Digestible information: The impact of Multiple Traffic Light nutritional labeling in a developing country

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DIGESTIBLE INFORMATION: THE IMPACT OF MULTIPLE TRAFFIC LIGHT NUTRITIONAL LABELING OVER CONSUMERS' DECISIONS IN A DEVELOPING COUNTRY

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Abstract—Bad dietary habits are among the main causes of increasing obesity and other health problems. According to the literature, information asymmetry and cognitive biases may lead to suboptimal decisions by individuals regarding food consumption. Many countries have implemented different forms of nutritional labelling in order to provide individuals with better information when making choices. We assess the Multiple Traffic Light (MTL) system, an alternative and simplified labelling format implemented in the UK. Although this system has been found to significantly improve consumer's understanding of nutritional quality, evidence regarding its effect on actual choices is scarce and uncertain. In order to evaluate this format's effectiveness on consumer decisions, we conduct a selection experiment with a particular sample: university students in a developing country. Our results show that the proposed nutritional labeling system has a significant positive effect on the nutritional quality of consumers' decisions regarding snacks and beverages. These findings contribute to the existing literature in two ways. First, we prove that MTL labels can in fact modify real consumer behavior towards healthier nutritional habits, despite the difficulties faced by previous work in identifying such an effect. Second, we provide new insights on how to assess the increasing problem of bad nutrition in emerging economies.

Key words: Nutritional labeling, Developing Countries, Experiment

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1. Introduction

According to a recent report from the World Health Organization, the incidence of obesity has more than doubled since 1980. In 2014, 39% of adults in the world were overweight, while an alarming 13% were obese. These conditions imply an excessive fat accumulation that may lead to health problems, especially when they start during childhood or adolescence. Specifically, scientific evidence shows that obesity and overweight are major risk factors for cardiovascular and respiratory diseases, diabetes, musculoskeletal disorders, and many kinds of cancer (World Health Organization, 2016). This alarming trend has several social costs. For instance, obesity is responsible for roughly 5% of global deaths and its economic burden is estimated to be around 2.8% of the world's GDP, which is equivalent to the impact from smoking or armed violence (McKinsey Global Institute, 2014). Moreover, many low and middle-income countries are becoming increasingly vulnerable to this problem, which adds to the already poor nutritional conditions of their populations (Popkin et al., 2011). Although the main cause of obesity is excessive consumption of food with high contents of fat and sugar, low-quality food industries are growing consistently all over the world while the prices for this kind of products are decreasing (Currie et al., 2010).

Increasing awareness of the relationship between food and health has led to a wide range of policies aimed at improving eating patterns. One major instrument that has been adopted worldwide is nutritional labelling, which attempts to provide consumers with information about the nutritional content of individual products at the point of purchase. Unfortunately, the results of these labelling policies have not been as straightforward as expected. Particularly, consumer understanding of labels has been found to be limited when the information provided is too detailed, and label use seems to be very heterogeneous among different social groups. According to some authors, this pattern can be explained by the costs of acquiring and processing nutritional information, which may be higher than the potential benefits of using it (Drichoutis et al., 2005). Alternatively, behavioral economists have stressed the role of cognitive biases in people's decision-making, which may lead to suboptimal behavior in the long term (Liu et al., 2013). Both views suggest the need of presenting information in a simpler way that highlights critical information, in order to improve consumers' choices without limiting their set of options.

Based on these findings, many countries are implementing different types of simplified label formats. However, each display is based on definite nutritional criteria that may lead to different outcomes and are susceptible to industry manipulation (Hawley et al., 2012). Therefore, it is important that these systems be validated by the literature in terms of their impact on real consumption decisions. In this research, we will focus on one specific labelling system called the "Multiple Traffic Light" (MTL). This format indicates the levels of four key nutrients present in most packaged foods in the form of a traffic light for easier understanding. We chose this specific format due to the evidence supporting its effectiveness. In fact, recent evaluations have found that this system is effective in improving consumer's understanding of the nutritional quality of their options, in comparison to other proposed labels (Campos et al., 2011).

However, there are surprisingly few studies assessing the real effects of the introduction of MTL labels on consumer behavior. This may be related to the fact that controlled experiments may lack external validity, while field experiments are very hard and costly to design and implement. Moreover, the few studies that have addressed this issue have found mixed evidence (Volkova & Ni Mhurchu, 2015). On the one hand, some failed to identify a clear improvement in dietary patterns after the introduction of MTL labels, using field data in settings as diverse as university cafeterias, supermarkets, and virtual shopping simulations (see Seward et al., 2016; Sacks et al., 2009; Borgmeier & Westenhoefer, 2009). Balcombe et al. (2010), on the other hand, found that the MTL system improves consumers' choices between different baskets of goods by employing an experimental setting.

The aim of this study is to contribute to the literature on MTL labels by providing further evidence on whether the introduction of this system can improve real behavior, in addition to its effect on consumers' understanding of the nutritional properties of labeled products. For this purpose, we conducted a randomized experiment where participants were offered a choice between three different options in two different food categories (crackers and beverages). As opposed to other experimental studies, we limit the test to a choice between individual items, which allows to isolate the effect of the introduction of MTL labels on consumers' decisions in a controlled setting. Additionally, we account for two important determinants of food choices: previous nutritional knowledge and interest for a healthy diet. Controlling for these variables allows us to identify the direct impact of the treatment on the choices made by consumers.

Furthermore, our study centers on a specific demographic group: students in a Peruvian university. This is relevant in two ways. First, young and educated individuals have been found to be among the more prone to using nutritional labels (Grunert & Wills, 2007), which allows for a better evaluation of the effect of actually processing the information provided on their final decisions. Second, most of the literature on the effect of MTL labels over consumers' choices has focused on developed countries. However, trends in food consumption in developing countries make it necessary to assess the effectiveness of labelling systems in these countries. In particular, overweight and obesity levels in Peru have experienced a significant increase in the last decades. Between 1975 and 2005, the percentage of adults with overweight raised from 24.9% to 32.6%, while obesity rose from 9% to an alarming 14.2%. By focusing on a developing country, we provide new evidence on how systems like the MTL can improve consumption habits in a context that has not been studied enough yet. Moreover, developing countries' specific characteristics most likely lead to different needs in terms of policy actions.

The structure of this paper is as follows. In Section 2, we review the previous literature on the effects of nutritional labelling and, more specifically, the MTL system. In Section 3, we present our methodology. Specifically, we explain the motivation, design, and implementation of our theoretical and experimental tests separately. Section 4 then presents the results of both tests, as well as a discussion of some of their implications. Finally, Section 5 concludes.

2. Literature Review

Nutritional labels are widely accepted nowadays as a way of providing useful information to consumers to help them make healthier decisions when choosing what to eat. One of the main advantages of this method is that it reduces the costs of searching for information without manipulating consumers' choice (Grunert & Wills, 2007). Theoretically, it is based on the ideas of Stigler (1961), who suggests that asymmetry of information may lead to a suboptimal equilibrium in the market. Assuming that individuals act rationally when choosing their food, this author's model implies that the provision of perfect information should lead to better decision making among consumers.

However, recent literature on the impact of nutritional labels has found mixed evidence regarding this theory. In a comprehensive literature review, Cowburn and Stockley (2005) report that while self-reported use of nutrition labels is high, actual use tends to be significantly lower. Additionally, comprehension of nutritional labels considerably decreases with the complexity of the information displayed. More recently, further studies have focused on the effects of the availability of information on dietary habits. While some of them found that consumers make healthier choices when provided with nutritional labels (Kim et al., 2000; Burton et al., 2006; Chu et al., 2009), others have stressed that these improvements are very modest and usually restricted to certain demographic groups (Variyam & Cawley, 2006; Downs et al., 2009).

Many authors have proposed reasons why the provision of information alone may not produce the desired outcomes in dietary habits. A first theory considers that individual use of nutritional labels depends on how the costs of acquiring and processing information compare with its potential benefits (Drichoutis et al., 2005). Following this view, consumers who take longer to understand complex labels or do not consider a healthy diet particularly desirable are less likely to use the information provided, as the additional costs probably outweigh the perceived benefits of doing so. Empirical evidence supports these ideas. Many studies have found that individuals with lower socioeconomic status and education attainment find it harder to understand nutritional labels (Campos et al., 2011), while personal factors like literacy and numeracy skills (Rothman et al., 2006) and previous nutritional knowledge (Méjean et al., 2011) also have an important role. In this regard, presenting information in a way that makes it easier to understand could help reduce its processing costs among these groups, leading to better health outcomes.

A second explanation for the observed effects of nutritional labelling has been developed by behavioral economists. According to Daniel Kahneman (2011), human judgement can be decomposed into two differentiated systems of thinking: one that is fast, instinctive and emotional ("System 1"), and one that is slower, logical and reflexive ("System 2"). As a result of the tendency to favor System 1 in certain situations, individuals are subject to different types of cognitive biases that may lead to suboptimal decisions concerning dietary habits. Based on this theory, Liu et al. (2013) point that the main biases affecting food choices are the tendency to overemphasize immediate benefits, the prevalence of short-term desires over long-term self-interest, and the preference for default options. These authors propose to adopt the concepts developed by Thaler and Sunstein (2008), who argue in favor of a new paternalistic approach to policy that focuses on *nudging* individual behavior toward self-interest, but without limiting their ultimate freedom of choice. According to this view, policies should attempt to improve label display in order to highlight the most important information, thus directing consumers' judgment towards healthier nutritional choices.

Due to these findings, many alternative labelling formats have been proposed in different countries. These new systems intend to highlight the most important information in a way that makes it easy to interpret, in order to reduce the costs of using it and avoid the prevalence of cognitive biases. One of these formats is the Multiple Traffic Light label, which we evaluate in this study. A review of the literature assessing the effectiveness of different labelling formats reveals that the MTL label has consistently been found to be among the highest performers in terms of improving consumer's identification of healthy foods in different settings and countries (Feunekes et al., 2008; Kelly & Hughes, 2009; Gorton et al., 2009; Roberto et al., 2012; Maubach, Hoek, & Mather, 2014). Additionally, it also appears to perform better at capturing the consumer's attention, which is essential for the processing of information (Becker et al., 2015).

Despite the evidence in favor of MTL labels, fewer studies have been able to identify changes in real behavior after the introduction of this system. For example, two studies, which employed short-term supermarket sales data before and after the implementation of the MTL label in the UK and Australia respectively, found no significant effect on the purchase of healthier products (Sacks et al., 2009; Sacks et al., 2011). A similar method was applied in the US, where Seward et al. (2016) implemented a seven-week MTL intervention at university cafeterias to evaluate its impact on the clients' decision patterns. However, the sales of healthy items in treated cafeterias remained roughly similar to those in the control group. Finally, a randomized study in Germany confirmed that MTL is the most effective label format regarding understanding by consumers. Still, when running a simulated shopping situation, the choice of food was not significantly influenced by exposure to these labels (Borgmeier & Westenhoefer, 2009).

Balcombe et al. (2010), on the other hand, did find a positive impact from the introduction of MTL labels. These authors employed a choice experiment to identify the effect of the MTL system in consumers' choices between different baskets of goods. Their results show that individuals with access to MTL nutritional labels have higher willingness-to-pay for healthier baskets, though these preferences vary between socioeconomic groups. Although our work resembles this study in terms of the experimental setting, our design differs in the quantity of the products considered in the experiment. While they focus on the increased complexity of choosing between different combinations of items, our experiment captures how exposure to simplified information affects the comparison between individual products. In that sense, our setting might be closer to the one employed by Borgmeier and Westenhoefer (2009), although theirs was a virtual shopping situation. Thus, we believe that generating a context were individuals have to make real choices increases the reliability of our results. In general, the lack of conclusive evidence regarding the effect of MTL labels on consumer decisions leaves a gap that calls for further studies on the topic.

3. Methodology

As we already mentioned, in this study we focus on one specific alternative nutritional labelling format: the Multiple Traffic Light system. This system was recommended in 2006 by the UK Food Standards Agency, and implemented voluntarily by many businesses afterwards (Malam et al., 2009). As we intend to assess the impact of better knowledge on actual consumer's behavior, it is useful to choose a labelling system that has been proven to improve consumer's understanding (see the discussion in the previous section). In particular, the standard MTL format indicates levels of four key nutrients present in most packaged foods, and classifies the content of each of them into three categories associated with a color.

However, in our experiment we considered only three nutrients (fat, sugar, and sodium) and four color categories: red (very high level), orange (high level), yellow (medium level), and green (low level). In order to ensure that consumers notice the information provided, we followed the guidelines proposed by Roberto and Khandpur (2014) for the display of nutritional labels. Therefore, our label was presented on the front part of the package, besides the name of the product, and in a size that was not smaller than 20% of the label. Each nutrient was presented in the corresponding color and complemented by a text indicating the level category. Additionally, the background of the label was white to increase the probability of capturing the consumer's attention. In Annex 1, we provide two examples of fictional labels.

In order to assess the effectiveness of out proposed MTL label, we conducted a two-staged experimental test. Each stage had a different objective. In particular, the theoretical test was designed to assess the effect of MTL labels on the understanding of nutritional quality among Peruvian university students. The experimental test, on the other hand, intended to evaluate whether improved understanding has a real effect on consumers' real food choices. Both experiments were conducted with completely different samples of students at Universidad del

Pacífico. This was done in order to prevent experimental subjects from getting used to the labelling format or adjusting their behavior prior to the second test. In this section, we will describe in detail the motivation, design and application of each of the two stages of the study.

3.1 Theoretical test

In the first stage, we employed a survey to determine the extent to which the MTL system improves consumers' understanding of nutritional labels and their perception of the nutritional quality of different types of food. Although many studies have shown that simplified labels like the MTL format are easier to process by consumers, we considered that it was necessary to validate those conclusions in our setting for two reasons. First, very few studies have tested this hypothesis in the context of an emerging country like Peru. Second, knowing beforehand that MTL nutritional labels have an impact on consumer's understanding of nutritional quality will facilitate the understanding of the mechanisms through which this system could affect real decisions. As we are interested in determining the extent to which the provision of better information may alter the market equilibrium, our identification strategy requires us to be sure that the treated individuals have in fact understood this information.

The selected sample for this stage consisted of 60 students, which were randomly distributed into a treatment and a control group. Despite the application of a random process to pick the participants, the final sample presented slight differences regarding sex and age between both groups (see Table 1). However, we do not think that this is determinant for our conclusions, as this stage was conducted as a pilot test. Once the participants had been assigned to a group, they filled a survey that was identical except for the use of the MTL labels in the case of the treated group. The first section of this survey was aimed at gathering information regarding the individuals' nutritional knowledge and their interest for a healthy diet. In order to obtain reliable measures of these two variables, the questions in this section were designed with the help of a professional nutritionist. This is particularly important, as literature has shown that both knowledge and interest for health are directly related to the effect of nutritional information on consumers' decisions. As a result of this process, two technical questions were included to quantify nutritional knowledge, while a Likert-scale item captured self-perception of nutritional habits (see Annex 2 for the complete survey).

TABLE 1
DESCRIPTIVE STATISTICS: THEORETICAL TEST

	Treatment Group	Control Group
Age	20.333	19.667
	(1.918)	(1.971)
Sex	0.333	0.5
	(0.48)	(0.5085)
N	30	30

Notes: Mean Values and standard deviations are displayed for each variable and by treatment group. Age indicates the age in years of the subject. Sex is a dummy that indicates whether the subject is female ("1") or male ("0"). All subjects in our sample were enrolled students at Universidad del Pacífico (Lima, Peru) in 2015.

The second section of the survey consisted in a set of exercises in which participants were asked to choose the healthiest option among a group of personal food items of the same category[2]. We used two different baskets comprised of four goods each: one with different types of soft drinks and another with salty packaged snacks. For each basket, participants answered two questions. In the first one, they were required to identify the healthiest item based on pictures of each product. This section intended to measure their intuition regarding the nutritional quality of the products presented. In the second exercise, participants were presented with the complete and uniform nutritional tables of the same products, as an input to identify the healthiest item. It is important to note that, in the second case, the nutritional labels were not explicitly linked to their corresponding product. Therefore, participants made their choice based exclusively on their interpretation of nutritional information. Naturally, only the surveys provided to the treatment group included the MTL labels, both for the picture and the nutritional table questions.

3.2 Experimental test

In the second stage, a choice experiment and a survey were designed to identify the impact of MTL labels on the consumers' actual choices. A new sample of 100 students, randomly assigned to treatment and control groups, was used in this test. A comparison of means between groups shows that the sample was balanced regarding sex and previous nutritional knowledge, while a significant difference was found between the age distributions (see Table 2). However, it will be proven that age is not a significant determinant of nutritional choices in our sample, which makes it unlikely that our results are biased due to this issue. Before completing the survey, each

[2] All the nutritional rankings of item baskets used in this research were developed with the support of a professional nutritionist.

participant was asked to pick a beverage and a pack of crackers among three options respectively. This was done before the students knew what the survey was about, in order to prevent them from modifying their conduct towards what they consider to be *desired*. Both baskets were comprised of products with similar prices but different nutritional quality. In a setting similar to the theoretical test, only the treatment group was offered products with MTL labels on them, while the control group received the same options but in their usual displays (see Annex 3).

TABLE 2
DESCRIPTIVE STATISTICS: EXPERIMENTAL TEST

	Treatment Group	Control Group	Difference
Age	20.72	18.9	-1.82***
	(0.277)	(0.324)	(0.426)
Sex	0.46	0.48	0.02
	(0.071)	(0.0713)	(0.101)
Question 1	3.04	3	-0.04
	(.136)	(.127)	(.187)
Question 2	799.6	538.5	-261.1
	(359.098)	(103.976)	(373.848)
N	50	50	

Notes: Mean Values and standard deviations are displayed for each variable and by treatment group. Age indicates the age in years of the subject. Sex is a dummy that indicates whether the subject is female ("1") or male ("0"). Question 1 is a discrete variable that indicates individual self-perception of nutritional habits. It ranges from "1" (very bad nutritional habits) to "5" (very good nutritional habits). Question 2 indicates the absolute difference between the subject's guess of the recommended daily caloric intake and its real value (2000 kcal). All subjects in our sample were enrolled students at Universidad del Pacífico (Lima, Peru) in 2015.

After making their choices, participants anonymously responded to a short survey that can be found in the Appendix. This allowed us to gather information regarding control variables: sex, age, interest for healthy eating, and previous nutritional knowledge. The last indicator was generated using the same questions that were employed in the theoretical test, while interest for healthy eating was identified by a self-perception Likert-scale item. Additionally, students presented with a set of questions similar to the one employed in the theoretical test. In this case, participants were asked to rank the products in both baskets, from the healthiest to the least healthy.

4. Results and discussion

4.1 Theoretical test

In order to analyze the responses to the survey, we considered that a participant's answer was satisfactory if she made the right choice in at least one of the two baskets in each of the questions (pictures and tables). In the case of the question using pictures, this means that a participant who guessed the healthiest item correctly in at least one of the baskets (beverages and/or salty packaged snacks) was considered to have sufficient intuition regarding nutritional quality of food items. Similarly, a participant who makes the correct choice in at least one of the baskets when shown nutritional tables was considered to have a proper understanding of the information displayed.

First, we focus on the individuals in the control group, who made their choices based on pictures (question 1) and traditional nutritional tables (question 2). According to our theoretical framework, providing nutritional information in any format should increase the probability of identifying the healthiest item among a set of options. Therefore, we expected the participants' answers to improve when the nutritional labels were shown, in comparison to the exercise where they had to choose based only on pictures of the products. In this latter case, they could only rely on their previous knowledge and intuition, whereas labels allow the use of logic and critical thinking to process the information provided and reach a conclusion. A descriptive revision of the results shows that the answers were in line with these predictions (see the second column of Table 3). The probability of choosing the right option in at least two of the baskets was only 6% when individuals in the control group were presented with pictures of the products. However, this probability increased to 30% in the second exercise, where detailed nutritional tables were provided to them.

TABLE 3
PROBABILITY OF RIGHT ANSWER: THEORETICAL TEST

	Treatment Group	Control Group
Q1: Pictures	0.8	0.067
	(0.486)	(0.157)
Q2: Nutritional Tables	0.667	0.3
	(0.473)	(0.312)
N	30	30

Notes: The probability of choosing the healthiest item in at least one of the two baskets and its standard deviation is displayed for each question and by treatment group.

Nevertheless, previous literature has highlighted that presenting detailed nutritional labels might lead to problems in the identification and interpretation of key facts. In particular, this may be due to excessive costs of processing the information (e.g., energy and time) or cognitive biases that arise when making choices. According to these assumptions, we expected the use of MTL labels to improve the probability of success, as it becomes easier for the participants to understand the key information required to identify the healthiest options. The results for the treatment group were also consistent with these predictions (see first column of Table 3). In fact, the share of right answers when individuals were presented with the MTL label was 80% in the first exercise (pictures) and 67% in the second (nutritional tables). This implies that MTL labels improve comprehension of nutritional information significantly relative to traditional nutritional tables. Specifically, the treatment raised the probability to choose the healthiest product in 37% percentage points relative to the control group in the second exercise, even when the latter used traditional nutritional tables to guide their choices.

Despite the limited size of the sample, these results constitute solid evidence that MTL labels improve the understanding of nutritional quality among Peruvian students. This premise allowed us to conduct our experimental test, which aimed to determine whether more information leads to better decisions by consumers.

4.2 Experimental test

Our conceptual framework states that presenting nutritional information in a display that is more likely to be understood by consumers should decrease the risk of being subject to cognitive biases, thus helping individuals to make choices that are more coherent with their long-term preferences. Therefore, one should expect that the treated individuals in the second stage of our study (i.e., the ones that are offered food options that display the MTL labels) are more likely to choose a healthier item than the students in the control group. Our results in the theoretical test, which showed that the fraction of individuals who guess the healthiest option among a basket of products increases substantially when MTL labels are introduced, provide stronger support for these predictions. Furthermore, the treatment group in the experimental test also had a better performance when asked to identify the healthiest item out of the options provided, although they no longer had the products in front of them. Specifically, 33.33% of individuals in the treatment group answered this question correctly, which constitutes an increase of 7.33 percentage points relative to the control group.

TABLE 4
DESCRIPTION OF DEPENDENT VARIABLES: EXPERIMENTAL TEST

	Cracker Score / Beverage Score		Combined Score	
	Possible values	Variable desciption	Possible values	Variable description
Binary	0, 1	Takes the value "1" if the subject chose the healthiest option in the basket, and "0" otherwise	0, 1, 2	Simple average of the binary score for crackers and beverages. Indicates whether the subject chose the healthiest option in none of the baskets ("0"), one basket ("0.5"), or both baskets ("1)
Extended	0, 1, 2	Indicates the ranking of the subject's choice in the basket, ranging from "0" (least healthy option) to "2" (healthiest option)	0, 1, 2, 3, 4	Sum of the extended score for crackers and beverages. It ranges from "0" (least healthy option in both baskets) to "4" (healthiest option in both baskets)

An analysis of the results for our real choice experiment confirms our hypothesis about the effects of information on individual behavior. In Table 4, we present a comparison of the dependent variables used in the different specifications that we tested in this section. For our first specification, we defined a binary score for each of the two baskets of products, which took the value of “1” if the individual chose the healthiest option, and “0” otherwise. Then, we calculated each individual’s combined score, which was defined as the sum of the scores corresponding to the two groups of items (beverages and crackers). Thus, our dependent variable could take one of three possible values: “2” if they chose the healthiest option in the two baskets, “1” if they chose the healthiest option in only one basket, and “0” otherwise. Using this score (upper-right variable in Table 4) as dependent variable, we conducted an OLS analysis to test the effect of the treatment on the probability of choosing the healthiest options in the two baskets of goods.

TABLE 5
OLS RESULTS FOR COMBINED BINARY SCORE

	I	II
MTL	**0.280****	**0.280****
	(0.134)	**(0.138)**
Age		-0.006
		(0.030)
Sex		0.469***
		(0.128)
Question 1		0.132*
		(0.068)
Question 2		-0.000
		(0.000)
N	100	100
R^2	0.042	0.192

Notes: ***, **, and * indicate statistical significance at the 0.01, 0.05 and 0.10 levels respectively. The dependent variable is defined as the average of the binary scores from choosing the healthiest option in the crackers and beverages baskets. It can therefore take one of three values: "2", if the healthiest option was chosen in the two baskets; "1", if it was chosen in only one of the two baskets; and "0", otherwise. MTL is a dummy variable that indicates whether the subject belongs to the Treatment Group (i.e., whether she was presented with products with MTL labels when making her choice).

Our results for this specification are presented in Table 5. We found that the treatment significantly increases the combined score by 0.28, and that this estimate is robust to the inclusion of other control variables. Additionally, we found that age does not have a significant effect over the score for choosing the healthiest option among the options provided. We also found that male students have a score that is in average 0.469 lower, which is consistent with previous findings on differences by gender in this topic. As we already mentioned, we introduced measures for individual self-perception of nutritional habits and previous nutritional knowledge in the analysis. Our results showed that a better self-perception of healthy dietary habits improved the score for making the right choices by 0.132 points, while the answer to a technical question regarding recommended daily caloric intake (a proxy for nutritional knowledge) did not have a significant effect on our outcome variable. However, it is important to note that our coefficient for the MTL label treatment captures the average effect of providing better information, regardless of previous interest or knowledge about dietary habits.

Despite these suggestive findings, we consider that it is possible that MTL labels not only increase the probability of choosing the healthiest item among the presented options, but also improve the nutritional quality of consumers' habits overall. Additionally, it is possible that the effect of MTL labels is heterogeneous among different food categories. In particular, its impact on choices between either beverages or crackers might be driving the estimated coefficients of the combined score in our model. In order to account for these two issues, we recoded the dependent variable into an extended score, for it to include more information about the subjects' decisions. In particular, for each basket of products we assigned a score of "0", "1", or "2", depending on whether the subject chose the worst, middle, or best option in terms of nutritional quality respectively. We then conducted OLS regressions for each basket (i.e., crackers and beverages) separately. This specification allowed us to identify whether the treatment and the included covariates increase the probability of choosing healthier items in each of these two food categories. Afterwards, we added the scores for the two groups of items into a new combined score, resulting in a variable that could take any discrete value between "0" (least healthy choice in both baskets) and "4" (healthiest choice in both baskets). We used this new combined score as a robustness check, in order to verify that the results from the extended model are consistent with our previous binary specification.

The results of the extended model are displayed in Table 6. In columns I to IV, we show the coefficients for each independent food category (both with and without including the control variables). The treatment appears to be effective for both food categories, as exposure to MTL labels increased the extended score for crackers and beverages in 0.2 and 0.38 respectively. However, this effect is only significant for the latter category, which supports our hypothesis regarding the heterogeneity of the treatment's impact. All other controls retained their signs from the previous estimation, but only the sex dummy in the beverage specification remained significant. This loss in efficiency is probably related to our relatively small sample size, but it is important to highlight that the treatment effect on beverage score remains significant despite these limitations. Moreover, the combined score specification also proved consistent with our previous findings using the binary model. Specifically, we found a significant increase in the combined extended score after exposure to the MTL label of between 0.58 and 0.633, depending on the covariates included in the model. Additionally, we confirmed that both being a woman and caring for health and nutrition significantly increase the probability of making healthier food choices when combining the results from the two baskets.

TABLE 6

OLS RESULTS FOR THE EXTENDED SCORE

	CRACKER SCORE		BEVERAGE SCORE		COMBINED SCORE	
	I	II	III	IV	V	VI
MTL	**0.200**	**0.198**	**0.380****	**0.435****	**0.58****	**0.633****
	(0.181)	**(0.196)**	**(0.182)**	**(0.188)**	**(0.257)**	**(0.263)**
Age		0.004		-0.043		-0.039
		(0.043)		(0.041)		(0.058)
Sex		0.284		0.616***		0.900***
		(0.182)		(0.174)		(0.243)
Question 1		0.111		0.138		0.249*
		(0.097)		(0.093)		(0.130)
Question 2		-0.000		0.000		-0.000
		(0.000)		(0.000)		(0.000)
N	100	100	100	100	100	100
R^2	0.012	0.066	0.043	0.184	0.049	0.206

Notes: ***, **, and * indicate statistical significance at the 0.01, 0.05 and 0.10 levels respectively. From columns I to IV, the dependent variable is the extended score for the nutritional quality of the cracker and veverage chosen. It can therefore take one of 3 values: "0" (least healthy option), "1" (middle option), and "2" (healthiest option). In the case of "Combined score" (columns V and VI), the dependent variable is defined as the sum of the extended scores corresponding to the crackers and beverages baskets. It can therefore take one of 5 values, which go from "0" (least healthy option in the two baskets) to 4 (healthiest option in the two baskets). MTL is dummy variable that indicates whether the subject belongs to the Treatment Group (i.e., whether she was presented with products with MTL labels when making her choice). The results are displayed as proportional odds ratios.

Given the ordinal nature of the extended scores, we also computed the marginal effects of the treatment variable for each possible outcome based on an ordered multinomial logistic regression model. This allows us to provide further evidence of the effects of MTL labels on nutritional decisions in the case of cracker, beverage, and combined scores. In Table 7, we present the difference between the probabilities of achieving each specific outcome, for treated and control individuals respectively. Consistent with our previous findings, the columns corresponding to crackers and beverages provide evidence of a positive effect of MTL labels on the nutritional quality of food choices, although this impact appears to be bigger for the beverage category. In fact, while treated individuals were 10.2 pp less likely to choose the least healthy cracker, this difference was as big as 22.8 pp in the case of beverages. Similarly, subjects exposed to MTL labels were 9.6 pp and 22.2 pp more likely to choose the healthiest option in the cracker and beverage baskets respectively. However, these differences were only significant in the beverage category.

An analysis of the computed margins for the combined score (which we present in the third column of Table 6) confirms that the treatment was effective at improving the overall nutritional quality of the subjects' decisions. In fact, individuals exposed to the MTL labels were 15.1 pp less likely to score "0" and 4.6 pp less likely to score "1" in comparison to the control subjects, which means that the proportion that chose the least healthy item in at least one of the baskets was considerably lower among this group. Similarly, treated individuals were 7.2 pp and 11.1 pp more likely to score "3" or "4" respectively (i.e., they chose the healthiest option in one or both food categories). Moreover, all these differences were significant to the 5% level, which provides further support for the robustness of our results.

TABLE 7
MARGINAL EFFECTS OF MTL LABELS FOR THE EXTENDED SCORE

OUTCOME	CRACKER SCORE	BEVERAGE SCORE	COMBINED SCORE
0	-0.102	-0.228**	-0.151**
	(0.099)	(0.092)	(0.06)
1	0.006	0.006	-0.046**
	(0.009)	(0.011)	(0.022)
2	0.096	0.222**	0.014
	(0.093)	(0.09)	(0.02)
3			0.072**
			(0.033)
4			0.111**
			(0.047)

Notes: ***, **, and * indicate statistical significance at the 0.01, 0.05 and 0.10 levels respectively. The category "Outcome" denotes the possible scores of the dependant variable (the extended score), which go from "0" to "2" in the first two columns and from "0" to "4" in the case of the combined score. The marginal effects displayed denote the difference in percentage points in the probability for achieving each outcome (score), between treated and non-treated individuals and given that all other variables are fixed at their mean values.

Overall, our results constitute strong evidence that providing consumers with simplified nutritional information not only improves their understanding of the nutritional quality of food items, but also helps them modify their behavior in a way that is consistent with their own preferences. According to our theoretical framework, this occurs through two mechanisms. First, the MTL reduces the costs of processing nutritional information, which makes consumers more likely to incorporate it in their decisions. Second, by displaying key features that are relevant for health, individuals are *nudged* into considering them when making their choices. According to the ideas of Kahneman (2011), this reduces the risk of cognitive biases altering behavior. Although our setting does not allow us to separate between these effects, we consider that future research should focus on this topic in order to improve our understanding of how MTL labels induce behavioral changes among consumers. Still, proving that consumer's choices can in fact be modified towards healthier dietary habits by this policy is an important contribution of our work. Our results also provide evidence that targeting students can be effective in improving dietary habits. Additionally, it constitutes the first successful evaluation of the application of this labelling format in a developing country, which opens a window for new health policies in other places with similar characteristics.

Regarding our methodology, our study is valuable because it consists in a controlled experiment, which allows us to identify the causal effect of the MTL label treatment. This is an important contribution, considering that most of the papers that evaluated real behavioral changes after the introduction of MTL did so in a natural experiment setting where it is impossible to control for all relevant factors. Although some controlled experiments may have external validity problems, these problems are limited in our case. Particularly, the strategy of presenting the food items before participants knew what the experiment was about allowed us to avoid behavior adjustments. Given that students are used to receiving food as a compensation for participating in university activities, there is no reason to expect that they were aware of being observed when making their decisions. Additionally, giving them the food items for free allowed us to abstract from the effects that price differentials might have on consumers' choices. Nevertheless, our design also has some limitations. First, our sample size was limited due to the difficulty of working with a big group in a small university. Second, participants in our experiment were a very homogeneous group, which complicates the extrapolation of our conclusions to other demographic groups.

5. Conclusions

In this study, we intended to evaluate whether presenting nutritional information in a simpler and friendlier format could affect real choices regarding food consumption. As an instrument, we adopted the MTL labels used in the UK, which have been shown to improve consumer's understanding of nutritional quality of food items significantly. Easier access to key information is expected to improve nutritional habits due to two complementary mechanisms. First, a reduction in the costs associated with acquiring information should lead to a higher demand for it, thus reducing information asymmetry problems. Second, this should also decrease the degree of cognitive biases affecting consumers' choices, which should in turn modify their behavior to make it more coherent with their true long-term preferences.

In order to assess these effects, we ran a choice experiment with a randomly selected sample of university students in a developing country. This setting allowed is to identify that offering MTL labelled food items increased the probability of choosing the healthiest item by 28 percentage points. This finding constitutes important evidence in favor of MTL labels, as very few papers had previously been able to capture an effect of this policy on real behavior of consumers. Our results open a new window of opportunity for other researchers to look into the determinants of the efficacy of this labelling format, in order to improve future design and targeting of these policies. For example, our results suggest that university students are a group that is likely to react positively to MTL labels and improve their dietary habits. Furthermore, we are the first to provide empirical evidence about the efficacy of MTL labels in a developing country. This could lead to further research in similar contexts, as higher incidence of health problems related to bad nutrition in emerging countries has become a problem that demands new and well-designed policies.

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Appendix: Survey used in the experimental test

ENCUESTA PARA INVESTIGACIÓN ECONÓMICA

*La siguiente encuesta será completamente anónima. No olvide escribir el código secreto brindado por sus encuestadores.

Edad	
Sexo	
Código Secreto	

Marque con una (X) los 02 productos que escogió de cada una de las canastas.

☐	**Pepsi**	☐	**Vainilla**
☐	**Tampico**	☐	**Margarita**
☐	**Aquarius**	☐	**Soda**

PREGUNTA 1.

Considero que mis hábitos alimenticios son _______________.

- ☐ Muy por debajo del promedio
- ☐ Bajo el promedio
- ☐ En el promedio
- ☐ Sobre el promedio
- ☐ Muy por encima del promedio

PREGUNTA 2.

¿Cuántas calorías debería consumir una persona promedio al día?

kcal

PREGUNTA 3.

Independientemente de la bebida que eligió, marque con un (✓) la opción que considere más saludable y con una (X) la opción que considere menos saludable.

- ☐ Pepsi
- ☐ Tampico
- ☐ Aquarius

PREGUNTA 4.

Independientemente del snack que eligió, marque con un (✓) la opción que considere más saludable y con una (X) la opción que considere menos saludable.

- [ ] Vainilla
- [ ] Margarita
- [ ] Soda

PREGUNTA 5.

¿Actualmente sigue algún regimiento alimenticio para bajar/controlar su peso?

- [ ] Sí
- [ ] No

PREGUNTA 6.

Complete el siguiente enunciado: "Cuando compro una bebida embotellada en presentación personal generalmente consumo…"

- [ ] Agua
- [ ] Jugos de fruta (Frugos, Tampico, etc.)
- [ ] Bebidas gaseosas (Coca Cola, Inca Kola, etc.)
- [ ] Bebidas rehidratantes (Sporade, Gatorade, etc.)

PREGUNTA 7.

Marque con una (X) hasta 02 opciones de productos que le hubiera gustado recibir en lugar de las galletas.

- [ ] Papitas / chifles / camote / tortees
- [ ] Galletas de avena / de maca / integrales
- [ ] Maní / pasas / frutas secas
- [ ] Chocolate
- [ ] Otros::___________________________

PREGUNTA 8.

¿Considera algún indicador nutricional como el más importante al momento de elegir un snack?

- [ ] Grasa
- [ ] Azúcar
- [ ] Sodio
- [ ] Calorías