as optical 3D sensors to visually track people movements, analyzes customer patterns when shopping for groceries both before and after the COVID-19 outbreak.

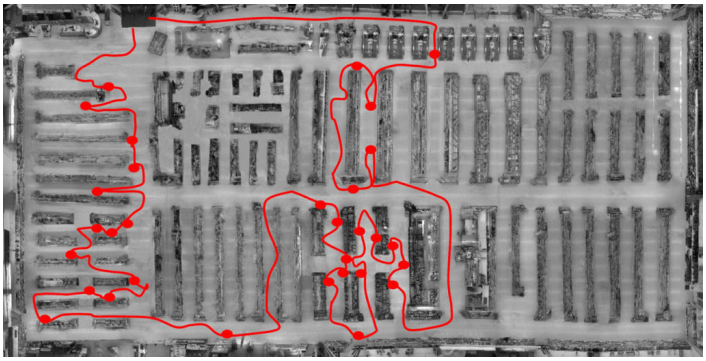

Figure 36: Typical customer journey BEFORE COVID-19

Figure 37: Typical customer journey AFTER COVID-19

From the images above, generated by mapping customer locations and movements inside a supermarket, it is clear that while before the outbreak a shopper would stroll randomly and make very frequent round trips and stops, they currently travel longer distances but no longer make long stops or round trips. [115]

[115] https://www.intotheminds.com/blog/en/covid-19-impact-food-retail/

5.2 Infographic on Twitter Usage

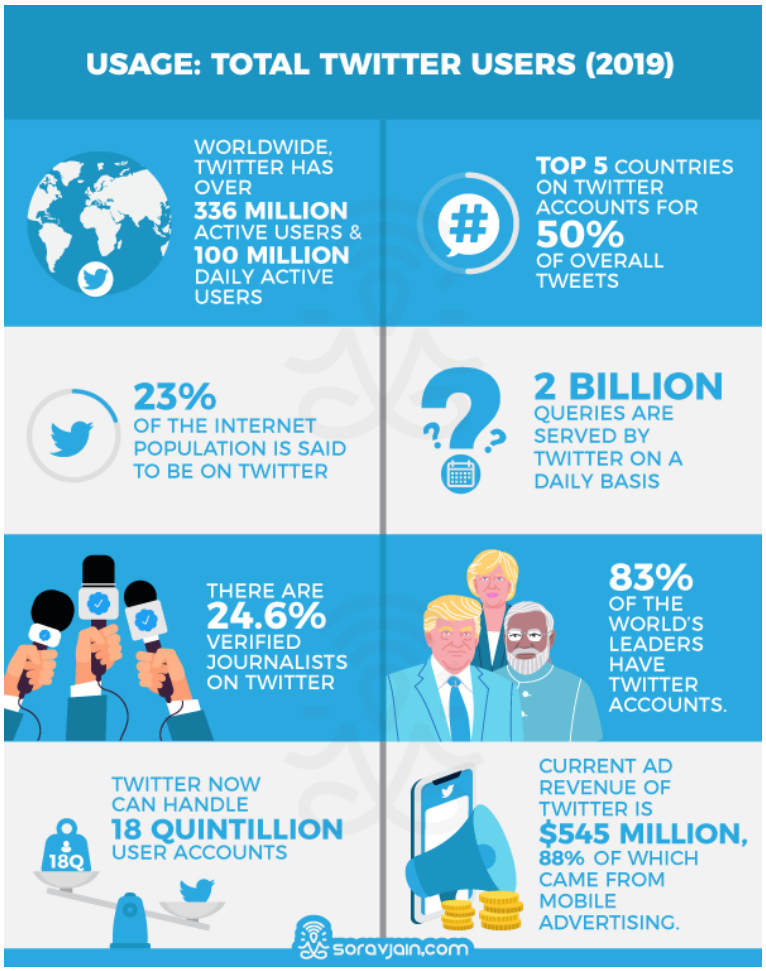

Figure 38: Infographic on Twitter usage data [Jain, 2020]

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Libera Università Internazionale degli Studi Sociali

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Master's Degree in Management of Innovation

Chair of Advanced Marketing Management

FRONT OF PACK LABELLING AND CONSUMER PERCEPTION

Through the Lens of Social Media

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Contents

Abstract

This master thesis examines the relationship between healthiness, eating habits and Front of Pack Labelling.

After an overview on the ongoing overweight epidemic and on the need for a healthier lifestyle, a synthesis of methods to improve dietary habits is discussed. A special focus is on history, features, effectiveness and best practices of labelling schemes with an accent on prevention and education.

Using a Twitter dataset of more than 15'000 elements, this work defines a replicable software method of assessing the effectiveness of FoP labelling schemes via an indirect algorithmic approach. It operates by correlating the machine-processed spontaneous discussion on social media with health-related population metrics, such as mindfulness and overweight rates.

The method is then applied to show that an inverse correlation exists between interest in labels and share of overweight population per country: the higher the share of overweight, the lower the interest. This can be explained by ineffective local policies with different strategies, or by national labelling standards that unfortunately, lead to downplaying the importance of the coordination role of the E.U.

Finally, an outline is presented on how to use the methodology to properly target and constantly re-evaluate the effectiveness of social media educational campaigns on the topic, framed in the current COVID-19 scenario.

Being in a car accident is horrible. Falling down a cliff is horrible. Cancer is horrible. And yet, all these things are unpredictable, and mostly unpreventable. One can live one's life in the best, healthiest, sanest way possible and still be affected by them.

So, why have ever-lasting effects from something that can easily be predicted and intercepted before anything bad happens?

This is the case of so-called non-communicable diseases, such as diabetes, heart conditions and obesity, that depend not only from sheer luck, genetics and environmental factors, but also by active choices of behavior by people. Specifically, by what we eat, how much we eat, and how we conduct our lifestyles.

Who are these people in danger? Not only adults, but children too. Belonging to a lower socio-economic group or living in a disadvantaged area significantly increase the chances of contracting these diseases. It's not only a matter of having enough money to to afford the luxury of eating too much, but also due to lacking nutritional knowledge or policies.

Obesity and overweight, in particular, do not only affect individuals. They have been defined the epidemic of the 21st century, because they are so widespread they put the health-care systems of the entire planet under enormous strain. Think about what we could do if we weren't so busy treating people affected by something that they could have simply avoided contracting.

It is thus a duty of institutions to tackle this issue. Measures must be devised at a global scale, to tackle price, availability and marketing of energy-dense food and drinks, and require high coordination between supra-national bodies, governments and health institutions.

Two are the main institutional approaches in dealing with these issues.

The first one consists in **monetary disincentives**, excises on unhealthy products or, in layman terms, a fat tax. Price is something that is easily understandable, and rises in that of unhealthy products is an effective tool to curb obesity. This taxation is significant when applied to the category of Soft Drink Beverages, or SBBs, which account for a significant percentage of calories consumed worldwide while providing little nutritional value. It can also generate an enormous cash flow, which could be used to support health care systems.

Countries such as France, South Africa and Mexico have had promising results. Yet, there is a substitution effect of excised products with ones that have not gone up in price but have the same amount of sugar, like chocolate over Coke. Moreover, there is the threat of customers just paying the higher price, as it happens with cigarettes.

The solution to this issue is educating customers on why the tax is levied, and why they should consume something else. Education must complement taxation.

Citizens have to know what they're doing wrong, and how they should systematically embrace an active and healthy lifestyle, something very difficult in our sedentary way of life.

This is why the so-called **cognitive approach** has been created. It assumes that people actually want to improve their diet and lifestyle, and would do so with the appropriate information. Yet, it is not easy to know whether what we're thinking of buying to eat is good for us or not. What are the metrics? What does "good" mean? Is "good" something absolute, or does it require an holistic approach that takes into consideration the whole diet? Institutions all over the world, both health-related and not, have been asking themselves exactly these questions, and have been looking for the right way to help citizens with these issues for the last few decades.

One of the tools that have been designed to direct food purchases towards healthy choices, and to simplify the information that customers have to evaluate when deciding what to eat, are **Front of Pack labels**, also known as FoP Labels.

They are defined as a form of **nutrition information** on the front of the pack that either *"repeats some or all of the numerical information from the mandatory nutrition declaration in a neutral or evaluative way"* or *"expresses the overall nutrition value of a food by using some or all of the information from the aforementioned nutrition declaration and/or other nutritional element"*.

These labels are simple, clear, sometimes colorful indicators placed on the front of food packagings, and their aim is to greatly **simplify said nutritional information**, to make comparisons easy and quick. On paper, they are the right tool for the job.

Or at least they should be: there is no agreement on which design is right, nor on what kind of information should be displayed on them, and even their effectiveness has been called into question. One of the biggest doubts is whether they are enough on their own, and if they can work without any prior nutritional knowledge from the customer.

The main stakeholders in this battle are Government agencies and Food Industry players. Many standards have arisen since the late eighties, with completely different ap-

proaches, almost one per state. E.U. countries have been very prolific in creating their own labelling schemes, such as Sweden's Keyhole, U.K.'s Multiple Traffic Lighs, France's Nutriscore and Italy's Nutrinform Battery, all voluntary in application. Other nations such as Singapore, Chile have developed their own versions.

Many are the vested interests in the topic, and sometimes the debate is driven more by national pride or by companies opposing them than by actual interest in people's health. This debate is particularly felt in the E.U. and France's Nutriscore is one of the most prominent contenders.

To understand the different approaches to labelling, together with their pros and cons, the main division happens with the kind of message.

Reductive Labels can be defined as only showing a reduced, standardized, amount of nutritional information to the customer, with no judgment or recommendation whatsoever. While they simplify comparisons, they still present data that has to be read and understood by customers, without a fast and easy way to find out whether the product is healthy or not.

Evaluative or Interpretive labels, on the other hand, employ algorithms that combine nutritional data concerning the product into a single, simple element, a judgment on the healthiness of the product, without presenting any data. Colors are used to express the evaluation on the product, with the usual green as good and red as bad. They can either summarize the product as a whole in an aggregated format, or have one indicator for each individual nutrient.

Nevertheless, **labels are hybrids defined on a continuum, and can contain both simplified nutritional information and an evaluating component for the customer**. Typical aspects of these labels, as identified by Van Der Bend et Al, 2018, include *the nutritional components evaluated, the measurement method, the coverage (whether they're thought for being applied to all product kinds or just a subset), the scoring approach and the tone of voice.*

The **effectiveness** of FoP Labels, presumed or actual, depends on many factors.

They steal away attention from the big, traditional, NFPs, and when present are sometimes one of the few nutritional evaluation points of a customer. This stresses the importance of a fair and objective label, as they can lead clients to simply trust them and overgeneralize the information shown.

They can also **generate confusion**, because of their lack of standardization: having multiple, dissimilar labels with dissimilar designs and no common underlying logic or algorithm does little in terms of helping customers.

A **strong halo effect** is also sometimes present. As labels are not mandatory, the simple existence of a health claim related to the product, even a negative one, wins over not having any claim at all. Customers can infer that an unlabelled product is unhealthier than a labelled one, even when talking about a negatively labelled food. Moreover, as labels can attribute separate scores to different nutritional aspects of a single product, customers may perceive a single health claim as an indicator of overall healthiness: a product that is "good" in fats could be considered "good" as a whole, even if it is 99% salt.

Labels have been shown to have little impact on consumers which have a strong **brand familiarity** with the brand considered. Generally, they are not an effective tool when an opinion on the product has already been formed, but are extremely powerful when evaluating a new product or brand.

Nevertheless, none of this works unless customers actually *want to eat better*. **Labels don't and cannot work on their own**. Taste, cost, brand and convenience have to be taken into consideration when evaluating customer choices. Even the most knowledgeable customers will not always buy what they know is the healthiest food.

Yet, even people that do not possess enough knowledge on the labels or on nutrition could employ them to influence their food purchasing decisions, only if they know how to properly read them.

Labels are not only meant for influencing consumers, but to **promote product reformulation** to improve their nutritional quality.

When faced with two options at the same price and taste, one healthier and one less healthy, customers will go for the former. **A manufacturer will never want to find itself in a position in which another product is preferred to its own**. If the indication comes from a scientifically accurate, independent nutritional label, the only way to become competitive again is to change the product to make it healthier.

In synthesis, the effort of bodies promoting healthier eating habits should be two-fold. On one hand, it should *promote a widespread adoption of FOP labels to educate customers* on what they're eating, to pick the healthier option. On the other hand, by accompanying the introduction of labels with a *push towards reformulation*, they could make a real difference in consumers' health.

We always have to keep in mind that **the small goal is to have people eat better, but the large picture is to improve one's lifestyle, and to prevent diseases that can easily be intercepted**. This can only be done by promoting knowledge and education on the topics.

All of this is particularly relevant in the current setting, in which the **COVID-19 pandemic has forever changed the way we live our lives**. We have been locked in our houses for months, doing **much less physical activity** and **our eating habits have worsened as well**, with products such as canned food or sweets. Less visits to hospitals also translate to less screening for illnesses that became statistically more evident when paired with overweight, such as heart issues. All things that are easily preventable by changing eating habits. *We need to eat and live better, and we need to do it now.*

Shopping patterns have changed drastically. People spend much less time in supermarkets, and leave home knowing exactly what they want. They cannot afford to waste time comparing products and understanding which one is healthier, and this could be easily be solved by a simple FoP label.

Moreover, **much more shopping is done online**, and thanks to the simplicity of these systems consumers are willing to try different foods and brands, even considering healthier options that they would have ignored in the past. Not being limited by the phys-

ical space on a food package can lead to more information being provided to the customer on their devices, and what better than digital FoP labels?

Up to now, we have provided the reader with a comprehensive overview of why FoP labels exist, how they're created, and their strengths and weaknesses. We have analyzed consumers' response to them and the measure in which they affect food purchasing behaviors.

On paper, this should be enough to create the perfect label, the presence of which can thus be correlated with an increase in health in the population.

Yet, all the surveys on existing FOP Labels that specifically ask respondents what they think are actually asking for customers to focus on them. They subsequently might show a bias that cannot easily be adjusted for.

We have thus proceeded in the definition of a **replicable software method of assessing the effectiveness of Front of Pack labelling schemes via an indirect algorithmic approach**. This work will analyze the *spontaneous machine-processed discussion on social media* that is related to them, with a specific focus on Twitter.

The final goal of this project is to create a working, actionable framework to gauge interest and effectiveness of Front of Pack labelling schemes on Social Media, composed by analyses that can be used to evaluate the country-specific effectiveness of these labels by correlating the discourse with some health-related population metrics, such as mindfulness and overweight rates.

Of course, this has to be inserted in a wider, more comprehensive information, education and knowledge sharing initiative: we know that labels work best when accompanied by knowing what they mean and most importantly how to properly use them. As Social media is so ubiquitous and has the instruments to deliver a tailored, targeted message, it could be the right tool to do so.

The **methodology** we have devised is **iterative**, and can be easily adjusted en-route with the intermediate data, in order to achieve the most precise results.

We began by **assessing different social media sites and platforms** through a framework we have created, looking for an easily accessible source of information that can be crawled through, to acquire a sizable quantity of textual data on the topic, formatted in a standardized way.

Spontaneity of the discussion is also an important factor: usually, people that take time to comment on a food-related forum are more educated on the topic of health, diet and food labels. This means their point of view is somewhat different from that of the general population, which we're trying to understand and influence.

By looking at all these elements, **Twitter has been selected**, as it satisfies our requirements.

In brief, Twitter is a "microblogging" system that allows users to send and receive short posts called *tweets*, that can include links to relevant websites and resources. It has more 500 million monthly active users worldwide.

It is structured as a directed graph: the nodes are the users, and the relationships between nodes, the edges, are established by a "follow" structure. Each user can decide to follow a number of other users, and can be similarly followed by others. They can create their own tweets or can **retweet** other people's tweets, sharing the content on their profile, usually as a form of endorsement.

All of this is accessible through software APIs, to retrieve a single tweet object with its text and all the corollary information such as geolocation.

The next phase is the **selection of keywords**, that are going to be used to search tweets related to the general topic of FoP labelling in order to generate a specific and correct dataset. The less specific the keywords, the bigger the dataset. Yet, as we have no way of having the software distinguish the actual meaning of the sentence, there is a requirement of specificity.

The **comprehensive literature review** we have performed is the source of the majority of said elements, as it comprises a vast number of specific terms related not only strictly to labels, but also to the health concepts that labels target.

It is important to **exclude false positives** and unrelated tweets as much as possible to avoid ambiguity. For example, a search for Nutriscore is 100% certain to give results that are related to the label but `Multiple Traffic Lights` will give many results related to traffic.

An **iterative approach** is thus employed: the search query has been adjusted by looking at the results of the initial one, in order to filter out unwanted or unnecessary elements. A specific focus has been placed on **tweets originating from the E.U.**, to understand more the ongoing debate on a single, shared, label framework for member states.

Starting from the query `Nutriscore OR Keyhole OR Multiple Traffic Lights OR Healthier Choice Symbol OR nutrition OR labelling OR fop label OR front of pack OR nutrients` we have gradually reduced it to look only at tweets concerning `Nutriscore`.

Subsequently, we defined the **analytical tools** to be used in order to **extract meaning** from the conversations in the dataset. All the code has been written in Python 3 and Jupyter Notebooks. It employs NLTK for advanced natural language processing and analysis, LangDetect for language detection, VADERSentiment to determine sentiment and polarity scores, and Pandas and Seaborn for statistical analysis and visualization. These are all open-source tools.

For each tweet, we performed

1. Elimination of Duplicates and Retweets
2. Determination of the language through a specific algorithm
3. Extraction of the country
4. Tokenization via Natural Language Processing

5. Sentiment Classification

After these steps, the dataset was combined and evaluated, in order to determine:

- Conversational Topics - what are the topics that involve Front of Pack Labelling? Why is the conversation happening? (Most Frequent Keywords, Hashtahgs, Word Cloud)
- Country and Language Share of the conversation - Which countries participate the most to the debate? In which languages does the debate happen?
- Overall Sentiment - What is the overall opinion of the topic?

After, we determined **whether a relationship exists between interest in Front of Pack labelling schemes, participation in the ongoing debate, and interest in health in general**. The interest in the labels is represented in the **per-country share of conversation** as per our iterative research query, and the interest in health is defined as **dependent on the share of overweight, obesity and physical activity**, derived from Europe-wide surveys made by EUROSTAT.

Pearson and Spearman correlation coefficients r, ρ and r^2 are thus computed between the variables, in order **to determine whether a relationship exists, direct or inverse, and the magnitude of said relationship**.

The Sankey diagram in Fig. 1 highlights the subsequent stages of filtering that have been made on the initial dataset. **15832 tweets were retrieved**, posted in the six months between 01-01-2020 ad 01-06-2020. After removing duplicates as per our algorithm, we are left with 5138 tweets, that have been split per country and per language.

Removing retweets and duplicates is important in the analyzed time frame because many are being republished under the direction of political leaders, both by people and by bots, to influence the perception of the debate. Such is the case for Italy, for example, in which the majority of retweets are political.

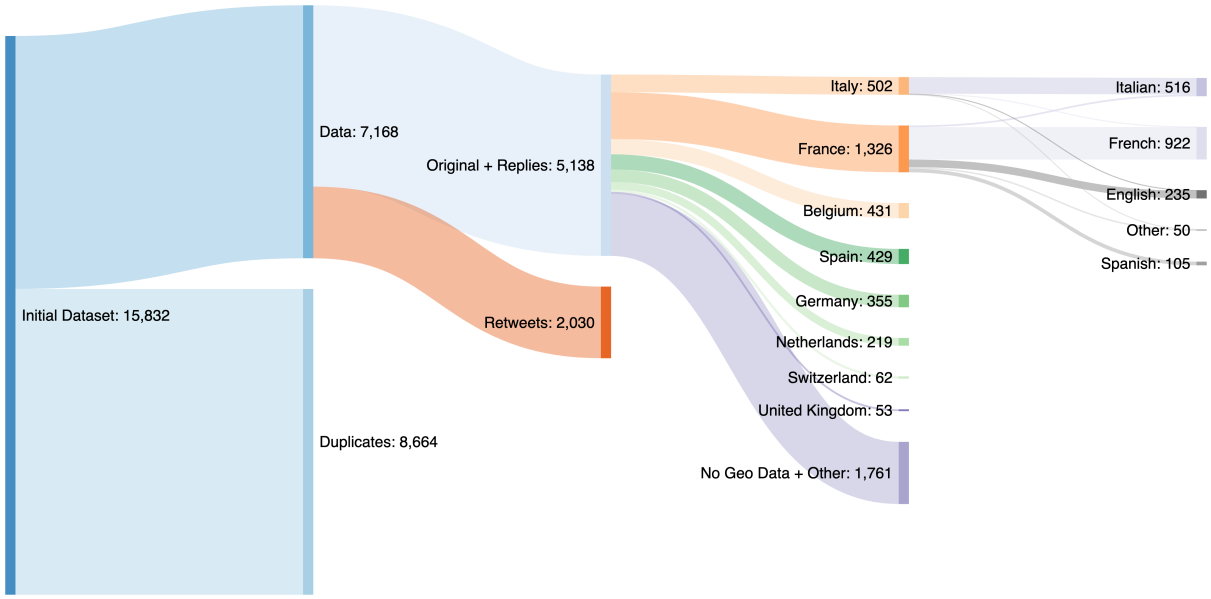

Figure 1: Sankey Diagram of the Dataset

We have determined the most active countries to be France, Italy, Belgium, Spain and Germany. Topics wise, as per the word-cloud in Fig. 2, `Nutriscore` takes up the majority of the discussion space, alongside words such as `battaglia` and `pronutriscore` that highlight the contrast at an European level.

Interesting is also the appearance of brand names such as `Danone`, `Nestlé` and `Coca Cola`. The Coca Cola vs Parmesan example is usually, and sometimes superficially, used by Nutriscore detractors in order to exemplify the alleged inferiority of the label. They say that the Nutriscore model has a fallacy because it rates Coke higher, and thus healthier, than Parmesan. While this is true, it depends on the fact that, by design, the label should not be used to compare different product categories. The other two are brands that are in favour of using Nutriscore, and that are actually employing it voluntarily on their packages.

The presence of this rhetorical statement highlights how **politicized the discussion around FoP labels, and Nutriscore in general, is**. And what is more politicized than the presence of `fratelliditalia`, `giorgiameloni` and `matteosalvinimi`, respectively the name of a Italian party and of an Italian politician that are strongly opposing the label and promoting `batteria`, the Italian Nutrinform Battery? While it is true and fair, as the Italians are saying, that Nutriscore does not take into consideration the full diet and only rates a single product in a vacuum, it's **more of a battle against France and a**

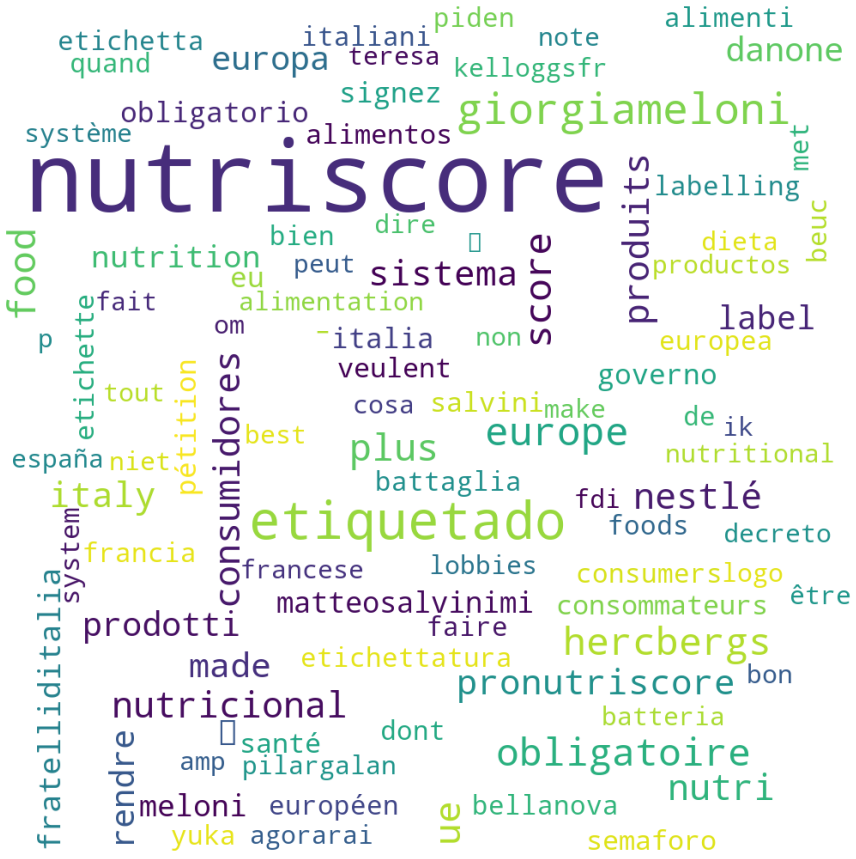

Figure 2: Word Cloud

perceived attack on made in Italy.

Nevertheless, **the discussion appears to forget what the labels should do**. No mentions to the purpose of labels, with words such as *obesity, overweight, activity, fitness* are made, thus reducing the debate only to something related to the labels themselves.

For what concerns the **Sentiment Analysis**, our calculations, albeit limited the tweets in English, indicate that **the topic is generally well perceived by tweeters**, and that the majority tweets can be seen as **promoting the concept of Front of Pack labelling instead of opposing it**.

And now, onto the core of our analysis, **to determine whether a relationship exists between the selected healthiness and mindfulness indicators, and interest towards the ongoing debate on Front of Pack labels.**

The countries for which we have a meaningful share of discourse percentage, determined over 15832 tweets, and that we will correlate, are: France, Italy, Belgium, Spain, Germany,

Netherlands, United Kingdom and Portugal.

We have determined that there is a **meaningful inverse relationship between the interest in the debate in the country and the number of overweight people**. In different words, the more overweight is the population of the country, the less interest in the EU-wide debate.

The EU countries with the largest share of nationals that are overweight, such as Malta, Croatia, Slovenia and United Kingdom, have little or no conversation concerning the topic.

This is an understandable, yet undesired outcome, as the labels should be seen as a tool to help reduce obesity, so it's in the interest of overweight people that eat unhealthily to implement them. This could be seen as happening because less interest, or simply less push by institutions towards nutritional topics, not only related to Front of Pack labels, leads to weight issues and bad nutrition.

Moreover, **no correlation has been found between discourse and active lifestyle**. This is an important, even if negative result, as an active and healthy lifestyle is one of the goals shared by all the healthiness initiatives that work on improving people's lives, and that definitely needs work on.

In conclusion, **the discourse on the topics of Nutrition, and the interest in obtaining an EU-Wide label, are extremely polarized and led by a politicized debate**. It's become more of a battle between National forces, mainly France and Italy. It looks like matter of national pride and a way to destabilize the European Union instead of an actual interest in health.

Even accounting for this bias towards France and Italy leaves a huge imbalance, as **EU countries that have the largest shares of overweight population** such as Malta or the U.K. **do not even take part in the debate**, or do so in a very limited form.

Our correlation analysis shows that the healthier **the country the more conversation about the topics happens, thus certifying via a strong inverse correlation that healthier nations are interested in ways to stay healthy, and in new tools**

they can use. On the other hand, countries with a high share of overweight citizens are not taking part in the conversation.

This can be explained by looking at the **policies they have enacted** to curb Non-Communicable Diseases, that **revolve more around either promoting food education and increased taxation or the application of different nutritional labels** that are already ingrained in the citizens' minds: labels that are apparently not working in the way they should. The role of coordination of the European Union is evidently not felt as useful in this area.

This trend has to be inverted: **all nations**, especially the ones with higher obesity and overweight rates, **have to be interested**, and need to want as many working tools as possible as to fight the non-communicable disease they will incur into. **This is not a fight that can be won alone**.

Social networking can have a pivotal role in this time, to **educate** customers on how to use and read the labels for their own best interest.

This is true especially for concerning **young adults**, the ones in which these diseases are most preventable. In the current situation of health emergency, in which computer usage has skyrocketed, together with online shopping, these **categories of people could have access to much more information on the topics** through Social Media.

A strategy of partnership between institutions and food-oriented influencers could be a viable means to educate people on the correct usage of labels, and on how to improve their lifestyle in general. All in an accurately targeted effort, that would really have lasting benefits on the health of the population

The framework we have developed can thus be used to target these campaigns on the countries that need it most, and to track their effectiveness in the medium-long term while continuously adjusting and retargeting them.

In conclusion, we have the tools, we are in the right time, and we are the verge of a silent epidemic that we cannot wait to treat any more. So, why wait?