May 11, 2022

To,
Mr. Amit Khare
Advisor to PM
Government of India,
New Delhi

Sub: Concerns Regarding Type of Front of Pack Labeling (FOPL) on Unhealthy Packaged Food Products

Dear Mr. Khare,

Your attention must have been drawn to recent debates on the type of health warnings, which should be mandated for display on unhealthy packaged food products, which are marketed in India. These are related to the nature of information that must be communicated to consumers, to assist them in making the right choices for protecting and promoting their health. A recently published article in Policy Circles (May 9, 2022) reveals information on how this well intended public health initiative became fundamentally flawed due to the process, which was adopted to choose the nature of health warnings for display on unhealthy packaged food products. An earlier media story reporting on the experience of a member of the scientific panel is also attached. (Annex 1, 2)

We are grateful that the Prime Minister's Office has reviewed this issue recently and asked FSSAI to speedily work towards a consensus. We hope that a further review by you will ensure that the right decisions are made which will match the intended public purpose.

We, the endorsers of a Position Statement on this issue (Annex-3), and experts working in the public health area would like to submit as under:-

1. The FSSAI insists on including **Health Star Rating (HSR)** in the draft regulation, based on the recommendation of IIM A study, which was done to resolve a controversy whereby consumers groups wanted "warning labels" and the food industry wanted HSR.

2. We believe the IIM A study is not methodologically sound and is not an appropriate basis for making a major health policy decision for India. Four independent national experts confirm our assertion. (Annex-4).

3. A well -conducted study has been published on May 6 "Which Front-of-Package Labels Help Indian Consumers Identify and Reduce Unhealthy Food Purchases? A Randomized Field Experiment". It concluded "Relative to the control, only the warning label led to a reduction in intentions to purchase the products. The results suggest that warning labels are the most effective FOPL to help Indian consumers identify and avoid unhealthy foods."(Annex-5)

4. Therefore, we request you to intervene in this matter of great importance concerning the health of more than a billion people of India. India being a big market is the focus of the food industry. This policy concerns the health of people of all ages and especially adolescents and children, sick persons suffering from ailments like diabetes and cancer, hypertension and kidney disease etc. Any delay in implementation would mean a lot to the health of the people. FSSAI plans to give 4 years for voluntary implementation. As one of the obesity surgeons stated a few days back that within 15 years the annual number of surgeries for obesity has increased from 200 to 20,000 in India. It will carry a huge cost in health for the Indian people, especially harming the younger generation who are the nation's future.

5. Our arguments are based on scientific evidence gathered globally. Health warning is a statement that clearly warns the consumer of something that is harmful in its impact on health. It also serves as a cautionary example to people or consumers who can take informed action. It identifies specific ingredients, which are undesirably high levels. Star conveys approval or endorsement, basis of which is not clear to the consumer. Reviewers for ranking things based on subjective criteria usually use such ratings or technical assessment known only to experts in films, TV shows, restaurants, and hotels. For example, a system of one to five stars is commonly used in hotel ratings, with five stars being the highest rating. It does not serve to inform or educate a consumer regarding harmful levels of specific nutrients.

6. Once the draft regulation is put up with HSR, it will be hard to change the structure. It forecloses the option to use a scientifically better validated label, which fits the public health purpose.

7. We request you for an appointment at an early date, over this or next week, for a delegation to meet you and discuss the matter in detail.

8. We shall be grateful for an early and affirmative response to our request.

With our best regards,

Sincerely Yours,

Prof. K. Srinath Reddy
President,
Public Health Foundation of India (PHFI)

Prof. HPS Sachdev
Senior Pediatrician & Epidemiologist,
Member , NAPi

Dr. Vandana Prasad
Community Pediatrician,
PHRN, and Jan Swasthya Abhiayan,
Member , NAP*i*

Dr. Antony.K.R
Independent Monitor, National Health Mission, Govt of India
Former Director, State Health Resource Centre, Chhattisgarh, India
Former Health & Nutrition Specialist, UNICEF, India

Dr. Arun Gupta MD, FIAP.
Central Coordinator, BPNI
Convener, Nutrition Advocacy in Public Interest(NAP*i*)
Former Member PM's Council on India's Nutrition Challenges

Annex-1

FSSAI sides with industry, puts consumers at risk

George Cheriyan — May 9, 2022

Food safety regulator FSSAI selected health star rating as the FOPL format for the country, ignoring opposition from consumer organisations.

The role of a food regulator is to encourage the consumption of safe, sanitised, nutritious and wholesome food and to inform consumers about the steps it takes to minimise the risks, set standards and ensure safety. The passage of Food Safety and Standards Act (FSSA) in 2006 ushered in an era of food safety in India. The FSSA is a landmark law because it consolidated all laws related to food and aligned India's food regulations with international standards.

The Act established a national apex regulatory body, the Food Safety and Standards Authority of India (FSSAI) which came into existence in 2011 to develop and enforce science-based standards for food and regulate the sector. However, even

after 16 years of the enactment of the Act and 11 years after its enforcement, FSSAI has failed to deliver in line with its objectives, highlighting the need for drastic changes in the way it functions.

Gaps in FSSAI functioning

An audit of FSSAI in December 2017 by the Comptroller and Auditor General of India (CAG) revealed gaps in the working of the body and raised several concerns over clearances and testing of food, lack of equipment, and a shortage of staff across various testing labs affiliated with it. It has also questioned the lack of guidelines and procedures to regulate the use of certain food items.

The CAG found that though it has been more than a decade since the enactment of the Act, FSSAI is yet to frame regulations and guidelines governing different procedures. The regulator does not even have a complete database on food business operators (FBOs) in the country. The audit report also found that there is an acute shortage of licensing and enforcement officers in states.

Stakeholder engagement

Despite several gaps in its functioning, FSSAI has many platforms to engage stakeholders and seek their views. The Food Authority itself consists of a chairperson and 22 members representing the Union ministries/ departments; states/UTs; two representatives each from the food industry consumer organisations; food technologists/ scientists; farmers organisations and one person representing retailer organisations.

The author is a member of the authority as a special invitee representing the consumers. The central advisory committee (CAC) of FSSAI is to ensure close cooperation between the authority and enforcement agencies and organisations operating in the field. It consists of all state food safety commissioners and two members each to represent the

interests of the food industry, agriculture, consumers, research bodies and food laboratories. The author was a member of the CAC from 2014 to May 2019, representing the interests of the consumers. The meetings were conducted on a periodic basis with advance notice with agenda circulated well in advance.
In the recent past many of the actions of FSSAI raised doubts about the capability of the regulator to deliver its mandate with the industry influencing many of its decisions. Several food experts have highlighted the need for the food regulator to be more vigilant to ensure food quality and safety as per its mandate, keeping in mind the context of the Covid-19 pandemic.

Advice about trans-fat free logo

In the last week of March, FSSAI asked the FBOs to get the products tested for trans fats and in case the products contained no more than 0.2 g per 100 g of food, then advised to use the trans-fat free logo on the product label. This advice was absurd because already mandatory regulation is in place for all FBOs.
As per the Food Safety and Standards (Food Products Standards and Food Additives) Tenth Amendment Regulations, 2020, trans-fat is banned in all foods, oils and fats with effect from January 1, 2022. Hence, the advice is irrelevant on any food product. In fact, FSSAI and the state food safety commissioners should have ensured full compliance. By asking FBOs to display trans-fat free logo, FSSAI is accepting its failure to ensure compliance and to penalise those who are violating the law. This shows how weak the regulator is.

Front of the pack labelling in India

Non-communicable diseases (NCDs) are responsible for 62% of all deaths in India. Preventable premature deaths account for 48% of the mortality. One of the reasons for increasing NCDs is the consumption of unhealthy food that is high in sugar, salt or saturated fat. All over the world, the cost effective way of warning the consumers about the unhealthy ingredients is the

use of simple and descriptive front of the pack labelling (FoPL). Across the world, a significant number of countries have implemented FoPL in different formats. India stands to lose $4.58 trillion before 2030 due to NCDs and mental health conditions. Cardiovascular diseases accounting for $2.17 trillion and mental health conditions ($1.03 trillion) will lead to huge economic losses. However, the food regulator has totally ignored the aspect of NCDs, and their links with food high in sugar, salt and fat. It has totally ignored the role FoPL could play while choosing the FoPL format.

The FoPL debate in India

FoPL was first recommended in 2014 by an expert committee constituted by FSSAI. After years of consultations, FSSAI published a draft Food Safety and Standards (Labelling and Display) Regulations, 2018 in May 2018. In 2019, FSSAI issued draft Food Safety Standards (Labelling and Display), Regulations, 2019. In 2019 December, FSSAI delinked FoPL from general labelling regulations.

During the pandemic outbreak, a stakeholder group was formed and regular meetings were held from January 2021 to fast track the process. From the inception, the author was part of this group and its consultations. The meetings were chaired by the then Executive Director (RCD) of FSSAI. After 5 consecutive monthly meetings and summing up the discussions, the Executive Director (RCD) relinquished his position on May 31, 2021 and returned to his parent department. It should be noted here that the CEO, FSSAI never attended any of these meetings.

On June 25, 2021, prior to the 6th meeting of the stakeholders, the CEO convened a meeting of consumer/ civil society organisations and parachuted the idea of health star rating (HSR), which was never mentioned/discussed in any of the stakeholders meetings. Though he sought the support of consumer organisations, they opposed the idea of HSR because of the experience of other countries with this label.

On June 30, a stakeholder meeting was convened and was chaired by the Chairperson. However, the CEO had taken over

complete control of the meeting. In the meeting, he introduced the idea of HSR which was again opposed by COs/CSOs. While the meeting was about to conclude, the CEO presented the following as recorded in the minutes of the stakeholders meeting on FoPL held on June 30, 2021.

"FSSAI may commission a survey-based study through an institution of excellence like IIMs to analyze major FoPL models that are available across the globe with the objective to identify ease of understanding and behavioral change of Indian consumers on a national level."

There was no space for discussion on this suggestion. It was only a suggestion by the CEO, no decision was taken to engage IIM-A for the survey. The author expressed concern about the time survey-based study will consume which may further delay the process, it was endorsed by the chairperson in her concluding remarks.

Power imbalance in favour of industry

Each of the seven stakeholders meetings, both physical and virtual, were attended by an average of 28-30 representatives other than FSSAI officials. Of this, the representatives of consumer organisations were only 4-5. Remaining 25 representatives were from the major industry associations and national/multinational food industries.

Though it was pointed out on several occasions, FSSAI was allowing the industry to participate in large numbers with a 6:1 ratio. In all the meetings, industries were dominating with a justification that they have only one response/one PPT, though it was allowed to be presented by 10-12 representatives including regulatory experts, legal experts, and health experts. During first week of February 2022 (after 6 rounds), FSSAI requested for nomination of additional representatives from consumer organisations. Though nominated, those representatives did not receive invitations for the February 15 meeting. Those who tried to join were prevented from attending the crucial meeting. The regulator seemed to be in fear of the industry associations/ MNCs. Even the neutrality of the scientific panel was under question because it has been

reported that industries have planted their people in these panels.

Unfortunate decision by FSSAI

On February 8, the author received a mail from Asst Director (RCD), FSSAI, intimating that FSSAI is holding a virtual meeting on February 15, 2022 at 03:30 pm for discussing the FoPL. It was not clear whether it was a meeting of COs or stakeholders. On February 10, I wrote an email seeking clarification and I was informed only on February 14 afternoon that it was a stakeholder meeting. Though asked repeatedly, no agenda was shared by FSSAI. A departure from earlier meetings, this was a meeting convened in the most undemocratic and non-transparent manner without any agenda or background materials.

On February 15, the stakeholder meeting was held under the control of the CEO. Two representatives from IIM-A and Dexter Consultancy presented the findings of the survey. Though asked, neither the PPT, survey report nor the questionnaire used in this survey was shared with the participants of the virtual meeting. The explanation of the CEO that he got the PPT only at 10.30 pm on February 14 and hence he could not circulate it was unbelievable. FSSAI concluded that HSR has come out as the recommended FOPL format. I along with other representatives of COs strongly opposed this decision and insisted to record descending note, which is recorded in the minutes as follows:

“Mr George Cheriyan from CUTS International and Mr Amit Khurana, CSE opposed the recommendation for use of HSR Model in India due to the reasons that health star ratings are taken with a positive connotation and do not meet the intention of FOPL regarding warning for negative nutrients, which may be overwhelmed by positive nutrients in the algorithm design for HSR.:

FSSAI reached at the decision that an initial period of four years, as recommended by the scientific panel, may be proposed for voluntary implementation of FOPL from mid-2023 to mid-2027. There was no discussion about a voluntary period

for implementation in any of the stakeholders meetings. COs opined that the FoPL should be made mandatory right from the inception considering the rising number of NCDs in the country. From the outcome of the meeting, it was clear that FSSAI totally yielded to the pressure of the industry. This being the fact, FSSAI and the CEO should stop spreading misinformation to media.

FSSAI is responsible for the formulation and enforcement of food safety standards in India. It is expected to act in a responsible manner for the sake of consumers. Instead of yielding to the pressure from the industry, the food regulator should act according to its mandate in an independent manner. It must take all necessary steps to ensure that food products are healthy and safe and use the global best practices to avoid repeating mistakes. More importantly, openness and transparency should be upheld in the public body that is accountable to the people whose trust and confidence are key to its effective functioning.

(The writer is Director, CUTS International. He is a member of FSSAI as a special invitee from consumer segment and a member of stakeholder group on FoPL. Views are personal)

https://www.policycircle.org/opinion/fssai-backs-health-star-rating/

Annex-2

THE KEN INDIA

PLAYING STAMPS & STICKERS

Seeing stars: FSSAI's food labelling decision opens a can of worms

After years of debate, FSSAI has chosen to go with a controversial 5-star system to rate the nutritional value of packaged foods. Now it must figure out how to generate consumer awareness, buy-in from industry, and set nutritional thresholds for its new system

Maitri Porecha, 8 Apr 2022

India's food industry is batting for the regulator's decision to paste 'health stars' on ultra-processed food packs. Consumer groups, though, want more in-your-face warning labels

IIM-A study conducted in over 20,000 people ranks health stars and warning labels in close competition, but recommends health stars

FSSAI's scientific panel feels the regulator has jumped the gun. It is now mulling ways to avoid rewarding more stars to 'unhealthy' food

Implementing the revised packaging will require buy-in from big and small companies, incentivisation and a massive awareness drive. Is India ready yet?

On 15 February, the conference hall of the Food Safety and Standards Authority of India (FSSAI) hosted a meeting that could have serious consequences on the overall health of India's population. The latest in a series of fiercely contested discussions, the meeting was meant to achieve consensus on how best to label packaged food to help consumers make healthier choices.

While previous meetings were deadlocked, this time, the FSSAI had an ace up its sleeve. A team of professors from the Indian Institute of Management, Ahmedabad (IIM-A) were ushered in to discuss the results of a pan-India survey. The survey was to identify what sort of labelling most effectively conveyed nutritional information. Having polled 20,564 respondents, the team from IIM-A pointed to one clear winner—Health Star Ratings, or HSR.

HSR rates foods on a five-star scale based on factors such as energy, saturated fat, sodium, total sugar, and healthier aspects such as protein, natural ingredients, and the like. The final rating is decided by an

algorithm that takes into account all this, with healthier food receiving higher ratings. These would be displayed on the front of the packaging.

India isn't alone in going the HSR route. Australia, too, adopted the HSR system as far back as 2014. But despite the Australian government's best intentions, things haven't quite gone to plan.

Mark Lawrence, professor of public health nutrition at Deakin University in Australia, told *The Ken* that 73% of ultra-processed food on supermarket shelves displayed ratings of 2.5 stars or higher. Effectively, said Lawrence, who studied the star rating implementation, the ratings failed to convey anything of value—nutrition-wise—to the consumer.

Worse, HSR also created a 'health halo' effect, which is the perception that a particular food is good for you even when there is little or no evidence to back this. Indeed, there were numerous instances where decidedly unhealthy products received the highest possible health rating.

In Australia, products like Diet Coke (loaded with artificial sweeteners) and 'no sugar' gummy candies received four and five stars respectively, while a pack of olives received one star, and free range eggs received four stars. Picture Credit - Mark Lawrence

Despite this precedent—or perhaps because of it—there was widespread support for the HSR approach among the 23 stakeholders present at the FSSAI meeting. Seventeen of these were major food and beverage companies, including Coca Cola, Dabur, ITC, Kelloggs, Nestle and Haldirams.

Many members of FSSAI's own expert scientific panel, however, were aghast. "We had insisted that a copy of the IIM-A study be shared with us for internal consultation before being presented to the larger group of stakeholders. This was so we could deliberate on it and prepare our comments, but we were given no time," said one member of the panel. They requested anonymity for fear of repercussions.

The stakes at play here are anything but trivial. Currently, 5.8 million Indians die every year from chronic diseases such as cancer, diabetes, and cardiovascular diseases. "Most of these deadly diseases, although hard to treat, may be prevented by modifying diet and transforming the food industry," Ashim Sanyal, chief operating officer of Voluntary Organisation in Interest of Consumer Education (VOICE), told *The Ken*. Sanyal is also a member of FSSAI's stakeholder committee.

FSSAI CEO Arun Singhal, though, appears to have no such apprehensions about HSR. Once the study was presented, he wasted no time, suggesting that the decision to include HSR on packaged foods be introduced as a draft regulation. The decision is all the more contentious since FSSAI wants to make HSR voluntary for manufacturers for a period of four years.

"After necessary approvals from the Health Ministry, the draft regulation will be notified in a gazette and then be open to public comments. The entire process of finalising this into a law may take a whole year," Singhal said.

FSSAI is already moving on to implementing HSR. It has instructed its scientific expert group to begin working on algorithms to calculate HSR. These will be customised to the Indian context in an attempt to avoid the Australian debacle, the expert panel member quoted above said. "Take for instance, *kaju katli* (a cashew-based milk sweet). No matter how many cashews you add, it has such mind-bogglingly high levels of sugar it can never attract more stars. Similarly, Gulab Jamun, (an Indian sweet made of deep-fried refined flour dumplings dunked in sugary syrup) attracted 1.5 stars," pointed out the expert member quoted above.

Explore more infographics like this in The Ken - Visual Stories

Health Stars versus Warning Labels

Since chips and biscuits are among the most commonly consumed junk food in the country, IIM-A designed its survey around them. Researchers designed a blue potato chips packet (visually mimicking the popular 'Lays' brand) and a yellow biscuit packet based on the packaging of the ubiquitous Parle-G

biscuit brand. No brand, however, was mentioned on the packaging.

Instead, the packaging sported different forms of front of package labelling (FoPL), including HSR, warning labels, nutriscore, etc. Field personnel showed these to respondents, using questionnaires to determine the efficacy of each of these methods in communicating nutritional information and warning consumers about unhealthy foods. IIM-A declined to share the questionnaire with *The Ken*.

Picture Credit - IIM-A

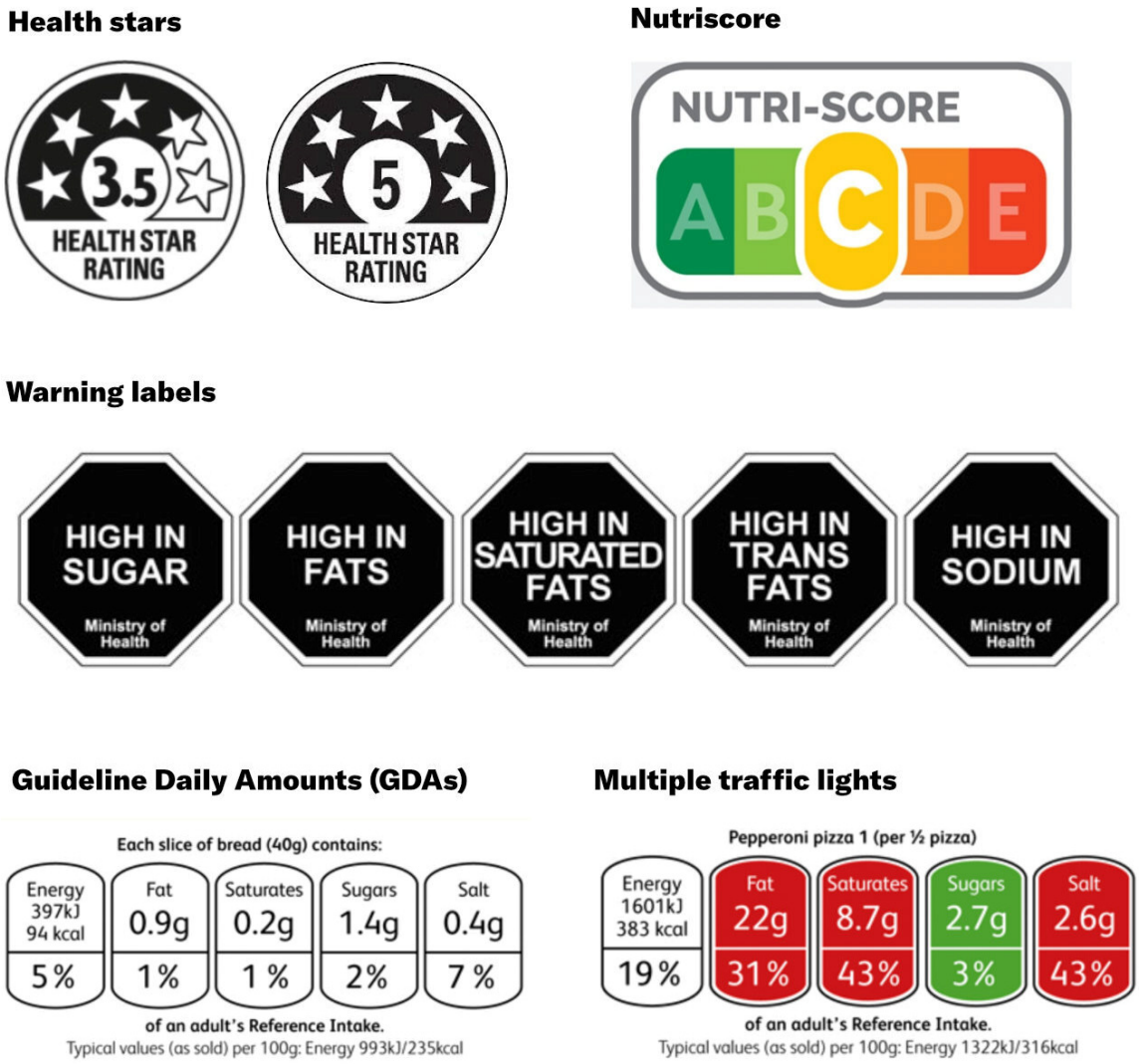
While the IIM-A team ultimately backed HSR, the survey results aren't nearly as flattering as one would expect. Respondents who, as part of the study's design, were manipulated to believe that chips and biscuits were healthy, were more strongly influenced to avoid unhealthy foods by warning labels than HSR. Even among respondents who were under no illusions about the health risks of junk food, warning labels were a more effective deterrent than HSR, the study noted.

Overall, health stars and warning labels found the most broad-based support across occupations, the study noted. However, despite warning labels scoring higher on average across the six parameters IIM-A was tracking, HSR came out ahead on more parameters, leading the group to ultimately recommend HSR.

"We were asked to recommend only one option for FoPL. If the objective is ease of identifying, understanding, and a change in purchase intention, we recommend health stars," Arvind Sahay, professor of marketing and international business at IIM-A, told *The Ken.*

One oft-cited reason why HSR often wins out, is that star ratings are commonly used across industries, making the system widely recognised. However, as Sanyal pointed out, electronic appliances and ultra-processed foods are incomparable. "Nutrition science is way more complex than that," he said.

Those like Sanyal prefer the use of warning labels. These text-based labels provide in-your-face nutritional information. A packet of chips, for instance, may be simply labelled as "high in fats and salt", eradicating any ambiguity in the mind of the consumer. Studies also back up their effectiveness.



Five categories of FoPL labelling used in IIM-A study. Picture Credit - The Ken Research

One study conducted by Mumbai-based Indian Institute of Population Sciences (IIPS) between January and March 2022 showed that 61% of participants who were shown warning labels could identify all excess nutrients in the food. Only 45% of those shown HSR could correctly interpret them. (It should be noted, though, that the IIM-A study was far larger—over 20,000 respondents across 20 states, whereas the IIPS study only surveyed 2,869 adults across six states. Urban and rural populations were part of both studies.)

IIPS, however, is far from the only body that's at odds with IIM-A's recommendations. Doctors at the Institute of Liver and Biliary Sciences, All India Institute of Medical Sciences, and multiple consumer groups have all cried foul. They argue that instead of following the Australian route, India should aim to replicate the warning labels implemented by South American countries such Chile and Uruguay.

Marcela Reyes, assistant professor at the University of Chile's Institute of Nutrition and Food Tech, told *The Ken* that it took Chile nearly a decade to introduce warning labels on packaged food. Reyes and her team analysed all naturally occurring food using the US Food and Drug Administration's data, and arrived at a median of 10 grams of sugar per 100 grams as a 'healthy' parameter. "Any food crossing this threshold was stamped as high in sugar in bold black hexagonal symbols," Reyes said.

Unsurprisingly, food and beverage majors—including Kelloggs, which is part of FSSAI's stakeholder group—were against the move. Kelloggs even dragged the Chilean government to court, but was ultimately unsuccessful in its efforts. The effects of Chile's warning labels are there for all to see. Far removed from the delusional 'health halo' effect seen in Australia, Chile has seen the sales of sugary drinks decrease by 23%, said Reyes.

Kelloggs in a legal case against the Chilean government said that it would not remove the popular illustration of 'Tony the Tiger,' the brand mascot off the cereal boxes. After Chile's Supreme Court ruled against the company, it had to take off the luring imagery. Nestle and other food and beverage companies faced a similar predicament. Picture Credit - Marcela Reyes

Setting thresholds

IIM-A's Sahay told *The Ken* that the purview of their survey was to identify ease of identification of labelling. It does not probe the underlying reasons for why HSR or warning labels may be a better fit for the Indian population. Where Sahay's problems end, however, the problems for members of FSSAI's scientific expert group begin.

If the new HSR system is adopted, manufacturers must upload the nutritional information of all their products on the Food Safety and Compliance System (FoSCoS), a licensing platform run by FSSAI. "The platform will automatically calculate the number of stars to be assigned on the basis of the algorithm, and provide artwork to the companies to revise their labels," Singhal explained. FSSAI, though, may be jumping the gun.

The body's ten-member scientific panel of nutritionists, most of them PhDs from various Indian universities, are hard at work analysing various food products on supermarket shelves. Like Reyes and her team in Chile, they too are attempting to identify thresholds for 'healthy' levels of fat, sugar, and sodium in foods and beverages.

Tossing science out of the window

Earlier, another expert group (which has since been dissolved) proposed setting thresholds in such a way that at least 22% of ultra-processed food brands fell in the 'healthy' category. That approach, as The Ken reported, was scrapped for being unscientific

For instance, a packet of Parle's Hide and Seek biscuits has 32.2 grams of sugar per 100 grams. Currently, this would be deemed unhealthy as per the World Health Organisation's recommendations of no more than six grams of sugar per every 100 grams. The expert group is proposing a sugar threshold of 20 grams per every hundred grams of the snack—over 3X higher than WHO's standards. Currently, there is a tug of war between the industry and FSSAI on upping these thresholds, as documented in the minutes of the latest FSSAI meeting, which *The Ken* has accessed.

Developing realistic thresholds will be crucial to implementing any sort of labelling system—especially with Indian sweets and snacks such as *gulab jamuns* or *namkeen* being major offenders for sugar and salt, respectively. These experts now face a classic chicken and egg situation. One of the expert members in the scientific panel said that FSSAI should have waited until these thresholds were set in stone before announcing the implementation of HSR.

Following the Australian debacle, FSSAI's Singhal told *The Ken* that the expert group is very closely analysing products to design a HSR algorithm that recognises India's unique needs. A nutrition expert who is part of FSSAI's expert group told *The Ken* that it is unlikely that most potato chips would manage a rating of more than half a star.

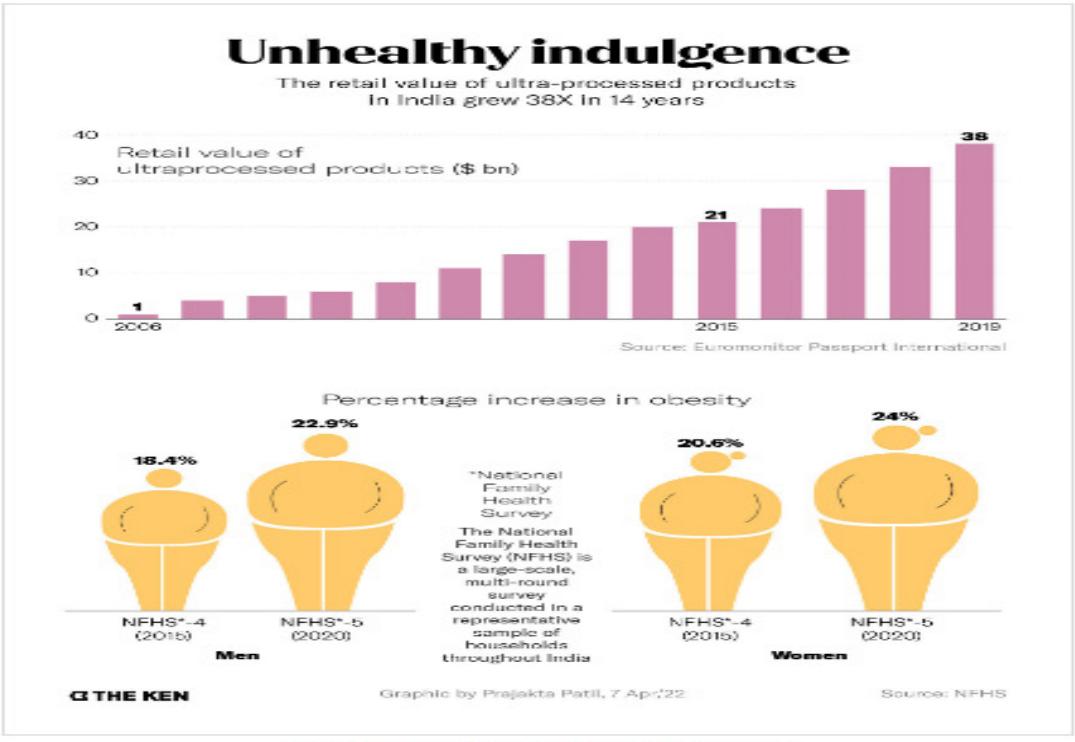
The expert, however, was apprehensive about how things may play out. For one, they said, there's the worry that food and beverage companies simply misrepresent the amount of salt, sugar, and fat in their labelling. In some cases, the expert said, products had more sodium than what was declared by the manufacturer. "We need to be vigilant about what companies are self-declaring on labels. They use multiple names on the pack as there are no regulations yet on reporting all ingredients in one place," the nutrition expert said.

Many names of junk

This could be monosodium glutamate, yeast extract, baking soda (sodium bicarbonate), preservatives like sodium benzoate in ketchups or sodium sulfite. On analysing products, we found that in some cases, levels of sodium from all these additives were found to be higher than those declared by the companies, said a member of FSSAI's expert group

According to the expert group's preliminary analysis, which *The Ken* accessed, even a bar of dark chocolate with fruits and nuts will attract a half-star rating because of its high sugar content. "We are mindful of the fact that the mere addition of a few nuts should not mask the negative nutritional content (high sugar, in this case) of the food," Singhal explained.

Similarly, instant noodles also attract a half-star rating. "Ready to eat soup mixes and soupy noodles are the worst due to the heavy presence of preservatives, anti-caking agents, and flavour enhancers," said the nutrition expert quoted above.



Explore more infographics like this in The Ken - Visual Stories

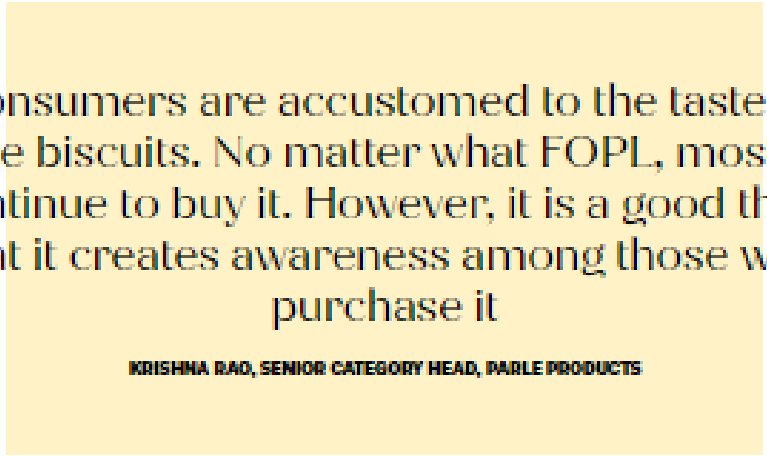
Sins of the sweet tooth

Even as FSSAI barrels along in its attempt to implement nutritional thresholds and HSR, the food and beverage industry is waiting and watching to see how they will be impacted.

Take digestive biscuits, for instance, which are generally marketed as healthy. According to the preliminary analysis accessed by *The Ken*, these biscuits would only garner a 1.5-star rating. This is because of their high fat and sugar content, with their high fibre the only saving grace.

Will these ratings actually impact large manufacturers such as Parle? That remains to be seen. Parle, for instance, runs a Rs 15,000 crore ($1.97 billion) operation, selling 100,000 tonnes of biscuits—including a premium range of digestive cookies and Parle-G. To get the cookie format right—which is softer in mouthfeel—manufacturers have to resort to a high-fat recipe, said Krishna Rao, senior category head at Parle Products. “None of the biscuits can be ‘healthy’. There is always a compromise,” said Rao.

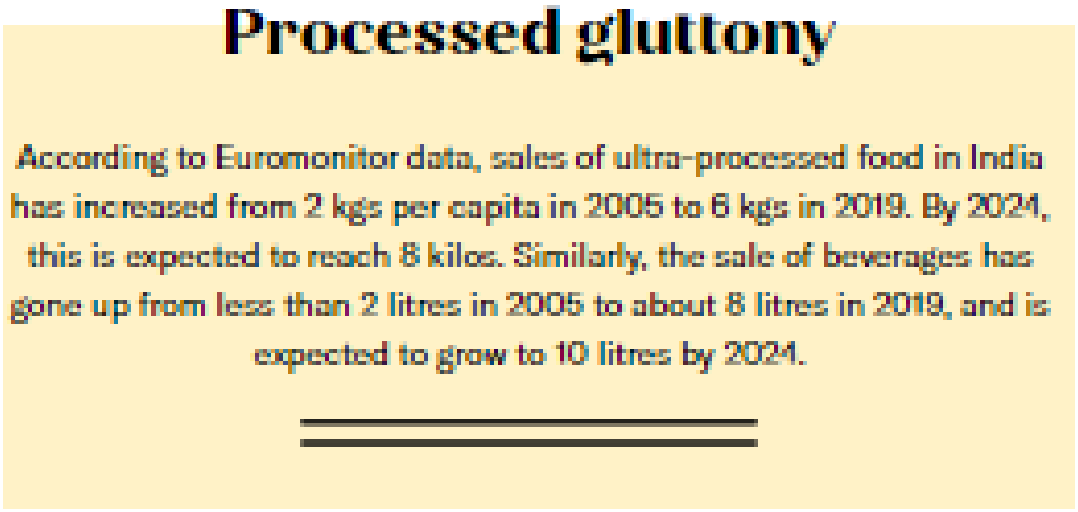
Rao said that the company will comply with FSSAI’s regulations—be it warning labels or health stars. However, there is no chance that Parle will reformulate its traditional Parle-G biscuit recipe (loaded with sugar and carbs) since it’s a runaway favourite across economic classes.



Consumers are accustomed to the taste of these biscuits. No matter what FOPL, most will continue to buy it. However, it is a good thing that it creates awareness among those who purchase it

KRISHNA RAO, SENIOR CATEGORY HEAD, PARLE PRODUCTS

Even as the HSR system is turning out to be neither carrot nor stick for large manufacturers, its value to consumers is also questionable, pointed out Delhi-based paediatrician Arun Gupta. “What would 1.5 stars say about a digestive biscuit—how much sugar is in it and what are the additives in this—to a borderline diabetic who chooses to consume it, thinking it is a better alternative?” asked Gupta, who is also the convenor of the Nutrition Advocacy in Public Interest (NAPi). NAPi has even approached the Prime Minister’s Office to overturn FSSAI’s decision.



Processed gluttony

According to Euromonitor data, sales of ultra-processed food in India has increased from 2 kgs per capita in 2005 to 6 kgs in 2019. By 2024, this is expected to reach 8 kilos. Similarly, the sale of beverages has gone up from less than 2 litres in 2005 to about 8 litres in 2019, and is expected to grow to 10 litres by 2024.

And while big brands may comply, the initial voluntary nature of the HSR regulations will find few takers among smaller manufacturers. Prabhu Gandhikumar, founder of TABP Snacks and Beverages, explains that this change could force a company with 10-15 products to make a one-time investment of Rs 8-12 lakh ($10,000 – 16,000) to implement packaging with the HSR. “For a company that has a turnover of Rs 1.5-2 crore ($197,000 – 263,500), that is almost 10% of revenue. What are the incentives for smaller companies to adopt FoPL?” Gandhikumar wondered.

Despite these unresolved issues, FSSAI is forging ahead. The success of this programme, though, will ultimately come down to three things—enforcement, incentivisation, and awareness. The first, to ensure manufacturers comply in both letter and spirit. The second, to ensure even smaller players come on board. And awareness, so that the HSR has its intended effect—helping consumers make healthier choices. The battle to protect India from junk food has only just begun.

Australia Chile Danone fat food safety FoPL Front of Pack Labelling FSSAI haldirams Health Star Rating IIM-A Kelloggs Mondelez Mother Dairy Nestle nutrition salt sugar Warning Labels WHO

AUTHOR

MAITRI PORECHA

Maitri writes about everything health for The Ken. For close to 10 years now, she has navigated hospital corridors in her search for a good story. In a past life, when she was not a journalist, she used to teach French at her neighbourhood school. Also an avid fan of forensics, she is always up for decoding mysteries in her free time.

VIEW FULL PROFILE

Annex-3

Position Statement

Front-of-Pack Labelling (FOPL) on Unhealthy Food/Drink Products

A Position Statement of Indian Organisations Protecting Public Health

Introduction

India is facing a public health crisis of rising obesity, diabetes, cancers, hypertension, cardiac diseases, renal disease and mental health, the Non-Communicable Diseases (NCDs). It is estimated that nearly 5.8 million people die from NCDs every year out of total deaths of about 9 million, contributing to about 60% of annual deaths.[1]The comprehensive national nutrition survey (CNNS) 2016, shows that more than half of the 5–19-year-oldsshow biomarkers of NCDs[2].

There is substantial scientific evidence showing that increased consumption of ultra-processed unhealthy food/drink products (UPFs) is associated with high risks of NCDs and all cause mortality.[3] Higher consumption of ultra-processed foods (>4 servings daily) was independently associated with a 62% relatively increased hazard for all cause mortality[4] and a recent meta-analysis showed that compared to low consumption, high consumption of UPF increased death risk by 29%[5] To create healthy food environment global experts call for warning labels on these food products.[6]

The fact is consumption of unhealthy food and drink products is rapidly rising in India.[7]These industrially processed packaged food products are usually high in sugar, salt, or saturated fats, which are detrimental to health. At the same time, evidence shows that ultra-processing itself is detrimental to the health of people independent of the nutrient content.[8]According to the World Heart Federation, *"Poor diet is responsible for more deaths worldwide than any other risk factor, and is a leading cause of obesity, type 2 diabetes, and cardiovascular disease"*[9]. Studies show association with renal function decline[10]. In a narrative review in 37 of the 43 studies examined, dietary exposure to ultra-processed foods was linked to overweight, obesity, cardio-metabolic hazards, cancer, type 2 diabetes, and cardiovascular illnesses, irritable bowel syndrome, depression, frailty problems in adults and all-cause mortality. Cardio-metabolic risks and asthma were two of the most common among children and adolescents.[11] Artificial sweeteners (particularly aspartame and acesulfame-K), commonly used in several food products, are linked to an increased cancer risk[12].

The Indian Academy of Pediatrics (IAP)'s *"Guidelines on the Fast and Junk Foods, Sugar Sweetened Beverages, Fruit Juices, and Energy Drinks"*[13] suggested a new acronym 'JUNCS' foods, for all unhealthy foods (Junk foods, Ultra-processed foods, Nutritionally inappropriate foods, Caffeinated/colored/ carbonated foods/beverages, and Sugar-sweetened beverages). It recommended limiting the consumption of the JUNCS foods through policy options including front of pack labelling (FOPL), restriction of marketing, higher taxation and improved school food environments.

In this statement we focus on the FOPL, which means information to be provided to the consumer upfront as a matter of human right as well as a public health intervention[14]. FOPL has arisen from the domain of behaviour change communication as a tool to achieve specifically desired public health goals; in this case, the reduction of overweight and obesity and consequent NCDs through the pathway of reduced consumption of foods that are too high in salt, sugar and fats as per standards set by the WHO (PAHO, 2021).[15]FOPL is a simple, inexpensive, practical and effective tool to inform consumers about the public health implications of the food that they are purchasing for consumption. Currently in use are Nutrient warning labels, color-coded traffic lights, Nutri-Score, Health Star Ratings (HSR), and Guidelines for Daily Allowance (GDA). Studies do suggest that consumers spend as little as ten seconds in selection of food items, therefore a label that would quickly and effectively lead to the ability of the consumer to identify unhealthy products would be the need of the hour.

The Global Evidence of Impact of Different Labels

Several countries in the Latin American such as Chile, Mexico[16], Uruguay, Brazil, Peru and Israel have accepted the use of warning labels as FOPL that has demonstrated change in consumption and outcomes. The consumption of sugary beverages in Chile decreased by about 24% after the introduction of this policy package including marketing restrictions[17].Most studies indicate that warning labels are the preferred mode of FOPL in order to reduce the consumption and impact on the immediate problem of increase consumption and weight gain[18].

'High-in' Warning Labels were found to be most effective, which communicates clear, non-quantitative messages about high levels of nutrients of concern and demonstrated the greatest efficacy in reducing the perceived healthfulness of a sweetened fruit[19]. The advantage of warning labels is that; unlike HSR, they serve to identify specific harmful components such as salt, sugar and fat. This factor is the most relevant to reduce consumption of unhealthy foods and thus prevent NCDs. A meta-analysis of over 100 research studies published in 2021 indicated that nutrient warning labels are more effective than traffic lights and Nutri-Score labels in discouraging unhealthy product purchases and lowering purchases of calories and saturated fat[20].

"No empirical evidence was found that implementation of traffic-light labeling changed soft-drink purchase habits in Ecuador, but there is evidence that it reduced sugar content in carbonated beverages in the country."[21] Another study from Ecuador found that traffic-light labeling did not have the expected effect of reducing purchases of carbonated soft drinks during its first year of implementation, especially those high in sugar.[22] A meta-analysis of five experiments assessing the effects of Health Star Rating (HSR) labels on sales found no significant effect on calories or sugar consumed, no impact on saturated fat or salt purchased.[23]Another systematic review showed HSR did not reveal an effect on food purchases compared with the control.[24] Participants in a shopping trial in Canada who saw "high in" nutrient warning signs bought less calories, sugar, and saturated fat from beverages and less calories and sodium from foods than those who didn't see the FOP label. Labels such as traffic lights, Health Star Ratings, and nutrition grade (i.e., Nutri-Score) did not show much effect.[25]

This joint position statement has been developed by the under signed organisations concerning various issues of health, public health, consumer rights, food, nutrition, women and children's health. This lays emphasis on the key strategy i.e. FOPL to reduce the consumption of ultra-processed unhealthy food or drink products in order to curtail the non-communicable diseases (NCDs). This Statement is developed through a consultative process after having comprehensively reviewed the scientific evidence. The Statement makes recommendations to the policymakers.

We the undersigned;

Appreciating the fact that FSSAI is working towards the FOPL and the NITI Aayog is considering policy measures like FOPL, higher taxation and restriction on marketing of unhealthy foods to reduce the consumption of unhealthy foods[26,27];

Knowing that NCDs can be curtailed by reducing the consumption of unhealthy food products and drinks, restriction of marketing of ultra-processed foods especially to children and Front-of-Pack Warning Labels on the food products;

Knowing that WHO Southeast Asia region (SEARO) has developed comprehensive nutrition profile models to categorise the food products and drinks whether they are high in a particular nutrient like salt, sugar or fat based on extensive expert consultations and country experiences including India[28], and that the World Health Organisation has provided guidance on food marketing as well as development of FOPL[29,30];

Concerned that the FSSAI's has taken a decision to include 'Health Star Rating' (HSR), a threshold which is 2-3 times higher nutrient content than recommended by WHO, and the addition of positive nutrients, in the draft regulation;

Concerned that the FSSAI has provided exceptionally long transition period of 4 to 5 years for implementing these measures on a mandatory basis;

Concerned that conflicts of interest prevailed at several consultations held to arrive at the decision;

Aware that 'misleading marketing' continues aggressively and targeted at children, and the food industry makes health claims by use of *'jaggery'* in place of sugar or with the use of some *fiber, fruit or nuts and* conceals the sugar content, which is the key information;

Aware that food industry uses 'health claims' occupying the FOPL, which confuses messages;

Realising that aggressive marketing and absence of FOPL contributes to increasing consumption of unhealthy food/drink products;

Knowing that it is the responsibility of the Government of India to warn the consumers about which food product is safe to consume and which is not;

Noting that the steps being taken by FSSAI may not help to achieve the intended objectives going by the scientific evidence;

Emphasising that scientific evidence, which in this case favours warning label on the unhealthy packaged food products, should guide the development of a public health policy to reduce the consumption of UPFs and the NCDs,;

Recommend the following actions based on scientific evidence, in order to achieve the objectives to reduce the consumption of unhealthy ultra-processed food products high in sugar, salt and fat and to and contribute to the reduction of NCDs;

1. 'Warning labels 'in 'symbols' or as 'high in' or 'excess of' nutrients of concern should be mandatory in the draft regulation of labelling and display and not the Health Star rating.
2. Thresholds for salt, sugar and fats should be based on the WHO SEARO' nutrient profile modeling.
3. Positive nutrients like *fruit, vegetable, nuts, and fiber* should not be weighted for labelling as these are used for making health claims for marketing.
4. Marketing of unhealthy foods/drinks targeting children should be immediately stopped through legislation.
5. Decisions on such public health issues should be made without any conflicts of interest even at a consultative level, interaction with the food industry may happen on a separate platform to hear their suggestions and discuss with experts to make decisions with public health interest in the center stage.
6. Once the notification on FOPL is finalized, a maximum of 12 to 18 months may be given to the food industry to comply with.
7. Government should lead a comprehensive public campaign through health systems, on which foods are safe to eat and which are not.

Developed by

Nutrition Advocacy in Public Interest (NAP*i*) http://www.napiindia.in/

Endorsing Organisations

1. Alliance for Sustainable & Holistic Agriculture (ASHA)-Kisan Swaraj Network
2. Association of Physicians of India (Malwa Branch)
3. Breastfeeding Promotion Network of India (BPNI)
4. Centre for Science and Environment (CSE)
5. Commonwealth Association for Health and Disability(COMHAD)
6. Consumer Voice
7. Cuts International
8. Epidemiology Foundation of India (EFI)
9. Indian Academy of Pediatrics (IAP)
10. Indian Association of Preventive & Social Medicine (IAPSM)
11. Indian Public Health Association (IPHA)
12. Indian Rheumatology Association (IRA)
13. Initiative for Health & Equity in Society (IHES)
14. Kidney Warriors Foundation
15. Non Communicable Diseases Prevention Academy (NCDPA)
16. Obesity Surgery Society of India (OSSI)
17. Pediatric and Adolescent Nutrition Society (PAN) -IAP Nutrition Chapter
18. People's Vigilance Committee on Human Rights (PVCHR)
19. Public Health Foundation of India (PHFI)
20. Public Health Resource Society (PHRS)
21. The Maharaja Sayajirao University of Baroda.
22. Foundation for People-centric Health Systems (FPHS)
23. Diabetes India
24. Indian Society of Nephrology

---

[1]Non-Communicable Disease and their risk factors, National Health Portal, https://www.nhp.gov.in/healthlyliving/ncd2019

[2]Sachdev, H.S., Porwal, A., Sarna, A. et al. Intra individual double-burden of anthropometric undernutrition and "metabolic obesity" in Indian children: a paradox that needs action. Eur J ClinNutr 75, 1205–1217 (2021). https://doi.org/10.1038/s41430-021-00916-3 accessed on 5 April 2022.

[3]Egnell, M., Crosetto, P., d'Almeida, T. et al. Modelling the impact of different front-of-package nutrition labels on mortality from non-communicable chronic disease. Int J BehavNutrPhys Act 16, 56 (2019). https://doi.org/10.1186/s12966-019-0817-2accessed on 5 April, 2022

[4]Rico-Campà, A., Martínez-González, M. A., Alvarez-Alvarez, I., Mendonça, R. D., de la Fuente-Arrillaga, C., Gómez-Donoso, C., & Bes-Rastrollo, M. (2019). Association between consumption of ultra-processed foods and all cause mortality: SUN prospective cohort study. BMJ (Clinical research ed.), 365, l1949.https://doi.org/10.1136/bmj.l1949 accessed on 5 April, 2022

[5] Taneri PE, Wehrli F, Roa Diaz ZM, Itodo OA, Salvador D, Raeisi-Dehkordi H, Bally L, Minder B, Kiefte-de Jong JC, Carmelli JL, Bano A, Glisic M, Muka T, Association Between Ultra-Processed Food ntake and All-Cause Mortality: A Systematic Review and Meta-Analysis, American Journal of Epidemiology, 2022;, kwac039, https://doi.org/10.1093/aje/kwac039 accessed on 5 April, 2022

[6]Ultra-processed Foods Need a Warning Label to Protect Consumers by World Food Policy Center, Duke Stanford, March 2022, https://www.youtube.com/watch?v=_z7WzF8JS8s

[7]Passport Packaged Food in India Euromonitor International January, https://www.euromonitor.com/packaged-food-in-india/report accessed on 5 April,2022

[8]Inclusion of ultra-processed foods within the regulatory framework A concept note for the Scientific Committee (SC) of the FSSAI by NAPi and BPNI, 14 Feb,2022, https://www.napiindia.in/docs/Concept-Note-for-regulating-UPF.pdf

[9] Champagne B, Arora M, ElSayed A, et al. World Heart Federation Policy Brief: Front-Of-Pack Labelling: Unhealthy Changes in the Global Food System. Glob Heart. 2020;15(1):70. Published 2020 Oct 16. doi: https://globalheartjournal.com/articles/10.5334/gh.935/

[10]Rey-García J, Donat-Vargas C, Sandoval-Insausti H, Bayan-Bravo A, Moreno-Franco B, Banegas JR, Rodríguez-Artalejo F, Guallar-Castillón P. Ultra-Processed Food Consumption is Associated with Renal Function Decline in Older Adults: A Prospective Cohort Study. Nutrients. 2021; 13(2):428. https://doi.org/10.3390/nu13020428

[11] Elizabeth L, Machado P, Zinöcker M, Baker P, Lawrence M. Ultra-processed foods and health outcomes: a narrative review. Nutrients. 2020 Jul;12(7):1955. https://pubmed.ncbi.nlm.nih.gov/32630022/

[12]Debras C, Chazelas E, Srour B, Druesne-Pecollo N, Esseddik Y, et al. (2022) Artificial sweeteners and cancer risk: Results from the NutriNet-Santé population-based cohort study. PLOS Medicine 19(3): e1003950. https://doi.org/10.1371/journal.pmed.1003950

[13]Gupta P, Shah D, Kumar P, Bedi N, Mittal HG, Mishra K, Khalil S, Elizabeth KE, Dalal R, Harish R, Kinjawadekar U. Indian Academy of Pediatrics guidelines on the fast and junk foods, sugar sweetened beverages, fruit juices, and energy drinks. Indian Pediatrics. 2019 Oct;56(10):849-63. https://pubmed.ncbi.nlm.nih.gov/31441436/, accessed on 5 April,2022

[14]Vargas-Meza J, Jaúregui A, PachecoMiranda S, Contreras-Manzano A, Barquera S (2019). Front-of-pack nutritional labels: Understanding by low- and middle-income Mexican consumers. PLoS ONE 14(11): e0225268. https://doi.org/10.1371/journal.pone.0225268 accessed on 5 April,2022

[15] Front-of-package labeling - PAHO/WHO | Pan American Health Organization accessed on 2 February 2022. https://www.paho.org/en/topics/front-package-labeling

[16]Basto-Abreu A, Torres-Alvarez R, Reyes-Sánchez F, González-Morales R, Canto-Osorio F, et al. (2020) Predicting obesity reduction after implementing warning labels in Mexico: A modeling study. PLOS Medicine 17(7): e1003221. https://doi.org/10.1371/journal.pmed.1003221 accessed on 5 April, 2022

[17]Taillie LS, Reyes M, Colchero MA, Popkin B, Corvalań C (2020) An evaluation of Chile's Law of Food Labeling and Advertising on sugarsweetened beverage purchases from 2015 to 2017: A before-and-after study. PLoS Med 17(2): e1003015. https://doi.org/10.1371/journal.pmed.1003015 accessed on 5 April, 2022

[18]Scientific Evidence for Use of Warning Labels and Health Star Rating on Unhealthy-Ultra-processed Food Products by NAPi and BPNI, March 2022, https://www.bpni.org/wp-content/uploads/2022/04/Sc-Evidence-for-warning-and-HSR-labels-on-unhealthy-food_-30-March.pdf

[19] Jáuregui A, White CM, Vanderlee L, Hall MG, Contreras-Manzano A, Nieto C, Sacks G, Thrasher JF, Hammond D, Barquera S. Impact of front-of-pack labels on the perceived healthfulness of a sweetened fruit drink: a randomised experiment in five countries. Public Health Nutrition, 25(4), 1094-1104.https://doi.org/10.1017/s1368980021004535 accessed on 5 April, 2022

[20]Song J, Brown MK, Tan M, MacGregor GA, Webster J, Campbell NR, Trieu K, Ni Mhurchu C, Cobb LK, He FJ. Impact of color-coded and warning nutrition labelling schemes: A systematic review and network meta-analysis. PLoS medicine. 2021 Oct 5;18(10):e1003765.

[21]Peñaherrera V, Carpio C, Sandoval L, Sánchez M, Cabrera T, Guerrero P, Borja I. Efecto del etiquetado de semáforo en el contenidonutricional y el consumo de bebidasgaseosas en Ecuador [Effect of traffic-light labeling on nutritional content and on consumption of carbonated beverages in Ecuador. Efeito da rotulagemnutricionalcommodelo de semáforo no consumo de refrigerantes no Equador]. Rev PanamSaludPublica. 2018 Dec 27;42:e177. Spanish. doi: 10.26633/RPSP.2018.177. PMID: 31093205; PMCID: PMC6398322.

[22] Sandoval LA, Carpio CE, Sanchez-Plata M (2019) The effect of 'Traffic-Light' nutritional labelling in carbonated soft drink purchases in Ecuador. PLOS ONE 14(10): e0222866. https://doi.org/10.1371/journal.pone.0222866accessed on 5 April, 2022

[23]Croker H, Packer J, Russell SJ, Stansfield C, Viner RM. Front of pack nutritional labelling schemes: a systematic review and meta analysis of recent evidence relating to objectively measured consumption and purchasing. J Hum Nutr Diet. 2020 Aug;33(4):518-537, https://pubmed.ncbi.nlm.nih.gov/32364292/ accessed on 5 April, 2022

[24]An R, Shi Y, Shen J, Bullard T, Liu G, Yang Q, Chen N, Cao L. Effect of front-of-package nutrition labeling on food purchases: a systematic review. Public Health. 2021 Feb;191:59-67, https://pubmed.ncbi.nlm.nih.gov/33517247/ accessed on 5 April, 2022

[25] Acton RB, Jones AC, Kirkpatrick SI, Roberto CA, Hammond D. Taxes and front-of-package labels improve the healthiness of beverage and snack purchases: a randomized experimental marketplace. International Journal of Behavioral Nutrition and Physical Activity. 2019 Dec;16(1):1-5. https://ijbnpa.biomedcentral.com/articles/10.1186/s12966-019-0799-0

[26]Minutes of FSSAI Stakeholders meeting 15th Feb. 2022.https://www.fssai.gov.in/upload/advisories/2022/02/6214b53d81294Minutes_FOPL_22_02_2022.pdf

[27]NitiAayog. Annual Report 2021-22, https://www.niti.gov.in/sites/default/files/2022-02/Annual_Report_2021_2022_%28English%29_22022022.pdf accessed on 5 April 2022

[28]World Health Organization. WHO Nutrient Profile Model for South-East Asia Region. New Delhi: WHO, Regional Office for South-East Asia. 2017. https://apps.who.int/iris/handle/10665/253459 accessed on 5 April, 2022

[29]World Health Organization. Food marketing exposure and power and their associations with food-related attitudes, beliefs, and behaviours: a narrative review, https://apps.who.int/iris/rest/bitstreams/1408388/retrieveaccessed on 5 April, 2022

[30]World Health Organization. Implementing nutrition labelling policies: a review of contextual factors, 2021, https://apps.who.int/iris/rest/bitstreams/1369774/retrieve, accessed on 5 April, 2022

Nutrition Advocacy in Public Interest – India (NAPi)
BP-33, Pitampura, Delhi-110034
Tel: +91-11-42683059
Email: napiindia.in@gmail.com
Website: http://www.napiindia.in/

Annex-4

CRITIQUE OF IIM AHMEDABAD STUDY

by 4 Independent Experts

Comments on the IIM Study : Consumer preference for different nutrition front-of-pack labels in India

Requested by NAPi

By: Dr. K.R.Antony. Public Health Consultant, Kerala. Independent Monitor, National Health Mission, Govt. of India and Former Director, State Health Resource Centre, Chhattisgarh, India.

What is the Objective of the study? Neither in the Executive Summary nor in the detailed Introduction it is clearly stated. We have to figure it out from the final paragraph on the Recommendation.

Why this question is important at the outset, because the methodology should follow meeting those objectives.

If it is “well established that FOPLs have ability to nudge healthy consumption behaviour with regards to packaged foods” as stated in the opening sentence of the Executive Summary then that aspect need not be probed and should be kept out of the methodology.

Is it then narrowing down to “lack of clarity on which kind of FOPL is most comprehensible, acceptable and yet effective” Methodology is to find out which of the five popular FOPLs is “the easiest to understand and influences purchase intentions alike”?

Tests were done on ease of understanding and change in purchase in intentions according to the Executive Summary. Respondents are asked to rate different aspects of FOPLs.

Classification of foods into healthy or unhealthy is a technical or professional step. This should be decided by a Governance body like FSSAI or Food and Nutrition experts or professionals, not even by the Food industry or Manufacturers. So then why do we seek the opinion of the Consumer knowledgeable or illiterate. It is pointless.

What is the role of categorization into three groups treated with “no health prime, healthy prime, non-healthy prime” Is there any added advantage to this extra step? Isn’t it confusing the respondent and prevents her or him from expression of the original understanding and opinion? The authors justify its purpose as “to judge the relative effectiveness of the different FOPLs as a signage for healthy and unhealthy foods”. The priming of the respondent is an unnecessary step in the methodology. If at all, the label must only carry a healthy prime to take a positive step with regard to decision to purchase. Ideal will be to provide the crystallized information in best acceptable way for consumption and leave it open for consumer to decide. We have done it with Tobacco packs and Alcohol bottles.

The methodology states that profile of the respondent is captured after the respondent has made a choice rating of the FOPL. There is no exclusion and inclusion criteria based on the profile of the respondent, before taking an opinion poll.

65-72% of the respondents are in the habit of reading labels. Automatically 28-35 % of respondents who do not read labels should be excluded from making a relative comparison between labels. This auto exclusion would have given more accurate information. Will you ever ask for opinion on relative merits of three comparable brands of whiskey to a teetotaller?

It is not a wise assumption that all people whom we interview know the scientific basis and concepts of basic Nutrition and they must be on the lookout for a commercial food product that can be beneficial or potentially harmful. Unless they have a responsibility to self-protect, they won't be bothered about warning on packaged foods. There must be some tools to assess this basic understanding level and then decide on inclusion or exclusion of the participant from the study.

The participants of the study must have the capacity to objectively evaluate the FOPL based on the information content, must have the ability to compare, identify least harmful, or identify higher content than recommended and complete the task.

Since the study revolved around only two packaged foods, biscuits and chips and their value share on marketing, purchase and consumption patterns, the preponderance of urban sample over rural across the country and in each state, what I notice, is justified. This is against the common dispersion of sampling units, (population proportionate sampling) in other population-based studies where there is a weightage for rural over urban areas.

Regarding the segment who can and would purchase packaged food, majority are from the affordable groups and only 31.6% of the respondents are from the less than Rs.10,000/- monthly household income. With regard to educational background what is the use of asking preferences on FOPLs to 13.8% of respondents with no schooling at all. In my opinion, they should have been exempted from quizzing.

Why respondents below 18 years are totally excluded? Young adolescents are big consumers of packaged foods like biscuits, chips and bottled soft drinks. There are 17.5% above 18 years who are students among the classification of respondents by Occupational groups. Occupational background hardly makes any difference with regard to purchasing biscuits and chips including 18.4% who are wage labourers. Wage labourers do buy packaged foods with spreading consumeristic culture spreading from urban poor to rural poor. Their decision making is based on the imitation factor or peer pressure, rather than informed choice.

What is overlooked in the sampling is the fact that the students above 6 years to 18 years who are big consumer segment of packaged unhealthy foods from their pocket money or they pressurise parents to buy. That is significant target population whose decision making with regard to purchase can be modified by scientific information and positive nudging. Importance of this segment is amply highlighted in Comprehensive National Nutrition Survey.

The primes whether healthy or unhealthy worked in reinforcing their opinions and influencing purchase positively or negatively according to the type prime used claims the authors. This only underscores the fact that gullible can be influenced by any maneuverer. Do we need another dimension in this study to re-establish that known fact then and complicate the methodology? The conventional wisdom is to package scientific facts to convince consumer and expect change “decision making” and behaviour positively. Anyway, in the conclusion and recommendation of the study, “Priming” healthy or unhealthy does not feature at all in its influence.

Price, brand, flavour and expiry date are influencing factors in decision making irrespective of Prime factor.

What do they want on the label? 45 % of control group want health risk related information, 35% wanted Nutrient composition and only 20% concerned about weight gain. Weight gain related, figure conscious, middle class and upper class, urban consumer looks for package information seriously but that is about a fifth of the market share. This is an important finding of the study with Policy implication on the warning labels.

The report does neither attach the survey questionnaire nor display the visual tools used to get the responses.

Overall, this is a very elaborate study in which some avoidable methodological errors have crept in. With exclusion of data responses from certain subsets for reasons explained above, from among the disaggregated data tables, it can make the findings crisper and more realistic. For example, elimination of responses from illiterate, those who never read food labels etc. We cannot do anything about the missing data from young adolescent children from age 10-18 years now and that void will remain.

In conclusion, no firm Policy guideline tips can be derived from the findings of this study.

……

Critical appraisal of the FOPL study

PHFI Review by:

Prof. Suparna Ghosh Jerath, Prof. Monika Arora
Dr. Niveditha Devasenapathy (The George Institute for Global Health)
May, 2,2022

Title of the study: Consumer preference for different nutrition front-of-pack labels in India

Summary of the study

a. **Design:** A large scale individual randomized control trial
b. **Population:** Community dwellers across age groups (18-60+ years)

c. **Interventions:** Exposure 5 FOPL with three different variants, another level of stratifications on priming (healthy, unhealthy, no priming)

d. **Control:** No FOPL, and then 3 levels of stratifications on priming (healthy, unhealthy, no priming)

e. **Outcome:** Behavioral: a) Purchase intention and b) ease of identification, understanding, reliability, complexity of label, label detecting the presence of unwanted nutrient. The primary outcome variable is purchase intention in the methodology but the results mention the ease of identification, understanding, reliability, and influence as primary outcome variables.

f. **Timing of outcome measurement:** Right after exposure to FOPL categories

Queries and comments

A. Study protocol

Query

Was this RCT pre-registered with a detailed study protocol and a priori definition of the outcome?

Comment

It will be helpful to know if the trial protocol was registered with sufficient details which would help us to assess any bias due to selective reporting of outcomes.

B. Methodology

B.1 Sampling and recruitment

Queries

The sequence of events

- How was the sample selected and recruitment done?
- How and when was the randomization done? The computer-generated randomization was done on which universe?
- How was the stratification done (prime/age/gender/urban/ rural)? Although the total sample size (20,564) is large enough, is the study powered for so many sub-group analyses?
- Around 62% of interviews were conducted in physical presence, whereas 38% were conducted online- how was randomization followed in an online survey, especially in rural areas?
  Also, how was representativeness ensured as those not using smartphones would have been left out of this study?
- How many contact points were there?

Comments

- The trial protocol should provide detailed information on the sequence of implementation of intervention such as contact, consent process, unit of randomization, implementation of randomization, priming, and exposure to different FOPL. This sequence is not clear in the study methodology.
- Need elaboration on rationale and reference for using prime in the study.

  Examples

  - Sample size has been specified in each prime but there is a need to elaborate upon how these sample sizes were arrived at and how were participants recruited in these primes?
  - After the choices were made, participants were asked to self-report on socio-demographic variables that include gender, age, occupation, etc. Please elaborate, what is the rationale for probing this information after choices have been made? Were any participants excluded after getting this information?
- The study was conducted on 18-60+ years, why have the authors not considered below 18 years to be not included in the study, as this is the age group which is largely impacted. Healthy behaviours and choices get etched at a very young age and the attractiveness of pack, schemes and promotions accompanying products influence the family's decision to buy specific products.

B.2 Ethical considerations

Comment

- The study involves data collection on human subjects but nowhere mentions about ethics
  approvals, consent procedures or documentation of the consent. If a waiver of consent was sought, then this should be explicitly mentioned in the report.

B.3 Intervention

Queries

- What were the exact questions asked to the participant?
- What was the language used for asking the questions? How have they defined the 6 items used to assess the effectiveness of types of FOPL in the local language?
- Was the questionnaire used for eliciting information validated?
- What was the language used in the package label?
- How was the intervention standardized? How were the interviewers trained? Since this is a Pan-India study, was the tool translated into different regional languages for better comprehension? Was a standardized protocol used for carrying out the entire data collection process?
- Who administered the intervention? Was (s)he the same person who randomized the participant into a group and then did priming (3 types) and

then showed the label to capture the “decision to purchase” response and then also conducted the interview?

- What was the finding of pre-testing and how were they included in the final questionnaire used for the main study?

Comments

- FOPL labels had one of the six items “Label helps detect the presence of an excess of an unwanted nutrient”. This would be influenced by nutrition literacy and perhaps the educational status of the respondents. Was any comparison drawn on baseline knowledge or health awareness score of respondents in prime vs no prime groups? Also, it would be interesting to know how these questions were framed for the diverse participants.
- The questions were pre-tested with 77 participants across states with representation across gender, age group, and education level. What about rural and urban representation at this stage?
- There is a need to address bias when the entire process seems to be “not blinded”
- In a trial, participant characteristics in each arm should be balanced. This validates the robustness of randomization. The report does not present or discuss baseline comparability of the key characteristics. Was there any effort made in this direction?
- Both interviewer and participant could see the label. Since person who enrolls, administers the intervention and measures the outcome is the same person how was performance bias and ascertainment bias addressed in this trial?
- It is a behavioral intervention. Does one-time priming bring about a behavior change? And why was priming given? In an RCT all the previous exposure and knowledge are supposed to balance out across the different arms.

C. Results and outcome

Queries

- Table 1: Different variants for each label type have been specified. Information on these variants needs to be elaborated upon for a better understanding of each treatment arm.
- Table 4: Mean scores and standard deviations for each group are mentioned; however, group differences, 95% CI, and the significance (p) value is not mentioned. Was the mean score for HSR significantly higher than all other types of FOPL?
- Table 5: How were scores converted to ranks? Was this an a priori decision to analyze using ranks?

- Table 6: Is the mean score of the warning label significantly higher than HSR? Was any statistical test applied to prove that ranks of HSR were better than warning labels?

Comments

- We do not see baseline characteristics table of the participants across treatment arms and the control arm (stratification by geography/ age/gender). Were they similar?
- Behaviour to purchase chips or biscuits is clustered in specific geographies. Did the authors adjust for clustering during the analysis?
- There are 15 treatment arms considered at some places, while they are collapsed to 5 treatment arms at others. This was based on the type of FOPLs and the variants were disregarded.
- How were the subpopulations selected to study the relative performance of labels? The findings across gender, age groups, place of living (rural and urban), and occupation are inconclusive. The authors' conclusion of HSR as the choice of FOPL is unconvincing. MTL, HSR and warning labels are also being reported as preferred modes of FOPL in different strata. Stratification should have been done based on age, geography, demography, and education instead of priming.
- Interaction between priming and FOPL needs to be well documented.
- Bias due to selective reporting of outcomes cannot be ruled out.

D. Overall comments

- This study lacks the scientific rigor, ethical requirements, and reporting requirements of an experimental design. The research question and primary outcome variable are not consistent throughout the study document. A time-stamped trial protocol will help the reader to know how much of the conclusion is based on post hoc decisions.
- The methodology is not explicit, unnecessarily complicated and bias due to selective reporting of outcomes in the reported results, and the conclusions cannot be ruled out. A very complicated study design with several levels of stratification with no conclusive findings.
- Very difficult to decipher the findings owing to several subgroups (perhaps not needed)
- A lot of ambiguity in terms of the behavioral intervention given and sequence of events (recruitment, different components of intervention given, and data collection)
- Geographic and demographic representation is well calculated. However, how this strategy was implemented is not well explained. What was the universe?
- There is no clarity on the statistical analysis undertaken at different stages of the study.

- The study appears to be perception-based marketing research and perhaps not an epidemiology-based RCT.
- The study needs to be re-done with all the critical considerations of RCT and the research questions need to be prioritized based on the questions asked from the policy perspective. In fact, this study can be a basis for a large well designed representative randomized controlled trial taking in all the lessons learned from the implementation of the study, intervention, and measurement of outcomes.
- In its current state, the study findings do not meaningfully inform policy on "consumer preference on front-of-pack nutrition labels" in the context of their health and wellbeing.

end of the document

……..

Comments on the IIM Study : Consumer preference for different nutrition front-of-pack labels in India

Requested by NAPi

May, 2nd 2022

By: Prof. Dr. Piyush Gupta, MD, FAMS *Professor and Head, Department of Pediatrics, University, College of Medical Sciences, Delhi; Immediate Past President, Indian Academy of Pediatrics*

At the behest of Food Safety and Standards Authority of India (FSSAI), Indian Institute of Management (IIM), Ahmedabad conducted a randomized controlled trial on more than 20,000 consumers to determine their preferences for different FoPLs, in order to frame policy for the Indian Market. The authors recommended that the Health Star Rating to be considered as a preferred choice for policy.

Here are my comments:

1. **Methodology**: For the results and conclusions to be valid, it is important to have a robust unquestionable methodology. More so when this has to be translated into policy and action at the National level by the regulatory body (read FSSAI). Let us therefore examine the applicability of this study for 1.3 billion consumers of this country. The IIM trial enrolled a nationally representative sample of 20,564 face to face respondents who were randomized to one of the six groups: no FoPL, HSR, Nutri-score, Warning labels, traffic lights, and monochrome GDA. The participants in the five intervention groups were further subcategorized into three groups: no health prime group, a healthy prime group, and an unhealthy prime group. Thus a

total of 15 treatment groups were created. Three variants of the label were used but there is no information why. Other than this, the control group also had three subgroups. Interventions were conducted in an heterogeneous manner (62% physically and the rest 7811 over video calls). It is also not clear how blinding was done.

2. **The missing piece**: The IIM study was limited to identify purchase intention for packaged biscuits and chips only. A very important group that was left out was sugar -sweetened beverages (SSBs).
3. **Objective vs subjective assessment:** The decisions were not based on objective measures that would really gauge the ability of the consumer to understand the nutrition information. Objectivity is an extremely important criteria while assessing FoPL. Subjective assessment has multiple confounders and thus is unsuitable for a policy decision with implications for the entire country. Similar studies from Chile, Uruguay, and Mexico are also based on objectivity.
4. **Contd.** As also stated above, the results appear to be based on self-reported measures of understanding, which are by and large, subjective. The questions fail to assess whether the participants are actually able to understand the FoPL. Consumers' decision needs to be based on their understanding of the nutrition content/information and not only on how attractive is a particular label. This is the underlying science behind making this policy.
5. **What was the exact stimulus**?: The IIM report also falters on several other aspects. The report also did not include the exact stimuli (treatment) the consumers were exposed to. Exact questions asked to the participants are not elaborated. Justification is not provided for using the healthy/unhealthy primes. The results of FoPL in the no prime condition were all that were needed, to answer the research question.
6. **The other study**: A study led by the scientists of International Institute for Population Sciences IIPS (2022) among 2,689 adults across 6 states (Assam, Delhi, Gujarat, Odisha, Karnataka, UP) has documented that all 5 FoPL were effective in influencing product perceptions and label reactions. And of these, warning labels showed the largest effect. HSR doesn't let the consumer realize the associated health risk with a particular food/beverage.
7. **Authors Selection:** According to the report, both HSR and warning labels appeared to be the most easily identified, most easy to comprehend, considered most reliable, and able to influence the consumer as compared to the rest of the labels. The report indicated that the Multiple Traffic Light (MTL) was the most preferred for health information and the presence of unwanted nutrients.
8. **Contd.** But the study concluded that HSR appears most acceptable. However, their final word on the best FoPL is to be taken with a pinch of salt as the evidence and justification given in this Report needs much to be desired.

9. If our main concern is to alert the consumer to unhealthy nutrients in terms of quantity or quality, then warning labels consistently score better and show a maximum effect size. Studies are available to show that warning label has the largest effect in the ability of consumer to correctly identify that a particular food has excess amounts of nutrients of concerns. In fact, the IIM report itself acknowledges that scientific evidence exists to prove that warning labels deter people from buying unhealthy food for their child, yet the HSR system has been recommended.
10. **CONCLUSION**: It is surprising why Warning label is left out in favour of HSR. Based on the above comments, the report does not sound valid for use in making a public health policy. Let me also provide my opinion below why India should go for warning labels on unhealthy, ultra-processed food products.
11. **Opinion:** Visually, the presence of one or two stars runs the danger of overcoming the absence of four or there stars. Add to it the fact that we've been taught to use 'stars' in an overt and explicit positive connotation, and it effectively renders the health-star rating system redundant as to alert someone to reject for consumption. The health-star rating is also open to industry-abuse. A health-star rating, in essence, could be interpreted for just about anything. It is well known that companies can benefit from misrepresenting their products at the cost of the consumer's health, many will choose to do so. The inefficacy of the Health-Star Rating System is evidenced also by the willingness of the food industry to adopt it, which views it as the a system that least affects its bottom-line. The whole point of advocating for a Nutritional Warning System as an FoPL is to allow the consumer to make an informed decision in a matter of seconds. FoPL only does that, whichever is the product if it crossed the limits. The health-star rating takes out all pertinent information, leaving the decision-making to emotion and guesswork. The Nutrient Warning Label is a direct, informative alternative to it. It gives the consumer the exact information they'd need without looking at the detailed list of nutrients on the back of the pack. A high amount of sugar, salt or fat can be immediately conveyed without any ambiguity. This is also the reason that the food industry, plagued by inertia, is vehemently opposed to it – it would mean shrugging off the complacency and actually reworking their products to be healthier and less harmful, in order to avoid the label. The Nutrient Warning Label thus has the potential to affect not only the consumer's psyche, but industry practice as well.

……

Review of the study: Consumer Preferences for Different Nutrition Front-of-Pack Labels in India conducted by IIM-A, Dexter. Feb 15, 2022

Requested by : Nutrition Advocacy in Public Interrst(NAPi)

By Prof. Dr. Abhaya Indrayan,

MSc, MS, PhD (Ohio State), FSMS, FAMS, FRSS, FASc. Former Professor of Biostatistics, University College of Medical Sciences Delhi.

The report describes the methodology and the results of their nationwide survey of 20,564 persons of age 18 years and above with nearly equal representation of males and females. The objective was to assess the preference for front-of-pack labels on food products (the survey was limited to chips and biscuits). These subjects were randomly allocated to 45 'treatment' groups (15 label types x 3 Primes) @ nearly 400 per group. In addition, 800 per Prime were in the Control group with no label. One of the Primes was 'None' and the other two were 'Healthy' and 'Unhealthy'. There are the prompts provided to the respondents regarding the food products. The survey was limited to 5 label types (Multiple Traffic Lights (MTL), Monochrome GDA, Nutri-Score, Warming Labels, and Health Star Rating (HSR). Three variants of each type of labels were also considered but the findings are stated after collapsing them. Thus, the need to have 3 variants of each type of label is not clear.(p 14)

Rationale of determining 400 as adequate sample size for each 'treatment' is not mentioned. These subjects have been divided into States, rural-urban, male-female, age-groups, and occupations – thus the spread of the representation of various categories looks very this. The results are rightly presented after collapsing these categories except at some places. However, the details of the method of random allocation are not provided – thus the findings cannot be taken on their face value. In addition, the sampling frame for the selection of the subjects is not clear, although the allocation of the sample to rural and urban segments is assiduously explained. Nearly one-sixth of the sample was discarded due to incompleteness or for other reasons. (p-17) This is substantial and may have introduced bias. This possibility has not been considered. About 62% interviews were physical and the remaining on video calls – both were rightly pooled because the buying intensions of these two groups were not found statistically significant despite not so small sample.

The rating for preference of the labels and purchase intension were elicited on a 7-point Likert scale. The report concludes that HSR was the most acceptable label, closely followed by Warning Label. However, the report says that MTL was the most preferred for indicating health information and the presence of unwanted nutrients, as well as for indicating purchase intension. Thus, the results were not as unequivocal as the report seems to convey in their conclusion.

From the consumer viewpoint, nutrient information is indeed useful, but perhaps equally useful is the information on the ill-effects of the constituents of the food products. The survey seems to be missing this crucial aspect. Perhaps Warning Labels serve this purpose well and they have been found to get nearly the same rating on average as the HSR. Warning Labels have received a significantly higher rating by 'No Prime' respondents for both chips and biscuits than the 'Healthy Prime' respondents (Table 3). Strongest effect of priming was observed with Warning Labels in the 'Healthy Prime' and 'Unhealthy Prime' groups (p.21). They were also marginally ahead in term of reducing purchase intention in both 'Healthy Prime' and 'Unhealthy Prime' groups (p.22). Warning labels were also observed to have more

extensive support across occupations (p.26). These findings have not received the prominence in the report they deserve.

Statistically, as already mentioned, the adequacy of the sample size is not explained, the sampling frame from which the sample was selected is not specified, and the method of selection is not fully explained. Possible effect of huge nonresponse on the findings is not discussed.

There are other minor statistical problems. The degrees of freedom (dfs) shown for the *t*-tests differ from each other and what they apparently ought to be, and no explanation for this discrepancy is provided (p.17). The *t*-values and *P*-values are shown at some places and not at other places though significance is concluded (e.g., top of p.25). The symbol *d* has been used without specifying that it (probably?) is Cohen's *d*. A complete table with means and *P*-values for the findings mentioned on page 25 would have enhanced the credibility gof the findings. The findings stated as bullet points on page 26 may not be statistically significant (no *P*-values given) because of small *n* in various subgroups. In the absence of a table and the data, the findings on page 27 (particularly the top paragraph) look subjective and unsubstantiated.

Considering all the above-mentioned points, the results and conclusion of the report are suspect. Warning Labels seem to deserve a better consideration.

Conflicts of Interest : None

ends.

 doi:10.20944/preprints202205.0058.v1

Annex-5

Article

Which Front-of-Package Labels Help Indian Consumers Identify and Reduce Unhealthy Food Purchases? A Randomized Field Experiment

S.K. Singh[1]* and Lindsey Smith Taillie,[2]*, Ashish Gupta[3], Maxime Bercholz[4], Barry Popkin[2], Nandita Murukutla[3]

[1] Department of Survey Research and Data Analytics; International Institute for Population Sciences, Deemed University; sksingh@iipsindia.ac.in
[2] Department of Nutrition, Gillings School of Global Public Health; Carolina Population Center; University of North Carolina at Chapel Hill; taillie@unc.edu; popkin@unc.edu
[3] Vital Strategies; agupta@vitalstrategies.org; nmurukutla@vitalstrategies.org
[4] Carolina Population Center; University of North Carolina at Chapel Hill; bercholz@email.unc.edu
* Denotes co-first authors and co-corresponding authors. Correspondence to: sksingh@iipsindia.ac.in for SKS and taillie@unc.edu for LST.

Abstract: Policies to require front-of-package labels (FOPLs) on foods may help Indian consumers better identify foods high in nutrients of concern including sugar, saturated fat, and sodium, and discourage their consumption, outcomes critical for preventing rises in diet-related non-communicable disease. The objective was to test whether FOPLs helped Indian consumers identify 'high-in' foods and reduce intentions to purchase them. We conducted an in-person randomized experiment (n=2,869 adults between ages 18 and 60 years old) in six states of India in 2022. Participants were randomized to one of five FOPLs: a control label (barcode), warning label (octagon with "High in [nutrient]"), Health Star Warning (HSR), Guideline Daily Amount (GDA), or traffic light label. Participants then viewed a series of foods high in sugar, saturated fat, or sodium with the assigned FOPL, and rated product perceptions and label reactions. Fewer than half of participants in the control group (39.1%) correctly identified all products high in nutrient(s) of concern. All FOPLs led to an increase in this outcome, with the biggest differences observed for the warning label (60.8%, p<0.001) followed by the traffic light label (54.8%, p<0.001), GDA (55.0%, p<0.001), and HSR (45.0%, p<0.01). Relative to the control, only the warning label led to a reduction in intentions to purchase the products. The results suggest that warning labels are the most effective FOPL to help Indian consumers identify and avoid unhealthy foods.

Keywords: warning labels; Health Star Rating; Nutriscore; GDA; food policy; obesity prevention; non-communicable diseases

1. Introduction

Over the past several decades, with the emergence of the epidemiological transition, India has experienced a growing problem of overweight and obesity and all the major nutrition-related noncommunicable diseases, especially diabetes and hypertension[1-3]. According to the latest National Family Growth study, nearly 1 in 4 adults and 1 in 20 children are classified as overweight or obese.[4] Rates are increasing faster

 doi:10.20944/preprints202205.0058.v1

in India than the world average, and obesity prevalence is expected to more than triple by the year 2040, without intervention.[5, 6] At the same time India faces a major double burden of malnutrition as stunting and other forms of undernutrition remain high among the rural poor, in particular. [7-9]

These changes have occurred at a time when a remarkable diet transformation is occurring in India which affects rich and poor, young and old. In particular, growth of ultraprocessed food consumption in India is significant. As shown in neighboring Nepal, even preschools are increasingly being fed these foods as one study found 25% of preschoolers' caloric intake came from ultraprocessed food and this was linked with higher levels of stunting.[10] From 2006 to 2019, sales of ultra-processed snack food and sweetened beverages in India grew from 1 billion USD to 38 billion USD.[11]

Many ready-to-eat or ready-to-heat foods and drinks are high in added sugars, sodium, saturated fats, and refined carbohydrates. Excessive consumption of these nutrients increases risk of obesity and related NCDs.[12-24] A growing literature of both a large random controlled trial and over 45 longitudinal cohort studies have linked ultra-processed food with increased risk of overweight/obesity, diet-related NCDs and total and heart disease-linked mortality.[15, 25].

To reduce consumption of packaged foods high in added sugar, sodium, saturated fat, and trans fats, front-of-package labels (FOPLS) have been recommended by the World Health Organization (WHO), the World Bank and others**.** [26-34] The primary goals of front-of-package labels (FOPLs) are to inform consumers about the nutritional quality of food in a way that is quick and easy to understand and improve the nutritional quality of food purchases, with a secondary goal of stimulating reformulation in the food supply[35]**.** Interpretive FOPLs are particularly promising because they not only provide information about nutritional content, but also help consumers judge the healthfulness (or unhealthfulness) of products and provide guidance (encouragement or discouragement) about the decision to purchase. These are important to reduce intake of the major unhealthy processed foods consumed in India. By synthesizing complex nutrition facts into interpretable information, these labels may be especially valuable for populations with low literacy.

The evidence base on FOPLs is growing rapidly. Warning labels perhaps have the strongest evidence with regards to discouraging purchases of foods high in nutrients of concern, with recent systematic reviews of experimental and quasi-experimental data showing that warnings reduce selection of unhealthy products by 26% to 36%.[36, 37] Another recent review, focused on sugar, found that warnings were the most effective at increasing consumers' understanding of the high nutrient content in foods.[38] Real-world evidence from Chile, the first country to implement mandatory front-of-pack warnings, found that warning labels were linked to a 24% decrease in purchases of unhealthy foods[39] and helped both parents and children identify unhealthy food and drinks and discourage their consumption[40]. In contrast, there is limited real-world data about the effectiveness of other common interpretive FOPLs, such as traffic light labels or the Health Stars Rating (HSR) system.[35] Real-world data on traffic light labeling systems has been mixed: one UK-based study found a sizeable reduction in calories purchased linked to the traffic light policy[41], while another study found no association with purchases.[42] Data from Ecuador, which implemented a mandatory traffic light labeling system in 2014, have found low self-reported use of the labeling system[43] and no evidence that traffic light labels have influenced purchasing behaviors.[44, 45] Real-world evidence on the effectiveness of the HSR system has also been quite poor. Data from Australia and New Zealand,

 doi:10.20944/preprints202205.0058.v1

which implemented voluntary HSR schemes in YEAR and YEAR, respectively, show low uptake of the HSR(72)(49), with implementation skewed towards products considered to be healthier (i.e., with higher ratings). To our knowledge, there is no real-world evaluation evidence that HSR leads to healthier food purchases; meta-analyses and systematic reviews of experimental studies have similarly found low- or no- evidence that HSR impacts purchasing behaviors.[46-49]. Evidence in favor of the industry-promoted Guideline Daily Amounts (GDA) system is the weakest of all, with an array of both experimental and real-world evaluation studies from across the globe finding that relative to almost all other FOPL types, the GDAs are poorly understood, take the most time to evaluate, and are the least effective at influencing purchases. [38, 47, 50-59]

However, at the time this study was planned, there was virtually no evidence about what FOPL system will work best to inform Indian consumers about foods excess in these nutrients of concern and discourage purchases of these products. In this context, the objective of this study was to experimentally evaluate the impact of FOPLs on consumers' ability to correctly identify products as containing excess levels of nutrients of concern and intentions to purchase them, relative to a control label, in a sample of Indian adults across six states. Secondary outcomes included consumers' reactions to the FOPLs and perceptions of unhealthy products.

Given the diversity of the Indian population in terms of language, culture, dietary intake, and educational attainment, it is also essential to ensure that any FOPL regulation works well across the entire population as well as for different food categories. To address this, we explored whether the impact of FOPLs varied by product type, educational level, and state.

2. Materials and Methods

IRB

This study was reviewed and approved by the Institutional Review Board (IRB) at the International Institute for Population Sciences (IIPS) in Mumbai, India and by **BRANY (Biomedical Research Alliance of New York),** a national organization that provides IRB services.

This study was pre-registered at Open Science Framework in December 2022: https://osf.io/8kx3e. De-identified data is available at [add link at time of publication]. Participants provided written consent or, for those who could not provide a signature, verbal consent.

Setting

We carried out an in-person field experiment in rural and urban areas of 6 states (Assam, Delhi, Gujarat, Odisha, Karnataka, Uttar Pradesh) from January to March of 2022). These states were chosen purposively as sentinel sites to represent the geographic areas of India as well as key associated sociodemographic variations. From each of these states, one district was selected (Delhi, Mysuru, Bhubaneshwar, Lucknow, Ahmedabad, Guwahati).

First, four wards (two urban, one semi-urban, one peri-urban) were randomly chosen from each district. Next listing of potential survey locations was undertaken in each of these selected wards. Each location was classified into four clusters, namely, peak day

 doi:10.20944/preprints202205.0058.v1

peak-time, peak-day lean-time, lean-day lean-time, and lean-day peak-time. This generated sampling frame of time-location clusters (TLCs). Four TLCs per ward were randomly selected from list for survey. These locations were the places that sold packaged food items. These could be either shop/retail outlet (called Kirana shops locally), large grocery store (in a shopping mall or on a high street), group of small shops, or smaller petty shops (tea stalls, shops selling *paan* – betel leaves wrapped around tobacco, fruits etc.).

Participants

The participants were 2,869 adults between ages 18 and 60 years old. Recruitment of participant was done by intercepting the customers using the nth interval calculated for the location using the footfall during the TLC (Interval=Total Footfall recorded at the location during listing/28). The details of the intercepts were filled in the intercept forms. Once the nth person was intercepted, s/he was checked for eligibility and a request was made for interview. Interviews were conducted with those who consented. After the interview, the next nth person was intercepted, whereas after the refusal, immediate next person was intercepted. The person who agreed for the interview, was taken to a close by comfortable place for interview where disturbances from the street were minimal.

Within each state, quota were used to obtain approximately 50% of participants who were women and with an educational level of 12 years or less. Eligibility criteria included being between ages 18-60 years old and being involved in decision-making related to grocery purchases for their household at least half the time.

Stimuli

Four FOPLs were selected for testing based on conversations with Indian health advocacy organizations and governmental organizations indicating that these labels were of interest for informing an impending FOPL regulation. In addition, the GDA was selected because has already been voluntarily implemented on some products in India. Images of the FOPLs (as mocked up on sweet biscuits) are depicted in **Figure 1**.

Figure 1. Front-of-package labels (FOPLs)

 doi:10.20944/preprints202205.0058.v1

Warning label: The main design was modeled on the proposed warning label used in South Africa.[60] A design agency adapted the warning for India through design testing with 15 adults in five cities of India to ensure that the label was noticeable and understandable in a socioeconomically diverse population. The warning label was comprised of a white holding strap with the marker word ALERT! and at least one triangle-shaped warning and up to three warnings, depending on the nutrient content of the product (with text, HIGH IN SUGAR, HIGH IN SODIUM, or HIGH IN SATURATED fat). Based on prior evidence that icons increase perceived effectiveness and comprehension of the label across populations speaking different languages[61] and literacy levels[60], icons depicting sugar, salt, and saturated fat were also used.

HSR The HSR was modeled after the existing HSR system used in Australia and New Zealand. The circular label stated HEALTH STAR RATING and depicted a number of stars from 0.5 to 5 shaded in black to indicate the healthfulness of the product, with fewer stars indicating less health and more stars indicating healthy.

Traffic light labels The traffic light label was based on a simplified version of the system used in the UK and Ecuador. The label presented color-coded information on sugar, sodium, and saturated fat for each product, with red signaling high, amber signaling medium, and green signaling low content of that nutrient.

GDA The GDA was based on the existing GDA used voluntarily by the food industry in many countries. The GDA contained four blue shaded shapes containing nutritional information on calories, saturated fat, sugar, and salt (both the absolute content in calories or grams as well as the percent of an adult's guideline daily amount).

Control label Similar previous FOPL experimental studies[62, 63], a barcode label was used as a control label because it serves as a piece of visual information on the front of the food package while conveying neutral information about the product's nutritional content.

The labels were displayed on a series of products, including a savory biscuit, a loaf of bread, a fruit drink, a sweet biscuit, and a package of instant noodles (**Appendix A**). These product categories were chosen because they are commonly consumed, are often high in nutrients of concern, and because they represent categories where there may be high levels of consumer confusion about nutritional content of the products. A professional designer designed mock products to avoid the influence of brand preferences, though to increase realism, the mock products and their nutritional information were based on popular Indian brands.

For each product, one commercial brand within each food category was selected. A mock nutrient profile was created based on this brand (±2% of the original nutrient profile model). Each label was then based off of the relevant nutrient profile model: for HSR, Australia's HSR calculator was used;[64] for warning labels and traffic light labels, the thresholds specified in the 2019 draft regulation for Food Safety Standards and Authority (FSSAI) were used; and for the GDA, national dietary guidelines were used.[65]

Cognitive testing and protocol development

The study protocol and measures used were developed and refined through an iterative process to ensure acceptability among diverse participants. First, study items were translated from English into five languages (Assamese, Gujarati, Hindi, Kannada, and Odia). Two rounds of cognitive interviews were completed to make sure the measures were properly adapted to the Indian context and well-understood in each language, while

 doi:10.20944/preprints202205.0058.v1

maintaining consistency with the underlying construct[66]. The interviews were completed in two phases, with each phase including four participants in each language (40 interviews total), with refinement of study measures occurring between phase one and two. After cognitive interviews were complete, items were refined, new additions were translated and back-translated to English before being reviewed by study co-authors. The field methodology (including recruitment and study implementation) was then pilot tested in a sample of 20 adults in an urban area of Delhi State in December of 2021 before further finalization of the study protocol.

Procedure

Participants were randomized to one of 5 arms: control label, HSR, warning, GDA, or traffic light label using an allocation ratio of 1:1:1:1:1. Participants then viewed a series of images of products, in random order, with an FOPL on the product according to assigned arm. In the control condition, all products had the barcode label. In the HSR condition, all products displayed stars. In the warning label condition, products displayed the relevant warning(s) for sugar, sodium, and/or saturated fat. In the GDA condition, all products had a GDA with the relevant nutritional information. In the traffic light condition, products displayed a multiple traffic light with the relevant color code (green, yellow, or red) for each nutrient.

Interviewers showed participants images of products using an A5 size booklet, in random order, and asked them to assess the product and their reactions to the label. At the end, the participant viewed images of all 5 FOPLs and answered questions about which label they preferred. All data were entered into a smartphone app during the interview.

At the end of the study, participants provided demographic information.

Measures

Socio-demographic and behavioral covariates were specified as follows: gender (man/woman), age (18-30, 31-40, 41 and older), education (≤12 years of education, >12 years), urbanicity (defined as peri-rural, semi-urban, and urban), and state (Assam, Delhi, Gujarat, Odisha, Karnataka, Uttar Pradesh). Languages included: Assamese (Assam), Gujarati (Gujarat), Hindi (Delhi, Uttar Pradesh), Kannada (Karnataka), and Odia (Odisha). Participants were also able to conduct the survey bilingually (in the language of the state and English), if they preferred. Financial situation was defined as a four-level variable: 1) can pay the bills and buy necessary and additional things; 2) can pay the bills and buy necessary things only; 3) can pay the bills but not buy necessary things; and 4) cannot pay bills. Household income was categorized as <RS. 10,0000; RS 10,001-25,000; 25,0001-50,000, and over RS. 50,000 Consumption of "high-in" food (sweet biscuits, salty biscuits, bread, and instant noodles) was categorized as never or less than one time per week, 1 time per week, or more than 2 times per week.

The codebook including product assessment items and label assessment items is available in **Appendix B**.

For all five products, participants rated their perceptions of the product. First, to assess their ability to correctly identify that the product had high contents of nutrients of concern, they answered the question "Do you think this product has high [nutrient of concern]?" (yes/no). For two products, the sweet biscuit and the instant noodles, the respondents were asked this question twice, one for each nutrient of concern.

 doi:10.20944/preprints202205.0058.v1

Next, they were asked, "Is this product unhealthy?" (yes/no). If they answered yes, they were asked, "how unhealthy is it?" with response options ranging from 1 to 3 (very much, somewhat, very little). They were then asked about visual attractiveness ("Do you think this product is visually attractive?") and intentions to purchase ("Will you purchase this product next week, if it were available?") with a yes/no response. Those who answered "yes" were asked the follow-up question ("How visually attractive," or "How likely," respectively) with two options again ranging from (1) very much to (3) very little.

Participants also completed a label assessment for three of five products (randomly selected). Participants answered whether the label grabbed their attention, made them feel concerned about the health problems of consuming the product, was understandable, taught them anything, was truthful, and was likable. For perceived message effectiveness, participants were asked if the label made them concerned about the health consequences of consuming the product, made the product seem unpleasant, and made them feel discouraged from wanting to consume the product. For all items, response options were yes/no. If the respondent answered yes, they were then asked "how much…" with responses ranging from (1) very much to (3) very little.

Finally, participants were asked to compare their label and select which label would a) most discourage them from consuming the product; b) most discourage them from feeding the product to a child age 1-12 years old; c) best informs them that the product has high [nutrient]; and d) is the easiest to understand.

Statistical Analysis

First, we recombined some measures. For all items measured on the Likert scale, we combined the agreement item (yes/no) with the strength of agreement item for each person to create a 4-point Likert scale, subsequently recoded from 1 (not at all) to 4 (very much) for a more intuitive interpretation. For perceived message effectiveness, Cronbach's alpha for the three items was > 0.7, so we created a scale that was the average of the three items for each product type. For the primary outcome, ability to correctly identify products high in nutrients of concern, we *a priori* specified this as correctly identifying *all* nutrients, since two products had multiple nutrients.

We descriptively reported sociodemographic characteristics and examined whether participant demographics differed by study arm using chi-square. Then, we descriptively reported unadjusted percentages and means (and standard deviations) for the two primary outcomes by product type.

For all main analyses, we examined differences between the control label and each of the other FOPL conditions. For all outcomes with multiple measurements for each person, we used mixed effects logistic regression for the correct identification of all 'high-in' nutrients and mixed effects linear regression for all other outcomes, with respondent-level random intercepts to account for repeated measures. Standard errors were clustered by interviewer. We included indicator variables for label type (between-subjects) and product type (within-subjects), as well as an interaction of label type and product type, if significant at the 5% level (as stated in the pre-registered analysis plan). The Holm procedure was used to adjust the p-values for multiple comparisons within each outcome (four tests for the four label types compared to the neutral label). This was done so the familywise error rate across the four tests within each outcome would not exceed 0.05, the nominal significance level.

 doi:10.20944/preprints202205.0058.v1

To evaluate the most discouraging label, the most informative label, and the label that was easiest to understand, we descriptively reported the percentage of participants that selected each label type as the most discouraging from consuming the product, most discouraging from feeding the product to a child, most informative, and the easiest to understand.

To assess whether the effect of FOPLs on the primary outcomes differed by socio-demographic and behavioral covariates, we conducted exploratory moderation analyses by adding, in turn, each moderator of interest and its interaction with label type to the main model. For potential moderators, we included education and state. We explored moderation by state instead of language (as stated in the pre-registration) since most states used their own language and state-level differences were of interest conceptually due to regional variation in the food supply and dietary behaviors. We also included urbanicity, gender, whether the survey was conducted bilingually, and weekly consumption of the five product types presented to the participants as additional exploratory moderators. As Cronbach's alpha was < 0.7 for the five consumption measures, separate models were estimated for each product, using the corresponding consumption measure as the exploratory moderator. Since separate models were fit for each product, there were no repeated measures and linear and logistic regressions were used. We tested for overall differences in the effect of each label (relative to the control, i.e. the difference in means between a given FOPL group and the control arm) across the levels of each moderator.

Finally, we conducted sensitivity analyses on the primary outcomes, in which we excluded participants who had been interviewed by one of the six interviewers with the highest or lowest three means among their respective respondents.

We used a two-sided significance level of 0.05 to conduct all statistical tests using Stata version 16.1.

3. Results

3.1 Descriptive results

Socio-demographic characteristics of the sample are reported in **Table 1**. No covariates were found to be unbalanced between study arms. The study was roughly distributed proportionately across all six states, with about half of the sample in urban areas and a quarter each in semi-urban and peri-rural areas. The sample was comprised of approximately half women and half with an education <12years, and the majority of the sample were able to pay the bills and buy what they need. Approximately 40% completed the interview in mixed language.

Table 1. Socio-demographic characteristics of the sample.

		Control	**Warning**	**GDA**	**HSR**	**MTL**	**Total**
		n = 574	n = 598	n = 554	n = 601	n = 542	n = 2869
	P-value	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
State	0.114						
Odisha		79 (13.8)	94 (15.7)	92 (16.6)	88 (14.6)	83 (15.3)	436 (15.2)
Uttar Pradesh		83 (14.5)	89 (14.9)	102 (18.4)	90 (15.0)	91 (16.8)	455 (15.9)
Assam		99 (17.2)	110 (18.4)	92 (16.6)	90 (15.0)	75 (13.8)	466 (16.2)
Delhi		110 (19.2)	82 (13.7)	94 (17.0)	108 (18.0)	97 (17.9)	491 (17.1)
Karnataka		96 (16.7)	119 (19.9)	94 (17.0)	120 (20.0)	84 (15.5)	513 (17.9)

 doi:10.20944/preprints202205.0058.v1

Gujarat		107 (18.6)	104 (17.4)	80 (14.4)	105 (17.5)	112 (20.7)	508 (17.7)
Urbanicity	0.603						
Urban		307 (53.5)	289 (48.3)	286 (51.6)	309 (51.4)	285 (52.6)	1476 (51.4)
Semi-Urban		133 (23.2)	168 (28.1)	131 (23.6)	149 (24.8)	124 (22.9)	705 (24.6)
Peri-rural		134 (23.3)	141 (23.6)	137 (24.7)	143 (23.8)	133 (24.5)	688 (24.0)
Age category	0.880						
18-30y		195 (34.0)	209 (34.9)	176 (31.8)	205 (34.1)	190 (35.1)	975 (34.0)
31-40y		200 (34.8)	220 (36.8)	212 (38.3)	211 (35.1)	187 (34.5)	1030 (35.9)
41-60y		179 (31.2)	169 (28.3)	166 (30.0)	185 (30.8)	165 (30.4)	864 (30.1)
Gender	0.933						
Man		290 (50.5)	301 (50.3)	286 (51.6)	298 (49.6)	266 (49.1)	1441 (50.2)
Woman		284 (49.5)	297 (49.7)	268 (48.4)	303 (50.4)	276 (50.9)	1428 (49.8)
Education level	0.098						
< 12 years		256 (44.6)	237 (39.6)	254 (45.8)	255 (42.4)	254 (46.9)	1256 (43.8)
≥12 years		318 (55.4)	361 (60.4)	300 (54.2)	346 (57.6)	288 (53.1)	1613 (56.2)
Salty biscuit intake	0.279						
<1x/week		171 (29.8)	167 (27.9)	167 (30.1)	188 (31.3)	166 (30.6)	859 (29.9)
1x/ week		189 (32.9)	211 (35.3)	159 (28.7)	200 (33.3)	189 (34.9)	948 (33.0)
>1x/ week		214 (37.3)	220 (36.8)	228 (41.2)	213 (35.4)	187 (34.5)	1062 (37.0)
Sweet biscuit intake	0.068						
<1x/week		112 (19.5)	112 (18.7)	119 (21.5)	142 (23.6)	118 (21.8)	603 (21.0)
1x/ week		164 (28.6)	155 (25.9)	164 (29.6)	158 (26.3)	122 (22.5)	763 (26.6)
>1x/ week		298 (51.9)	331 (55.4)	271 (48.9)	301 (50.1)	302 (55.7)	1503 (52.4)
Bread intake	0.696						
<1x/week		137 (23.9)	169 (28.3)	146 (26.4)	156 (26.0)	130 (24.0)	738 (25.7)
1x/ week		148 (25.8)	151 (25.3)	145 (26.2)	168 (28.0)	148 (27.3)	760 (26.5)
>1x/ week		289 (50.3)	278 (46.5)	263 (47.5)	277 (46.1)	264 (48.7)	1371 (47.8)
Fruit drink intake	0.139						
<1x/week		245 (42.7)	231 (38.6)	248 (44.8)	251 (41.8)	228 (42.1)	1203 (41.9)
1x/ week		141 (24.6)	139 (23.2)	139 (25.1)	137 (22.8)	145 (26.8)	701 (24.4)
>1x/ week		188 (32.8)	228 (38.1)	167 (30.1)	213 (35.4)	169 (31.2)	965 (33.6)
Noodles intake	0.515						
<1x/week		201 (35.0)	202 (33.8)	206 (37.2)	238 (39.6)	190 (35.1)	1037 (36.1)
1x/ week		139 (24.2)	144 (24.1)	139 (25.1)	145 (24.1)	139 (25.6)	706 (24.6)
>1x/ week		234 (40.8)	252 (42.1)	209 (37.7)	218 (36.3)	213 (39.3)	1126 (39.2)
Financial situation	0.212						
Can pay bills, buy needed and additional things		216 (37.6)	247 (41.3)	208 (37.5)	240 (39.9)	200 (36.9)	1111 (38.7)
Can pay bills, buy what is needed		251 (43.7)	251 (42.0)	259 (46.8)	257 (42.8)	261 (48.2)	1279 (44.6)
Can only pay bills		86 (15.0)	80 (13.4)	57 (10.3)	78 (13.0)	60 (11.1)	361 (12.6)

Cannot pay bills		21 (3.7)	20 (3.3)	30 (5.4)	26 (4.3)	21 (3.9)	118 (4.1)
Mixed language	0.274						
Yes		231 (40.2)	242 (40.5)	204 (36.8)	251 (41.8)	234 (43.2)	1162 (40.5)

Note: Intake was measured as self-reported frequency of weekly consumption over previous 30 days. Mixed language reflects whether the language was conducted bilingually in the native state language and English. The P-value is from a chi-square test for differences by arm.

Overall descriptive results for all label and product assessment outcomes can be found in **Appendix C**. Descriptive results for label choice can be found in **Appendix D**.

Descriptive results for the primary outcomes by product type can be found in **Appendix E**. For the percent of participants who correctly identified all products high in nutrient(s) of concern, there were some observable differences by product type, with the highest percentage of participants in the control group correctly identifying the fruit drink (60.5%) and the lowest percentage identifying the sweet biscuit (24.7%). Thus, the difference between each FOPL and the control arm was smaller for all FOPL types for fruit drinks relative to most other product types. In contrast, the difference between each FOPL and the control arm tended to be higher for noodles and savory biscuits relative to the other products, though this varied somewhat by FOPL type. There were minimal differences by product type for intentions to purchase.

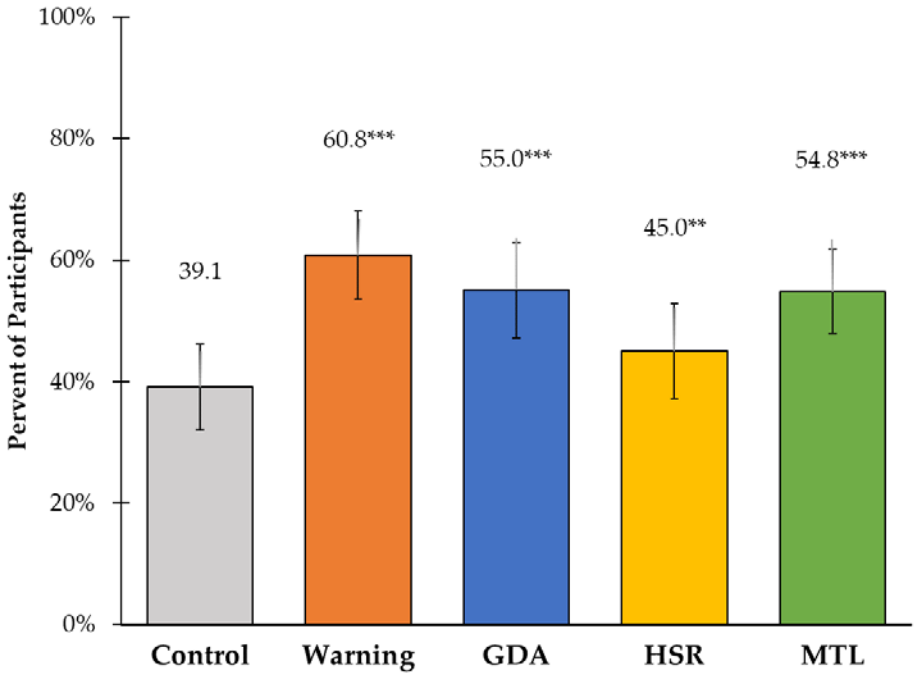
Descriptive results for the primary outcomes by state can be found in **Appendix F**. In the control group, Assam and Delhi were the states that had the lowest percentage of participants correctly identified products as containing high levels of nutrient(s) of concern (25.9% and 24.4%, respectively), while Uttar Pradesh and Karnataka were the highest (53.0% and 56.75%, respectively). For all FOPL types, the difference between each FOPL and the control arm was the smallest for the state of Odisha. For most FOPLs, the difference between each FOPL and the control arm was the greatest for the state of Uttar Pradesh, followed by Gujarat.

There were also observable differences in intentions to purchase products high in nutrients of concern by state. In the control group, intentions to purchase were highest in Assam (3.1 ± 0.8) to the lowest in Delhi (2.3 ± 1.1) and Gujarat (2.4 ± 1.0) and Odisha (2.4 ± 1.1)

3.2 Main results

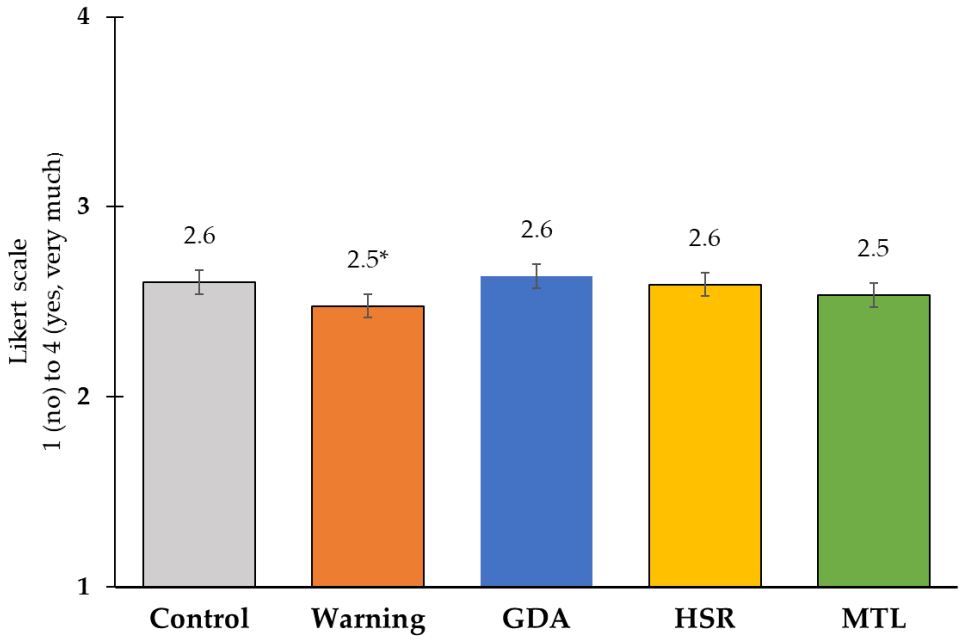
Results on the primary outcomes can be found in **Figure 2** and **Figure 3.** Relative to the control group (39.1% of participants; 95% CI 32.0, 46.2), each FOPL led to an increase in the percentage of participants who correctly identified all products with high levels of nutrient(s) of concern, with the biggest differences observed for the warning label (60.8%, 95% CI 53.5, 68.0; p<0.001) followed by the traffic light label (54.8%, 95% CI 47.9, 61.8; p<0.001), GDA label (55.0%, 95% CI 47.1, 62.9; p<0.001), and HSR label (45.0%, 95% CI 37.2, 52.8; p<0.01). Relative to the control label (2.6, 95% CI 2.5, 2.7), only the warning label led to a reduction in intentions to consume (2.5, 95% CI 2.4, 2.5; p<0.01). Full numerical results for both outcomes are shown in **Appendix G.**

 doi:10.20944/preprints202205.0058.v1



*** P-value <0.001 relative to the control label; ** P-value <0.01; * P-value <0.05; GDA= Guideline Daily Amounts, HSR= Health Star Rating, MTL= Multiple Traffic Light Label.

Figure 2. Percent of participants who correctly identified that products were high in nutrient(s) of concern, by study arm



** P-value <0.001 relative to the control label; ** P-value <0.01; * P-value <0.05; GDA= Guideline Daily Amounts, HSR= Health Star Rating, MTL= Multiple Traffic Light Label.

Figure 3. Mean purchase intentions, by study arm

 doi:10.20944/preprints202205.0058.v1

Results on other secondary outcomes can be found in **Table 2.** Relative to the control group (1.7, 95% CI 1.5, 1.8), each FOPL led to an increase in perceived message effectiveness, with the biggest difference observed for the warning label (2.1, 95% CI 1.9, 2.3; p<0.001), followed by the traffic light label (2.0, 95% CI 1.9, 2.2; p<0.001) and the GDA label (1.9, 95% CI 1.7, 2.0; p<0.001) and HSR label (1.9, 95% CI 1.8, 2.1; p<0.001).

Relative to the control group, all FOPL types led to increases in perceptions that products were unhealthy, while all but the HSR led to increases in perceptions that products were visually attractive (p<0.05 for all comparisons). With regards to label perceptions, relative to the control group, all FOPLs were rated higher as being attention-grabbing, making participants concerned about the health consequences of consuming the product, as being understandable, and as teaching them something new (p<0.05 for all comparisons). Relative to the control label, all FOPLs except for the HSR were rated higher on being true, while only the GDA and traffic light label were rated higher on being likable.

Table 2. Label reactions and product perceptions by arm, mean (95% CI)

	Control	Warning	p	GDA	p	HSR	P	MTL	p
Product perceptions									
Product is…									
Unhealthy	1.7 (1.6, 1.8)	2.1 (2.1, 2.2)	<0.001	1.9 (1.9, 2.0)	<.0.001	1.8 (1.8, 1.9)	0.002	2.0 (1.9, 2.1)	<0.001
Visually attractive	2.7 (2.6,2.8)	2.8 (2.7, 2.9)	0.048	2.9 (2.8, 3.0)	<0.001	2.8 (2.7, 2.8)	0.142	2.9 (2.7, 2.9)	0.004
Label reactions									
The label….									
Grabs attention	2.7 (2.6, 2.9)	2.9 (2.8, 3.1)	0.031	3.0 (2.8, 3.1)	0.004	2.8 (2.7,3.0)	0.040	3.0 (2.8, 3.1)	0.004
Makes me concerned about health consequences	1.9 (1.8, 1.9)	2.4 (2.3, 2.5)	<0.001	2.3 (2.2, 2.3)	<0.001	2.2 (2.1, 2.2)	<0.001	2.3 (2.2, 2.4)	<0.001
Is understandable	2.4 (2.2, 2.6)	2.8 (2.7, 3.0)	<0.001	2.8 (2.7, 3.0)	<0.001	2.7 (2.6, 2.9)	<0.001	2.7 (2.6, 2.9)	<0.001
Taught me something new	2.3 (2.1, 2.5)	2.8 (2.6, 3.0)	<0.001	2.8 (2.6, 3.0)	<0.001	2.7 (2.5, 2.8)	<0.001	2.7 (2.5, 2.9)	<0.001
Is true	2.6 (2.5, 2.7)	2.9 (2.7, 3.0)	<0.001	2.9 (2.7, 3.1)	<0.001	2.7 (2.5, 2.8)	0.066	2.8 (2.6, 3.0)	0.006
Liking the label	2.7 (2.5,2.9)	2.9 (2.7, 3.0)	0.072	2.9 (2.8,3.1)	0.035	2.8 (2.7,3.0)	0.054	2.9 (2.8,3.1)	0.006
PME	1.7 (1.5, 1.8)	2.1 (1.9,2.3)	<0.001	1.9 (1.7, 2.0)	<0.001	1.9 (1.8 2.1)	<0.001	2.0 (1.8, 2.2)	<0.001)

PME= perceived message effectiveness

 doi:10.20944/preprints202205.0058.v1

3.3 Moderation by sociodemographic and behavioral characteristics.

Results on moderation of the main outcomes by FOPL type can be found in **Tables 3** and **4**. For the ability to correctly identify all products high in nutrient(s) of concern, there was no moderation by any variable except for state (**Table 3**). For the impact of FOPLs on participants' ability to correctly identify products high in nutrients of concern, the pattern of results suggested that the impact of FOPLS was greatest among Uttar Pradesh. This state had the biggest differences between FOPL type (GDA, HSR, MTL) and control (or second biggest differences, for warning labels). In contrast, the impact of FOPLs was smallest in Odisha, with FOPLs either leading to no statistical difference compared to the control (warning labels, GDA, MTL) or a negative difference (HSR). Despite these differences there was some degree of consistency in the difference between FOPLs and the control across states, with the pattern of results generally showing the biggest differences for warnings, then for GDA or MTL, and relatively small differences for HSR.

Table 3. Effect of FOPL type on the percent of participants who correctly identified products high in nutrients of concern by moderation of socio-demographic characteristics

	Control	**Warning**		**GDA**		**HSR**		**MTL**	
	% (95% CI)	% (95% CI)	P[a]	% (95% CI)	P[a]	% (95% CI)	P[a]	% (95% CI)	P[a]
Education									
< 12 years	35.2 (27.3, 43.1)	51.5 (42.3, 60.6)	0.000	49.5 (40.3, 58.7)	0.000	45.2 (36.3, 54.2)	0.002	46.7 (37.9, 55.6)	0.000
≥12 years	42.3 (34.8, 49.8)	66.6 (59.5, 73.7)	0.000	59.6 (51.9, 67.3)	0.000	44.8 (36.3, 53.4)	0.437	61.8 (54.7, 68.9)	0.000
P[b]		**0.073**		**0.469**		**0.120**		**0.074**	
Language of interview									
State language	41.5 (34.1, 48.8)	63.3 (55.6, 71.1)	0.000	54.9 (45.4, 64.4)	0.001	44.6 (35.6, 53.6)	0.279	57.6 (50.8, 64.4)	0.000
Mixed (state language and English)	35.5 (23.8, 47.3)	57.0 (44.2, 69.7)	0.001	55.2 (42.9, 67.5)	0.000	45.7 (33.4, 57.9)	0.002	51.0 (38.0, 64.1)	0.001
P[b]		**0.955**		**0.354**		**0.103**		**0.910**	
Urbanicity									
Urban	40.0	59.9 (52.7, 67.1)	0.000	54.0 (44.4, 63.5)	0.001	47.3 (39.2, 55.3)	0.013	54.6 (47.0, 62.2)	0.000

 doi:10.20944/preprints202205.0058.v1

	(32.2, 47.7)							
Semi-Urban	44.1 (36.0, 52.2)	68.0 (59.9, 76.0)	0.000	58.7 (48.8, 68.7)	0.004	44.8 (34.1, 55.4)	0.858	55.7 (46.2, 65.1)	0.015
Peri-rural	32.2 (24.1, 40.3)	53.8 (44.0, 63.5)	0.000	53.6 (45.7, 61.5)	0.000	40.4 (30.4, 50.5)	0.054	54.6 (46.7, 62.4)	0.000
P[b]		**0.678**		**0.273**		**0.244**		**0.135**	
Gender									
Men	40.6 (32.3, 48.9)	61.2 (54.4, 68.0)	0.000	54.2 (45.5, 62.9)	0.000	46.6 (37.9, 55.2)	0.094	54.3 (46.0, 62.7)	0.000
Women	37.6 (30.1, 45.2)	60.4 (51.4, 69.3)	0.000	55.9 (46.4, 65.4)	0.000	43.5 (34.8, 52.2)	0.054	55.3 (47.5, 63.0)	0.000
P[b]		**0.607**		**0.316**		**0.981**		**0.301**	
State									
Odisha	47.1 (32.2, 62.1)	46.4 (30.9, 62.0)	0.923	50.4 (36.7, 64.0)	0.521	39.1 (24.0, 54.2)	0.024	42.7 (25.5, 59.8)	0.322
Uttar Pradesh	54.1 (32.7, 75.5)	86.0 (76.7, 95.2)	0.002	86.0 (77.7, 94.3)	0.001	68.5 (47.1, 90.0)	0.011	78.9 (68.0, 89.8)	0.012
Assam	25.8 (11.3, 40.3)	47.2 (34.7, 59.8)	0.002	33.2 (19.5, 47.0)	0.138	21.9 (6.0, 37.9)	0.121	45.8 (31.2, 60.3)	0.002
Delhi	23.2 (9.1, 37.3)	59.5 (42.5, 76.5)	0.000	42.6 (27.6, 57.5)	0.037	30.4 (23.1, 37.8)	0.229	42.0 (27.2, 56.8)	0.014
Karnataka	57.4 (43.8, 71.0)	72.2 (58.4, 86.0)	0.000	60.7 (47.0, 74.4)	0.178	63.4 (51.8, 75.0)	0.026	64.8 (55.4, 74.3)	0.046
Gujarat	33.4 (18.2, 48.6)	53.8 (34.6, 73.1)	0.023	52.4 (34.5, 70.3)	0.063	44.5 (24.2, 64.8)	0.109	53.0 (36.8, 69.2)	0.006
P[b]		**0.025**		**0.027**		**0.000**		**0.002**	

Table continued, next page

 doi:10.20944/preprints202205.0058.v1

	Control % (95% CI)	Warning % (95% CI)	P[a]	GDA % (95% CI)	P[a]	HSR % (95% CI)	P[a]	MTL % (95% CI)	P[a]
Sweet biscuit intake									
<1x/week	25.0 (13.1, 36.9)	51.8 (36.4, 67.2)	0.000	36.1 (22.7, 49.5)	0.071	27.5 (16.4, 38.6)	0.645	36.4 (27.0, 45.9)	0.050
1x/ week	22.0 (14.0, 29.9)	39.4 (27.1, 51.6)	0.002	35.4 (22.1, 48.6)	0.013	27.8 (16.2, 39.5)	0.231	29.5 (20.1, 38.9)	0.095
>1x/ week	26.2 (15.9, 36.5)	49.2 (38.7, 59.8)	0.000	42.4 (29.7, 55.1)	0.001	30.9 (19.6, 42.2)	0.218	36.8 (26.4, 47.2)	0.006
P[b]		**0.347**		**0.732**		**0.894**		**0.788**	
Bread intake									
<1x/week	42.3 (31.0, 53.7)	66.3 (54.8, 77.7)	0.000	50.0 (39.4, 60.6)	0.205	50.0 (37.8, 62.2)	0.320	61.5 (52.7, 70.4)	0.002
1x/ week	50.0 (37.0, 63.0)	62.9 (48.6, 77.2)	0.091	54.5 (41.9, 67.1)	0.555	50.0 (38.0, 62.0)	1.000	60.8 (48.1, 73.5)	0.110
>1x/ week	45.0 (35.2, 54.8)	73.0 (64.8, 81.2)	0.000	61.6 (50.0, 73.2)	0.001	48.0 (36.7, 59.3)	0.455	62.5 (51.4, 73.6)	0.004
P[b]		**0.148**		**0.292**		**0.718**		**0.582**	
Fruit drink intake									
<1x/week	58.4 (47.2, 69.6)	75.8 (66.0, 85.5)	0.000	73.8 (63.0, 84.5)	0.005	69.7 (57.6, 81.8)	0.041	75.0 (62.7, 87.3)	0.000
1x/ week	59.6 (46.6, 72.6)	79.1 (68.7, 89.6)	0.004	77.0 (66.4, 87.6)	0.012	61.3 (44.5, 78.1)	0.798	75.2 (64.4, 86.0)	0.017
>1x/ week	63.8 (52.2, 75.5)	76.3 (66.1, 86.5)	0.020	70.7 (58.6, 82.7)	0.264	59.2 (47.0, 71.3)	0.365	70.4 (60.2, 80.6)	0.266

P^b		**0.522**		**0.363**		**0.138**		**0.336**	
Noodle intake									
<1x/week	31.3 (20.9, 41.8)	62.9 (52.5, 73.2)	0.000	48.5 (36.9, 60.2)	0.004	44.1 (30.6, 57.6)	0.028	54.7 (46.5, 63.0)	0.000
1x/ week	29.5 (18.2, 40.8)	54.2 (41.6, 66.8)	0.000	47.5 (36.7, 58.3)	0.004	44.1 (34.0, 54.3)	0.007	41.7 (30.1, 53.4)	0.070
>1x/ week	27.4 (18.4, 36.3)	46.8 (35.0, 58.6)	0.000	45.9 (33.6, 58.3)	0.002	34.4 (22.9, 45.9)	0.097	53.5 (41.4, 65.6)	0.000
P^b		**0.207**		**0.983**		**0.559**		**0.218**	
Savory biscuit intake									
<1x/week	32.7 (20.8, 44.7)	52.7 (38.9, 66.5)	0.001	52.1 (40.7, 63.4)	0.000	46.3 (33.9, 58.6)	0.013	53.6 (43.4, 63.9)	0.001
1x/ week	40.2 (29.2, 51.2)	59.2 (48.8, 69.7)	0.002	57.2 (45.2, 69.3)	0.010	40.5 (29.6, 51.4)	0.951	51.9 (41.5, 62.2)	0.037
>1x/ week	34.6 (22.9, 46.3)	60.0 (47.4, 72.6)	0.000	61.0 (47.3, 74.7)	0.000	44.6 (30.3, 58.9)	0.017	57.8 (42.2, 73.3)	0.001
P^b		**0.673**		**0.344**		**0.096**		**0.267**	

Note: P^a is the value for the difference between each FOPL type and the control. P^b is the value for equal differences with the control mean across moderation levels, within FOPL arm.

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 6 May 2022 doi:10.20944/preprints202205.0058.v1

For intentions to purchase, there was no moderation by most variables (**Table 4)**. For the HSR label, there was moderation by urbanicity such that the effect of HSR was greater for semi-urban and peri-rural areas than for urban areas (p=0.004).

Table 4. Effect of FOPL type on intentions to consume products high in nutrients of concern by moderation of socio-demographic characteristics

	Control	Warning		GDA		HSR		MTL	
	Mean (95% CI)	Mean (95% CI)	P[a]	Mean (95% CI)	P[a]	Mean (95% CI)	P[a]	Mean (95% CI)	P[a]
Education									
< 12 years	2.6 (2.4, 2.8)	2.5 (2.3, 2.7)	0.408	2.6 (2.5, 2.8)	0.507	2.6 (2.5, 2.8)	0.743	2.5 (2.4, 2.7)	0.405
≥12 years	2.6 (2.5, 2.8)	2.4 (2.3, 2.6)	0.014	2.6 (2.5, 2.8)	0.875	2.6 (2.4, 2.7)	0.433	2.5 (2.4, 2.7)	0.256
P[b]		0.298		0.647		0.503		0.941	
Language of interview									
State language	2.7 (2.5, 2.9)	2.6 (2.4, 2.8)	0.086	2.7 (2.5, 2.9)	0.801	2.7 (2.5, 2.8)	0.446	2.6 (2.4, 2.8)	0.159
Mixed (state language and English)	2.4 (2.2, 2.7)	2.3 (2.1, 2.5)	0.115	2.5 (2.3, 2.7)	0.284	2.5 (2.3, 2.6)	0.606	2.4 (2.2, 2.6)	0.906
P[b]		0.720		0.329		0.377		0.312	
Urbanicity									
Urban	2.6 (2.4, 2.8)	2.4 (2.3, 2.6)	0.005	2.6 (2.5, 2.8)	0.793	2.5 (2.3, 2.6)	0.033	2.5 (2.4, 2.7)	0.256
Semi-Urban	2.6 (2.4, 2.7)	2.6 (2.4, 2.8)	0.643	2.7 (2.6, 2.9)	0.053	2.7 (2.5, 2.8)	0.139	2.5 (2.3, 2.6)	0.299
Peri-rural	2.6 (2.4, 2.9)	2.4 (2.2, 2.6)	0.033	2.6 (2.4, 2.8)	0.508	2.7 (2.6, 2.9)	0.312	2.6 (2.4, 2.9)	0.944
P[b]		0.055		0.208		0.004		0.780	
Gender									
Men	2.6 (2.4, 2.8)	2.5 (2.3, 2.7)	0.113	2.7 (2.5, 2.9)	0.705	2.6 (2.4, 2.8)	0.741	2.6 (2.4, 2.8)	0.501
Women	2.6 (2.4, 2.8)	2.4 (2.3, 2.6)	0.070	2.6 (2.5, 2.8)	0.728	2.6 (2.4, 2.7)	0.992	2.5 (2.3, 2.7)	0.235
P[b]		0.765		0.916		0.806		0.788	
State									
Odisha	2.4 (2.1, 2.7)	2.2 (2.0, 2.5)	0.123	2.2 (1.9, 2.4)	0.061	2.2 (2.0, 2.5)	0.033	2.1 (1.8, 2.4)	0.002
Uttar Pradesh	2.7 (2.2, 3.1)	2.6 (2.3, 3.0)	0.945	2.8 (2.4, 3.1)	0.610	2.7 (2.4, 3.0)	0.976	2.8 (2.4, 3.1)	0.552
Assam	3.1 (2.9, 3.3)	2.8 (2.7, 3.0)	0.043	3.1 (2.9, 3.3)	0.951	3.1 (2.8, 3.3)	0.714	3.0 (2.9, 3.1)	0.217
Delhi	2.3 (2.1, 2.6)	2.0 (1.6, 2.3)	0.004	2.5 (2.2, 2.8)	0.250	2.4 (2.1, 2.6)	0.663	2.3 (2.1, 2.5)	0.910
Karnataka	2.7 (2.5, 2.9)	2.8 (2.5, 3.1)	0.362	2.8 (2.6, 3.0)	0.322	2.7 (2.5, 2.9)	0.707	2.7 (2.4, 3.1)	0.847
Gujarat	2.4 (2.0, 2.9)	2.2 (1.8, 2.6)	0.015	2.4 (2.1, 2.7)	0.900	2.5 (2.1, 2.8)	0.808	2.4 (2.1, 2.7)	0.608
P[b]		0.056		0.304		0.492		0.177	
Sweet biscuit intake									
<1x/week	2.6 (2.3, 2.8)	2.5 (2.2, 2.7)	0.555	2.5 (2.3, 2.8)	0.845	2.5 (2.3, 2.7)	0.654	2.3 (2.1, 2.5)	0.048
1x/ week	2.6 (2.4, 2.8)	2.5 (2.3, 2.7)	0.341	2.7 (2.5, 2.9)	0.470	2.7 (2.5, 2.8)	0.337	2.7 (2.5, 2.9)	0.407
>1x/ week	2.7 (2.5, 2.9)	2.5 (2.3, 2.7)	0.056	2.7 (2.5, 3.0)	0.675	2.7 (2.5, 2.9)	0.884	2.6 (2.4, 2.9)	0.500
P[b]		0.820		0.718		0.627		0.070	

 doi:10.20944/preprints202205.0058.v1

Bread intake									
<1x/week	2.5 (2.3, 2.8)	2.4 (2.1, 2.7)	0.470	2.5 (2.3, 2.7)	0.768	2.5 (2.2, 2.7)	0.515	2.2 (2.0, 2.4)	0.029
1x/ week	2.6 (2.3, 2.9)	2.4 (2.1, 2.7)	0.079	2.5 (2.3, 2.6)	0.207	2.6 (2.4, 2.7)	0.716	2.6 (2.3, 2.8)	0.779
>1x/ week	2.7 (2.5, 2.9)	2.6 (2.4, 2.8)	0.527	2.8 (2.6, 3.0)	0.212	2.8 (2.7, 3.0)	0.112	2.7 (2.4, 2.9)	0.663
P^b		0.724		0.142		0.325		0.140	
Fruit drink intake									
<1x/week	2.5 (2.3, 2.8)	2.4 (2.1, 2.7)	0.271	2.6 (2.4, 2.8)	0.437	2.5 (2.3, 2.7)	0.996	2.3 (2.1, 2.6)	0.100
1x/ week	2.5 (2.3, 2.8)	2.4 (2.2, 2.6)	0.485	2.5 (2.3, 2.7)	0.876	2.6 (2.4, 2.8)	0.470	2.6 (2.4, 2.8)	0.491
>1x/ week	2.7 (2.5, 2.8)	2.5 (2.3, 2.7)	0.094	2.7 (2.5, 3.0)	0.453	2.7 (2.5, 2.8)	0.974	2.6 (2.4, 2.9)	0.940
P^b		0.765		0.886		0.790		0.220	

Table continued, next page

	Mean (95% CI)	Mean (95% CI)	P^a	Mean (95% CI)	P^a	Mean (95% CI)	P^a	Mean (95% CI)	P^a
Noodle intake									
<1x/week	2.5 (2.3, 2.7)	2.4 (2.1, 2.7)	0.556	2.4 (2.2, 2.7)	0.826	2.4 (2.2, 2.6)	0.337	2.3 (2.1, 2.5)	0.033
1x/ week	2.6 (2.3, 2.8)	2.4 (2.2, 2.6)	0.096	2.7 (2.5, 2.9)	0.159	2.5 (2.3, 2.7)	0.559	2.6 (2.4, 2.8)	0.950
>1x/ week	2.6 (2.3, 2.9)	2.5 (2.3, 2.6)	0.203	2.6 (2.5, 2.8)	0.746	2.6 (2.3, 2.8)	0.882	2.6 (2.4, 2.8)	0.818
P^b		0.782		0.500		0.840		0.208	
Savory biscuit intake									
<1x/week	2.5 (2.3, 2.7)	2.5 (2.3, 2.7)	0.886	2.5 (2.3, 2.8)	0.606	2.4 (2.2, 2.7)	0.639	2.5 (2.3, 2.7)	0.710
1x/ week	2.7 (2.4, 2.9)	2.5 (2.4, 2.7)	0.263	2.6 (2.4, 2.8)	0.592	2.6 (2.4, 2.8)	0.449	2.7 (2.5, 2.9)	0.959
>1x/ week	2.8 (2.5, 3.0)	2.5 (2.3, 2.8)	0.012	2.7 (2.5, 3.0)	0.957	2.8 (2.6, 3.0)	0.834	2.6 (2.3, 3.0)	0.325
P^b		0.329		0.739		0.783		0.636	

Note: P^a is the value for the difference between each FOPL type and the control. P^b is the value for equal differences with the control mean across moderation levels, within FOPL arm.

 doi:10.20944/preprints202205.0058.v1

Label selection

The results for when participants were asked which label they prefer are shown in **Figure 4**. Warning labels were most often selected as most likely to discourage consumption of the high-in products by adults, and warnings, GDA, and HSR most often selected as the most likely to discourage feeding the products to children. Participants selected MTL as the easiest to understand label and GDA as the most informative label.

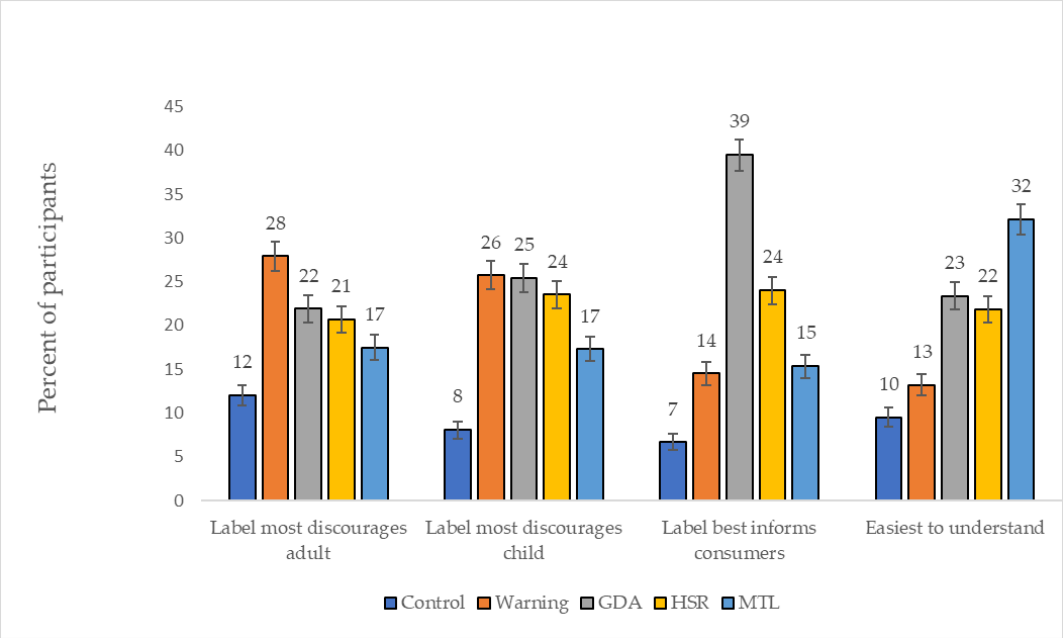


Figure 4. Percent of participants selecting a particular FOPL

Sensitivity analyses

Results from the sensitivity analyses of main outcomes excluding respondents who were interviewed by interviewers with the highest or lowest means are found in **Appendix H**. There was no difference in the pattern of results for either outcome.

4. Discussion

This experimental in-person study of adults in six states of India found that, relative to a control label, FOPLs improved participant's ability to correctly identify products high in nutrients of concern, including sugar, saturated fat, and sodium. The warning label showed the biggest impact on this outcome and was also the only FOPL to reduce participants' intentions to purchase these unhealthy products. Warning labels also showed the biggest impact on a number of secondary outcomes, including perceived message effectiveness, an outcome that has been previously shown to predict behavioral change.[67]

The finding that warning labels were the most effective FOPL on the pre-specified primary outcomes-- helping consumers identify products high in nutrients of concern and reducing intentions to purchase these products-- is consistent with prior conceptual frameworks, empirical evidence, and public health goals.

First, the conceptual framework for nutrient warnings posits that they are particularly well suited to reduce consumption of 'high-in' products because of their binary nature,

which facilitates quick decisions, and their ability to signal a warning, which communicates action (to discourage consumption). [35, 68] Second, our study results are consistent with other empirical evidence in India and elsewhere. For example, our finding that warnings were the only FOPL to impact behavioral intentions is consistent with a separate recent study conducted on FOPLs among Indian consumers, which also found that, compared to GDA and HSR labels, the warnings led to the biggest impact on intentions to purchase unhealthy products. [69] In addition, our findings are consistent with a recently published systematic review of randomized controlled trials and quasi-experiments, which found that warning labels were more effective than color coded labels (e.g., traffic lights) in discouraging unhealthy food purchasing behavior.[36]

It is worth noting that there is some controversy in the field about which public health goals should be prioritized when it comes to the desired outcome of an FOPL system. The current study was designed to test FOPLs' impact on antecedents to reducing purchases of foods and drinks high in nutrients of concern because global dietary recommendations consistently agree on the importance on preventing or reducing consumption of excess amounts of sugar, sodium, saturated fat, and added sugar.[70-72] These results suggest that warning labels hold the most promise for helping Indian consumers identify 'high-in' products and discourage their consumption, though these findings should be replicated in a behavioral trial in which actual purchases or intake behaviors are measured.

In contrast, this study found that the HSR system was the lowest-performing FOPL (relative to the control) with regards to helping consumers identify "high-in" products, and had no impact on behavioral intentions. These findings are consistent with a recent study which found that even when only a single star is displayed, warning labels outperform the HSR system in reducing intention to purchase 'high-in' products[73]. In addition, a recent experiment among Colombian adults found that the HSR consistently performed worse than the warning label on multiple outcomes, including identifying "high in" products and reducing intentions to purchase these products[74].

One likely reason for the HSR's low performance is that it was designed with different public goals in mind. While warnings are designed with the goal to discourage the most unhealthy purchases, while others, like the HSR are designed to nudge towards "healthier" purchases. Previous studies have showed that the HSR help consumers rank products based on healthfulness [75] and help nudge them towards healthier choices[76]. Yet, it is unclear from a health perspective whether shifting consumers from a lower-scoring product to a higher-scoring product will result in meaningful gains for health. This of particular concern because in a mandatory HSR system, ultraprocessed products could be eligible to carry up to 5 stars, implying that these products are healthier and should be encouraged- despite a rapdily growing body of evidence from controlled feeding studies and from many prospective cohort studies showing that ultraprocessed foods are linked to weight gain, overweight/obesity, and an array of adverse cardiometabolic effects[17, 25, 77-98] In addition, others have criticized the HSR system for misrepresenting nutrition science,[99] in part due to the use of an algorithm that does not reflect how human metabolism works (e.g., the presence of beneficial ingredients such as fiber or protein does not offset the harms of sugar, sodium, or saturated fat). To design an effective FOPL system for Indian consumers, policymakers should consider not only the design of the FOPL itself, but the underlying nutirtional profile and health goal (e.g., reducing consumption of the most unhealthy items vs. encouraging healthier (yet likely to be ultraprocessed) options).

 doi:10.20944/preprints202205.0058.v1

With regards to secondary outcomes on product perceptions and label reactions, outcomes were mixed, though the pattern suggested a strong performance of warning labels and poor performance for HSR. Warning labels performed best on perceived message effectiveness, a scale that reflects both message perceptions (judgments about how well the message will lead to persuasion) and effects perceptions (how well the message will change behavioral antecedents or the actual behavior).[100, 101] Perceived message effectiveness has been used in the development of many health messages across a range of products[102-104], and is predictive of behavioral change[67], offering further support for warnings as a strong FOPL to discourage consumption of "high-in" products among Indian consumers. Warning labels also performed best on other outcomes (identifying products as unhealthy, making participants concerned about health consequences) and similarly to the GDA and/or the MTL on other outcomes (understandable, taught me something new, is true, liking), though the magnitude of difference between FOPLs was small across all outcomes. The GDA and MTL performed best on grabbing attention and led to the smallest increase in visual attractiveness (a positive outcome, given that the goal is to decrease participants' desire to consume a product). The HSR performed worse than all other FOPL types tested (except the control) on every secondary outcome.

When shown all the FOPLS and asked to select which one they most preferred on a range of outcomes, results were mixed. Warning labels were most frequently chosen as the label that would most discourage consumption by adults or feeding the products to children. In contrast, GDA label and MTL label were selected as most informative and easiest to understand. However, there is no evidence that these preference measures are predictive of actual behavior change. In addition, conceptually, preference for or 'liking' of the label may inversely associated with the intended behavioral change (discouraging purchases) as they may attract consumers towards selecting the product.

With regards to effect modification by socio-demographic and dietary factors, our study found mixed results. Importantly, we found that the impact of FOPLS did not vary for high vs. low educated populations, which suggests that FOPLs hold promise as a population intervention across populations. On the other hand, this study did not assess literacy, and so were not able to understand whether the FOPLs performed well among illiterate populations, which is especially important considering that approximately a quarter of the population is illiterate (and this figure is higher amongst women and in rural areas). [105] Few studies have looked at FOPLS among illiterate populations. However, principles of visual communication suggest and empirical data shows that imagery can better convey health risk information than can text or numerical information, [106-109] particularly to low literacy groups. This suggests that the warning label (which in this study, carried icons depicting sugar, salt, and saturated fat) and the HSR (which uses stars) would hold an advantage over labels such as the traffic light or GDA label. Limited empirical data also illustrates the promise of using icons with warnings, in particular: one focus group study in South Africa suggested that warnings with icons would work well among illiterate population.[60] Other work from the US found that warnings with icons were perceived as more effective among populations with lower English language literacy.[109] Future research in India should test the effectiveness of FOPLs in populations with low literacy.

We did observe some differences in the impact of FOPL by state. While the pattern of results consistently found that warning labels performed best, the impact of FOPLs was the smallest in the state of Odisha, where FOPLs either had no impact (warnings, GDA, or MTL) or a negative impact (HSR), relative to the control. An effective FOPL policy for India should consider using a state-based educational campaign to ensure that the FOPL is well-understood and used across different populations.

 doi:10.20944/preprints202205.0058.v1

Limitations of this study included that it measured only participants' self-reported perceptions and reactions. Future experimental trials with more realistic products in more realistic settings that more closely mirror real-world food environments will be necessary. In addition, further testing in populations with low literacy will be important to ensuring that an FOPL system works well for all Indian consumers. Strengths of this study included the large sample, inclusion of six states (and five languages).

5. Conclusions

The results of this in-person randomized experiment found that warning labels performed best on helping Indian consumers identify products that are high in sugar, sodium, and saturated fat and were the only FOPL type to reduce intentions to purchase these products. This pattern of results suggests that the warning label is the optimal FOPL to achieve the goal of reducing purchases intakes of unhealthy products high in nutrients of concern. Replication of this study with behavioral outcomes would provide stronger evidence to support FOPL policies in the Indian population.

Author Contributions: Conceptualization, LST, NM, SKS, AG; methodology, LST, NM, SKS, AG, MB; investigation SKS, NM, AG; formal analysis, MB, writing- original draft preparation LST; writing- review and editing- LST, BP, NM, SKS, AG, MB. All authors have read and agreed to the published manuscript.

Funding: This study received funding from Resolve to Save Lives and Bloomberg Philanthropies.

Institutional Review Board Statement: This study was reviewed and approved by the Institutional Review Board at the International Institute for Population Sciences (IIPS) in Mumbai, India and under applicable U.S. regulations about human-subjects research by a duly constituted Institutional Review Board.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: De-identified data can be found at Open Science Framework at: [link to be posted when paper is published].

Acknowledgments: Authors thank Changescape, a survey research company, for implementation of fieldwork.

Conflicts of Interest: The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, or in the decision to publish the results.

Appendix A.

Figure A1. Images of products used, without FOPLs

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 6 May 2022 doi:10.20944/preprints202205.0058.v1

Appendix B. Codebook
Product Assessment

 doi:10.20944/preprints202205.0058.v1

Excs_sf	B10. Do you think this product has high [sugar/sodium/saturated fat]?	1 = Yes 0= No
Unhealthy_sf	B11a. Is this product unhealthy?	1 = Yes (Go to C11b) 0= No (Go to C12a)
	B11b. How unhealthy it is?	1 = Very much 2 = Somewhat 3 = Very little
Ppa_sf	B12a. Do you think this product is visually attractive?	1 = Yes (Go to C12b) 0= No (Go to C13a)
	B12b. How visually attractive is this product?	1 = Very much 2 = Somewhat 3 = Very little
Buy_lkly_sf	B13a. Will you purchase this product next week, if it were available?	1 = Yes (Go to C13b) 0= No
	B13b. How likely is it for you to want to purchase this product next week, if it were available?	1 = Very much 2 = Somewhat 3 = Very little

Label Assessment

Attention_sf	B1a. Does this label grab your attention?	1 = Yes (Go to C1b) 0= No (Go to C2a)
	B1b. How much does this label grab your attention?	1 = Very much 2 = Somewhat 3 = Very little
PME_conc_sf	B2a. Does the label make you feel concerned about the health consequences of consuming this product?	1 = Yes (Go to C2b) 0= No (Go to C3a)
	B2b. How concerned would you be about the health consequences of consuming this product?	1 = Very much 2 = Somewhat 3 = Very little
PME_unpl_sf	B3a. Does the label make this product seem unpleasant to you?	1 = Yes (Go to C3b) 0= No (Go to C4a)
	B3b. How unpleasant does this product seem to you?	1 = Very much 2 = Somewhat 3 = Very little
Pme_disc_sf	B4a. Does the label make you feel discouraged from wanting to consume this product?	1 = Yes (Got to C4b) 0= No (Go to C5a)
	B4b. How discouraged do you feel from wanting to consume this product?	1 = Very much 2 = Somewhat 3 = Very little

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 6 May 2022 doi:10.20944/preprints202205.0058.v1

Cog_elab_sf	B5a. Does the label make you think about the health problems caused by consuming this product?	1 = Yes (Go to C5b) 0= No (Go to C6a)
	B5b. How much does the label make you think about the health problems caused by consuming this product?	1 = Very much 2 = Somewhat 3 = Very little
Understand_sf	B6a. Do you understand what the label means?	1 = Yes (Go to C6b) 0= No (Go to C7a)
	B6b. How much do you understand what the label means?	1 = Very much 2 = Somewhat 3 = Very little
Learn_new_sf	B7a. Has the label taught you anything?	1 = Yes (Go to C7b) 0= No (Go to C8a)
	B7b. How much has the label taught you?	1 = Very much 2 = Somewhat 3 = Very little
Trust_sf	B8a. Do you think what label says is true?	1 = Yes (Go to C8b) 0= No (Go to C9a)
	B8b. How much do you think what the label says is true?	1 = Very much 2 = Somewhat 3 = Very little
Liking_sf	B9a. Do you like to have this label on the products?	1 = Yes (Go to C9b) 0= No (Go T0 10a)
	B9b. How much would you like for products to have the label?	1 = Very much 2 = Somewhat 3 = Very little

Appendix C.

Table. Descriptive statistics for the product and label assessment outcomes by arm

	n	Control	Warning	GDA	HSR	MTL
Product perceptions		**n (%)**	**n (%)**	**n (%)**	**n (%)**	**n (%)**
Identified all "high-in" nutrients	14345	1125 (39.2)	1819 (60.8)	1517 (54.8)	1363 (45.4)	1495 (55.2)
		Mean (SD)	**Mean (SD)**	**Mean (SD)**	**Mean (SD)**	**Mean (SD)**
How likely would you be to buy this product next week?	14345	2.6 (1.1)	2.5 (1.0)	2.6 (1.0)	2.6 (1.0)	2.5 (1.1)
How unhealthy is this product?	14345	1.7 (1.0)	2.1 (1.2)	1.9 (1.2)	1.8 (1.1)	2.0 (1.2)
How visually attractive is this product?	14345	2.7 (1.1)	2.8 (1.0)	2.9 (1.0)	2.8 (1.0)	2.9 (1.0)
Label reactions						
Does the label grab your attention?	8607	2.7 (1.0)	2.9 (1.0)	3.0 (1.0)	2.8 (1.0)	3.0 (1.0)
Perceived message effectiveness	8607	1.7 (0.8)	2.1 (0.9)	1.9 (0.8)	1.9 (0.9)	2.0 (0.9)
Does the label make you think about health problems caused by this product?	8607	1.9 (1.1)	2.4 (1.2)	2.3 (1.2)	2.2 (1.2)	2.3 (1.2)

 doi:10.20944/preprints202205.0058.v1

Do you understand the label?	8607	2.4 (1.1)	2.8 (1.1)	2.8 (1.1)	2.7 (1.1)	2.8 (1.1)
Does the label teach you anything?	8607	2.3 (1.2)	2.8 (1.1)	2.8 (1.1)	2.7 (1.1)	2.7 (1.2)
Do you think what the label says is true?	8607	2.6 (1.1)	2.9 (1.1)	2.9 (1.0)	2.7 (1.1)	2.8 (1.1)
Do you like to have the label on this product?	8607	2.7 (1.1)	2.9 (1.0)	2.9 (1.0)	2.8 (1.0)	2.9 (1.0)

Note: Product perceptions were assessed on all 5 products, label reactions were assessed on 3 products.

Appendix D.

Table. Descriptive statistics for the label choice outcomes by arm

		Control	**Warning**	**GDA**	**HSR**	**MTL**
	n	**n (%)**	**n (%)**	**n (%)**	**n (%)**	**n (%)**
Which label discourages you most from consuming this product?	2869					
Control		66 (11.5)	73 (12.2)	61 (11.0)	80 (13.3)	65 (12.0)
Warning		174 (30.3)	171 (28.6)	137 (24.7)	161 (26.8)	158 (29.2)
GDA		113 (19.7)	124 (20.7)	125 (22.6)	149 (24.8)	117 (21.6)
HSR		124 (21.6)	131 (21.9)	110 (19.9)	126 (21.0)	102 (18.8)
MTL		97 (16.9)	99 (16.6)	121 (21.8)	85 (14.1)	100 (18.5)
Which label discourages you most from feeding this product to a child?	2869					
Control		52 (9.1)	54 (9.0)	43 (7.8)	41 (6.8)	41 (7.6)
Warning		140 (24.4)	146 (24.4)	138 (24.9)	174 (29.0)	140 (25.8)
GDA		148 (25.8)	164 (27.4)	153 (27.6)	139 (23.1)	125 (23.1)
HSR		136 (23.7)	139 (23.2)	126 (22.7)	148 (24.6)	126 (23.2)
MTL		98 (17.1)	95 (15.9)	94 (17.0)	99 (16.5)	110 (20.3)

 doi:10.20944/preprints202205.0058.v1

Which label best informs you that this product has high [nutrient]?	2869					
Control		44 (7.7)	37 (6.2)	37 (6.7)	43 (7.2)	30 (5.5)
Warning		70 (12.2)	99 (16.6)	91 (16.4)	78 (13.0)	78 (14.4)
GDA		234 (40.8)	237 (39.6)	221 (39.9)	234 (38.9)	207 (38.2)
HSR		133 (23.2)	149 (24.9)	125 (22.6)	147 (24.5)	135 (24.9)
MTL		93 (16.2)	76 (12.7)	80 (14.4)	99 (16.5)	92 (17.0)
Which label is easiest to understand?	2869					
Control		77 (13.4)	45 (7.5)	50 (9.0)	56 (9.3)	45 (8.3)
Warning		66 (11.5)	97 (16.2)	75 (13.5)	67 (11.1)	74 (13.7)
GDA		131 (22.8)	152 (25.4)	148 (26.7)	134 (22.3)	105 (19.4)
HSR		120 (20.9)	130 (21.7)	122 (22.0)	142 (23.6)	112 (20.7)
MTL		180 (31.4)	174 (29.1)	159 (28.7)	202 (33.6)	206 (38.0)

Appendix E.

Table. Descriptive results on primary outcomes by study arm, by product type

	Control		**Warning**		**GDA**		**HSR**		**MTL**	
Correctly identified all high-in "nutrients	n	%	n	%	n	%	n	%	n	%
Sweet biscuits	142	24.7	282	47.2	216	39.0	176	29.3	190	35.1
Bread	262	45.6	410	68.6	314	56.7	295	49.1	335	61.8
Fruit drink	347	60.5	459	76.8	408	73.6	385	64.1	399	73.6
Noodles	168	29.3	323	54.0	262	47.3	244	40.6	276	50.9
Savory biscuits	206	35.9	345	57.7	317	57.2	263	43.8	295	54.4
Purchase intentions	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Sweet biscuits	2.6	1.1	2.5	1.0	2.7	1.0	2.6	1.0	2.6	1.1
Bread	2.6	1.1	2.5	1.1	2.6	1.0	2.7	1.0	2.5	1.1
Fruit drink	2.6	1.1	2.4	1.0	2.6	1.0	2.6	1.0	2.5	1.1
Noodles	2.5	1.1	2.4	1.0	2.6	1.0	2.5	1.1	2.5	1.0
Savory biscuits	2.6	1.0	2.5	1.0	2.6	1.0	2.6	1.0	2.6	1.1

 doi:10.20944/preprints202205.0058.v1

Appendix F.

Table. Descriptive results on primary outcomes by study arm, by state

	Control		**Warning**		**GDA**		**HSR**		**MTL**	
Correctly identified all high-in "nutrients	n	%	n	%	n	%	n	%	n	%
Odisha	189	47.8	221	47.0	233	50.7	173	39.3	180	43.4
Uttar Pradesh	224	54.0	382	85.8	438	85.9	305	67.8	363	79.8
Assam	128	25.9	260	47.3	154	33.5	101	22.4	172	45.9
Delhi	134	24.4	241	58.8	201	42.8	168	31.1	208	42.9
Karnataka	272	56.7	429	72.1	283	60.2	380	63.3	272	64.8
Gujarat	178	33.3	286	55.0	208	52.0	236	45.0	300	53.6
Purchase intentions	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Odisha	2.4	1.1	2.2	1.1	2.2	1.1	2.2	1.1	2.1	1.1
Uttar Pradesh	2.7	1.1	2.6	1.0	2.8	1.0	2.7	1.0	2.8	1.0
Assam	3.1	0.8	2.8	1.0	3.1	0.8	3.1	0.9	3	0.9
Delhi	2.3	1.1	2	1.1	2.5	1.1	2.4	1.1	2.3	1.1
Karnataka	2.7	0.9	2.8	0.9	2.8	0.9	2.7	0.9	2.7	0.9

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 6 May 2022 doi:10.20944/preprints202205.0058.v1

Gujarat	2.4	1.0	2.2	0.9	2.4	0.9	2.5	0.9	2.4	1.0

Appendix G.

Table. Results for primary outcome by label arm (n=14,345 observations).

	Control	**Warning**		**GDA**		**HSR**		**MTL**	
	%	**%**	**p**	**%**	**p**	**%**	**p**	**%**	**p**
	(95% CI)	**(95% CI)**		**(95% CI)**		**(95% CI)**		**(95% CI)**	
Identified all	39.1	60.8	<0.001	55.0	<0.001	45.0	0.008	54.8	<0.001
"high-in" nutrients	(32.0, 46.2)	(53.5, 68.0)		(47.1, 62.9)		(37.1, 52.8)		(47.9, 61.8)	
	Mean	**Mean**		**Mean**		**Mean**		**Mean (95%**	
	(95% CI)	**(95% CI)**		**(95% CI)**		**(95% CI)**		**CI)**	
How likely would	2.6	2.5	0.018	2.6	1.000	2.6	0.7263	2.6	0.393
you be to buy this	(2.5, 2.7)	(2.4, 2.5)		(2.6, 2.7)		(2.5, 2.7)		(2.5, 2.6)	
product next week?									

 doi:10.20944/preprints202205.0058.v1

Appendix H.

Table. Sensitivity results of primary outcomes excluding interviewers with the highest or lowest three means among their respective respondents (n=354 and 303 respondents [1770 and 1515 obs.] for identifying all excess nutrients and purchase intentions, respectively)

	n	Control	Warning	GDA	HSR	MTL
		% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)
Identified all "high-in" nutrients	12575	38.6 (32.0, 45.2)	62.7 (57.1, 68.3)	54.8 (47.1, 62.5)	43.9 (36.3, 51.5)	58.6 (51.3, 62.3)
		Mean (95% CI)	**Mean (95% CI)**	**Mean (95% CI)**	**Mean (95% CI)**	**Mean (95% CI)**
How likely would you be to buy this product next week?	12830	2.6 (2.5, 2.7)	2.5 (2.4, 2.6)	2.6 (2.5, 2.7)	2.6 (2.5, 2.6)	2.6 (2.5, 2.6)

References

1. Shetty P. Public health: India's diabetes time bomb. *Nature*. 2012/05/01 2012;485(7398):S14-S16. doi:10.1038/485S14a

2. Misra A, Khurana L. Obesity-related non-communicable diseases: South Asians vs White Caucasians. Review. *Int J Obes (Lond)*. Feb 2011;35(2):167-87. doi:10.1038/ijo.2010.135

3. Misra A, Khurana L. The metabolic syndrome in South Asians: epidemiology, determinants, and prevention. *Metab SyndrRelat Disord*. 2009;7(6):497-514.

4. World Obesity Federation. Global Obesity Observatory: India. Accessed March 6, 2022. https://data.worldobesity.org/country/india-95/#data_prevalence

5. Luhar S, Timæus IM, Jones R, et al. Forecasting the prevalence of overweight and obesity in India to 2040. *PloS one*. 2020;15(2):e0229438.

6. Aiyar A, Rahman A, Pingali P. India's rural transformation and rising obesity burden. *World Development*. 2021/02/01/ 2021;138:105258. doi:https://doi.org/10.1016/j.worlddev.2020.105258

7. Popkin BM, Corvalan C, Grummer-Strawn LM. Dynamics of the double burden of malnutrition and the changing nutrition reality. *The Lancet*. 2020;395(10217):65-74.

8. Subramanian SV, Kawachi I, Smith GD. Income inequality and the double burden of under- and overnutrition in India. Research Support, N.I.H., Extramural. *J Epidemiol Community Health*. Sep 2007;61(9):802-9. doi:10.1136/jech.2006.053801

9. Meenakshi J. Trends and patterns in the triple burden of malnutrition in India. *Agricultural Economics*. 2016;47(S1):115-134.

10. Pries AM, Rehman AM, Filteau S, Sharma N, Upadhyay A, Ferguson EL. Unhealthy Snack Food and Beverage Consumption Is Associated with Lower Dietary Adequacy and Length-for-Age z-Scores among 12–23-Month-Olds in Kathmandu Valley, Nepal. *The Journal of Nutrition*. 2019;149(10):1843-1851. doi:10.1093/jn/nxz140

11. Euromonitor International. Passport Nutrition. Euomonitor International. Accessed June 15, 2021. http://www.euromonitor.com/.

12. Anand SS, Hawkes C, de Souza RJ, et al. Food Consumption and its Impact on Cardiovascular Disease: Importance of Solutions Focused on the Globalized Food System: A Report From the Workshop Convened by the World Heart Federation. *Journal of the American College of Cardiology*. Oct 06 2015;66(14):1590-614. doi:10.1016/j.jacc.2015.07.050

13. Report of a WHO Forum and Technical Meeting. Reducing Salt Intake in Populations. 2006;

14. WHO/FAO. Diet, nutrition and the prevention of chronic diseases: Report of a joint WHO/FAO expert consultation. Technical Report Series 916. 2003;

15. Pagliai G, Dinu M, Madarena MP, Bonaccio M, Iacoviello L, Sofi F. Consumption of ultra-processed foods and health status: a systematic review and meta-analysis. *British Journal of Nutrition*. 2021;125(3):308-318. doi:10.1017/S0007114520002688

16. Lane MM, Davis JA, Beattie S, et al. Ultraprocessed food and chronic noncommunicable diseases: A systematic review and meta - analysis of 43 observational studies. *Obesity Reviews*. 2020;doi:10.1111/obr.13146

17. Askari M, Heshmati J, Shahinfar H, Tripathi N, Daneshzad E. Ultra-processed food and the risk of overweight and obesity: a systematic review and meta-analysis of observational studies. *International Journal of Obesity*. 2020:44, pages 2080–2091.

18. Chen X, Zhang Z, Yang H, et al. Consumption of ultra-processed foods and health outcomes: a systematic review of epidemiological studies. *Nutrition Journal*. 2020/08/20 2020;19(1):86. doi:10.1186/s12937-020-00604-1

19. Meneguelli TS, Hinkelmann JV, Hermsdorff HHM, Zulet MÁ, Martínez JA, Bressan J. Food consumption by degree of processing and cardiometabolic risk: a systematic review. *International journal of food sciences and nutrition*. 2020;71(6):678-692.

20. Elizabeth L, Machado P, Zinöcker M, Baker P, Lawrence M. Ultra-Processed Foods and Health Outcomes: A Narrative Review. *Nutrients*. 2020;12(7):1955.

21. Santos FSd, Dias MdS, Mintem GC, Oliveira IOd, Gigante DP. Food processing and cardiometabolic risk factors: a systematic review. *Revista de Saúde Pública*. 2020;54:70.

22. U.S. Department of Health and Human Services and the U.S. Department of Agriculture. Scientific Report of the 2015 Dietary Guidelines Advisory Committee. 2015;

23. World Health Organization. Guideline: Sugars Intake for Adults and Children. 2015.
24. World Cancer Research Fund International. Curbing global sugar consumption: Effective food policy actions to help promote healthy diets and tackle obesity. WCRF; 2015. http://www.wcrf.org/int/policy/our-policy-work/curbing-global-sugar-consumption
25. Hall KD. Ultra-processed diets cause excess calorie intake and weight gain: A one-month inpatient randomized controlled trial of ad libitum food intake. *Cell Metabolism*. July 2 2019 30:67-77. doi: https://doi.org/10.1016/j.cmet.2019.05.008
26. World Health Organization. Global strategy on diet, physical activity and health. 2004;
27. World Health Organization. Guiding principles and framework manual for front-of-pack labelling for promoting healthy diets. Accessed September 29, 2021. https://apps.who.int/nutrition/publications/policies/guidingprinciples-labelling-promoting-healthydiet/en/index.html
28. World Health Organization. Sodium intake for adults and children:Guidance summary. WHO. Accessed October 29, 2021.
29. World Health Organization Western Pacific. Reducing sodium in food and excessive salt intake. WHO Western Pacific,. Accessed 2 November 2021. https://www.who.int/china/activities/reducing-sodium-in-food-and-excessive-salt-intake
30. Guideline: sugars intake for adults and children (World Health Organization) 49 (2015).
31. Draft guidelines on saturated fatty acid and trans-fatty acid intake for adults and children (WHO) 103 (2018).
32. Shekar M, Popkin, Barry M. *Obesity: Health and Economic Consequences of an Impending Global Challenge*. the World Bank; 2020:204.
33. World Cancer Research Fund International. Curbing global sugar consumption: Effective food policy actions to help promote healthy diets and tackle obesity'. WCRF; 2015. http://www.wcrf.org/int/policy/our-policy-work/curbing-global-sugar-consumption
34. World Cancer Research Fund/American Institute for Cancer Research. Diet, nutrition, physical activity and cancer: a global perspective. *Continuous Update Project Expert Report*. 2018;
35. Roberto CA, Ng SW, Ganderats-Fuentes M, et al. The Influence of Front-of-Package Nutrition Labeling on Consumer Behavior and Product Reformulation. *Annual Review of Nutrition*. 2021;41:529-550.
36. Song J, Brown MK, Tan M, et al. Impact of color-coded and warning nutrition labelling schemes: A systematic review and network meta-analysis. *PLoS medicine*. 2021;18(10):e1003765.
37. Grummon AH, Hall MG. Sugary drink warnings: A meta-analysis of experimental studies. *PLoS medicine*. May 2020;17(5):e1003120. doi:10.1371/journal.pmed.1003120
38. Scapin T, Fernandes AC, Curioni CC, et al. Influence of sugar label formats on consumer understanding and amount of sugar in food choices: a systematic review and meta-analyses. *Nutrition Reviews*. 2021;79(7):788-801.
39. Taillie L, Bercholz M, Popkin B, Reyes M, Colchero A, Corvalan C. Changes in food purchases after Chile's polices on food labeling, marketing, and sales in schools: a before and after study. *Lancety Planetary Health*. 2021;In press
40. Correa T, Fierro C, Reyes M, Carpentier FRD, Taillie LS, Corvalan C. Responses to the Chilean law of food labeling and advertising: exploring knowledge, perceptions and behaviors of mothers of young children. *International Journal of Behavioral Nutrition and Physical Activity*. 2019;16(1):21.
41. Fichera E, von Hinke S. The response to nutritional labels: Evidence from a quasi-experiment. *Journal of Health Economics*. 2020;72:102326.
42. Sacks G, Rayner M, Swinburn B. Impact of front-of-pack 'traffic-light' nutrition labelling on consumer food purchases in the UK. *Health Promotion International*. December 1, 2009 2009;24(4):344-352. doi:10.1093/heapro/dap032
43. Radosevich A, Mendes FdC, Villegas R, Mora-Garcia G, Garcia-Larsen V. Awareness, Understanding and Use of the 'Traffic Light' Food Labelling Policy and Educational Level in Ecuador – Findings from the National Nutrition Survey 2018. *Current Developments in Nutrition*. 2020;4(Supplement_2):1731-1731. doi:10.1093/cdn/nzaa064_021
44. Sandoval LA, Carpio CE, Sanchez-Plata M. The effect of 'Traffic-Light'nutritional labelling in carbonated soft drink purchases in Ecuador. *PloS one*. 2019;14(10)

45. Peñaherrera V, Carpio C, Sandoval L, et al. Effect of traffic-light labeling on nutritional content and on consumption of carbonated beverages in EcuadorEfeito da rotulagem nutricional com modelo de semáforo no consumo de refrigerantes no Equador. *Revista Panamericana de Salud Publica= Pan American Journal of Public Health*. 2018;42:e177-e177.

46. Croker H, Packer J, Russell SJ, Stansfield C, Viner RM. Front of pack nutritional labelling schemes: a systematic review and meta-analysis of recent evidence relating to objectively measured consumption and purchasing. *Journal of Human Nutrition and Dietetics*. 2020;n/a(n/a)doi:10.1111/jhn.12758

47. Neal B, Crino M, Dunford E, et al. Effects of different types of front-of-pack labelling information on the healthiness of food purchases—a randomised controlled trial. *Nutrients*. 2017;9(12):1284.

48. Ni Mhurchu C, Volkova E, Jiang Y, et al. Effects of interpretive nutrition labels on consumer food purchases: the Starlight randomized controlled trial. *The American journal of clinical nutrition*. 2017;105(3):695-704.

49. Acton RB, Hammond D. The impact of price and nutrition labelling on sugary drink purchases: Results from an experimental marketplace study. *Appetite*. 2018;121:129-137. doi:10.1016/j.appet.2017.11.089

50. Siegrist M, Leins-Hess R, Keller C. Which front-of-pack nutrition label is the most efficient one? The results of an eye-tracker study. *Food Quality and Preference*. 2015/01/01/ 2015;39:183-190. doi:https://doi.org/10.1016/j.foodqual.2014.07.010

51. Ducrot P, Méjean C, Julia C, et al. Effectiveness of Front-Of-Pack Nutrition Labels in French Adults: Results from the NutriNet-Santé Cohort Study. *PLoS ONE*. 10/28
12/02/received
10/01/accepted 2015;10(10):e0140898. doi:10.1371/journal.pone.0140898

52. Ducrot P, Julia C, Mejean C, et al. Impact of Different Front-of-Pack Nutrition Labels on Consumer Purchasing Intentions: A Randomized Controlled Trial. *Am J Prev Med*. May 2016;50(5):627-636. doi:10.1016/j.amepre.2015.10.020

53. Julia C, Péneau S, Buscail C, et al. Perception of different formats of front-of-pack nutrition labels according to sociodemographic, lifestyle and dietary factors in a French population: cross-sectional study among the NutriNet-Santé cohort participants. *BMJ Open*. 06/15
01/26/received
04/11/accepted 2017;7(6):e016108. doi:10.1136/bmjopen-2017-016108

54. Talati Z, Norman R, Pettigrew S, et al. The impact of interpretive and reductive front-of-pack labels on food choice and willingness to pay. *international journal of behavioral nutrition and physical activity*. 2017;14(1):171.

55. Vargas-Meza J, Jáuregui A, Contreras-Manzano A, Nieto C, Barquera S. Acceptability and understanding of front-of-pack nutritional labels: an experimental study in Mexican consumers. *BMC Public Health*. 2019/12/30 2019;19(1):1751. doi:10.1186/s12889-019-8108-z

56. Jáuregui A, Vargas-Meza J, Nieto C, et al. Impact of front-of-pack nutrition labels on consumer purchasing intentions: a randomized experiment in low- and middle-income Mexican adults. *BMC Public Health*. 2020/04/06 2020;20(1):463. doi:10.1186/s12889-020-08549-0

57. Deliza R, de Alcantara M, Pereira R, Ares G. How do different warning signs compare with the guideline daily amount and traffic-light system? *Food Quality and Preference*. 2020;80:103821.

58. Temple NJ. Front-of-package food labels: A narrative review. *Appetite*. 2020/01/01/ 2020;144:104485. doi:https://doi.org/10.1016/j.appet.2019.104485

59. Hock K, Acton RB, Jáuregui A, Vanderlee L, White CM, Hammond D. Experimental study of front-of-package nutrition labels' efficacy on perceived healthfulness of sugar-sweetened beverages among youth in six countries. *Preventive Medicine Reports*. 2021/12/01/ 2021;24:101577. doi:https://doi.org/10.1016/j.pmedr.2021.101577

60. Bopape M, Taillie LS, Frank T, et al. South African consumers' perceptions of front-of-package warning labels on unhealthy foods and drinks. *PloS one*. 2021;16(9):e0257626.

61. Hall MG, Lazard AJ, Grummon AH, Higgins I, Richter APC, Taillie LS. Designing impactful warnings for sugary drinks: A randomized clinical trial with Latino and non-Latino parents. *Pediatrics*. Under Review;

62. Grummon AH, Taillie LS, Golden SD, Hall MG, Ranney LM, Brewer NT. Sugar-Sweetened Beverage Health Warnings and Purchases: A Randomized Controlled Trial. *American journal of preventive medicine*. Nov 2019;57(5):601-610. doi:10.1016/j.amepre.2019.06.019

63. Hall MG, Grummon AH, Higgins ICA, et al. The impact of pictorial health warnings on purchases of sugary drinks for children: A randomized controlled trial. *PLoS medicine*. Feb 2022;19(2):e1003885. doi:10.1371/journal.pmed.1003885

64. Australia Co. Health Star Rating Calculator. Accessed January 1, 2022. http://www.healthstarrating.gov.au/internet/healthstarrating/publishing.nsf/Content/excel-calculator

65. National Institute of Nutrition DoHR, Ministry of Health and Family Welfare, Government of India. Nutrient Requirements for Indians. Accessed January 1, 2022. https://www.nin.res.in/RDA_Full_Report_2020.html

66. Beatty PC, Willis GB. Research Synthesis: The Practice of Cognitive Interviewing. *Public Opinion Quarterly*. 2007;71(2):287-311. doi:10.1093/poq/nfm006

67. Noar SM, Barker J, Bell T, Yzer M. Does Perceived Message Effectiveness Predict the Actual Effectiveness of Tobacco Education Messages? A Systematic Review and Meta-Analysis. *Health Commun*. Feb 2020;35(2):148-157. doi:10.1080/10410236.2018.1547675

68. Taillie LS, Hall MG, Popkin BM, Ng SW, Murukutla N. Experimental Studies of Front-of-Package Nutrient Warning Labels on Sugar-Sweetened Beverages and Ultra-Processed Foods: A Scoping Review. *Nutrients*. Feb 22 2020;12(2)doi:10.3390/nu12020569

69. Sahay A, Sanghvi R, Ghosh R. Consumer preferences for different nutrition front-of-pack labels in India. *Under review*. 2022;

70. PAHO. *Recommendations from a Pan American Health Organization Expert Consultation on the Marketing of Food and Non-Alcoholic Beverages to Children in the Americas*. Vol. 1. 2012:1-41. *Sustainable Development and Enviromental Health Area*.

71. WHO Nutrient Profile Model for South-East Asia region (WHO) 22 (2017).

72. Nutrient Profile Model (Pan American Health Organization,) 32 (2016).

73. Hamlin R, Hamlin B. An Experimental Comparison of the Impact of 'Warning'and 'Health Star Rating'FoP Labels on Adolescents' Choice of Breakfast Cereals in New Zealand. *Nutrients*. 2020;12(6):1545.

74. Mora-Plazas M, Aida Higgins IC, Gomez LF, et al. Impact of nutrient warning labels on choice of ultra-processed food and drinks high in sugar, sodium, and saturated fat in Colombia: A randomized controlled trial. *PLOS ONE*. 2022;17(2):e0263324.

75. Vanderlee L, Franco-Arellano B, Ahmed M, Oh A, Lou W, L'Abbé MR. The efficacy of 'high in'warning labels, health star and traffic light front-of-package labelling: An online randomised control trial. *Public Health Nutrition*. 2021;24(1):62-74.

76. Anderson CL, O'Connor EL. The effect of the health star rating on consumer decision-making. *Food Quality and Preference*. 2019/04/01/ 2019;73:215-225. doi:https://doi.org/10.1016/j.foodqual.2018.11.005

77. Hall KD, Ayuketah A, Brychta R, et al. Ultra-processed diets cause excess calorie intake and weight gain: an inpatient randomized controlled trial of ad libitum food intake. *Cell Metab*. 2019;

78. Vandevijvere S, Jaacks LM, Monteiro CA, et al. Global trends in ultraprocessed food and drink product sales and their association with adult body mass index trajectories. *Obesity Reviews*. 2019;

79. Mendonça RdD, Pimenta AM, Gea A, et al. Ultraprocessed food consumption and risk of overweight and obesity: the University of Navarra Follow-Up (SUN) cohort study. *The American Journal of Clinical Nutrition*. 2016;104(5):1433-1440. doi:10.3945/ajcn.116.135004

80. Rauber F, Campagnolo P, Hoffman DJ, Vitolo MR. Consumption of ultra-processed food products and its effects on children's lipid profiles: a longitudinal study. *Nutrition, Metabolism and Cardiovascular Diseases*. 2015;25(1):116-122.

81. Fiolet T, Srour B, Sellem L, et al. Consumption of ultra-processed foods and cancer risk: results from NutriNet-Santé prospective cohort. *bmj*. 2018;360:k322.

82. Adjibade M, Julia C, Allès B, et al. Prospective association between ultra-processed food consumption and incident depressive symptoms in the French NutriNet-Santé cohort. *BMC medicine*. 2019;17(1):78.

83. Costa C, Rauber F, Leffa P, Sangalli C, Campagnolo P, Vitolo M. Ultra-processed food consumption and its effects on anthropometric and glucose profile: A longitudinal study during childhood. *Nutrition, Metabolism and Cardiovascular Diseases*. 2019;29(2):177-184.

84. Cunha DB, da Costa THM, da Veiga GV, Pereira RA, Sichieri R. Ultra-processed food consumption and adiposity trajectories in a Brazilian cohort of adolescents: ELANA study. *Nutrition & diabetes*. 2018;8(1):28.

85. Gómez-Donoso C, Sánchez-Villegas A, Martínez-González MA, et al. Ultra-processed food consumption and the incidence of depression in a Mediterranean cohort: The SUN Project. *European journal of nutrition*. 2019:1-11.

86. Kim H, Hu EA, Rebholz CM. Ultra-processed food intake and mortality in the USA: Results from the Third National Health and Nutrition Examination Survey (NHANES III, 1988–1994). *Public health nutrition*. 2019;22(10):1777-1785.

87. Mendonça RdD, Lopes ACS, Pimenta AM, Gea A, Martinez-Gonzalez MA, Bes-Rastrollo M. Ultra-processed food consumption and the incidence of hypertension in a Mediterranean cohort: the Seguimiento Universidad de Navarra Project. *American journal of hypertension*. 2017;30(4):358-366.

88. Rico-Campà A, Martínez-González MA, Alvarez-Alvarez I, et al. Association between consumption of ultra-processed foods and all cause mortality: SUN prospective cohort study. *bmj*. 2019;365:l1949.

89. Rohatgi KW, Tinius RA, Cade WT, Steele EM, Cahill AG, Parra DC. Relationships between consumption of ultra-processed foods, gestational weight gain and neonatal outcomes in a sample of US pregnant women. *PeerJ*. 2017;5:e4091.

90. Rauber F, da Costa Louzada ML, Steele E, Millett C, Monteiro CA, Levy RB. Ultra-processed food consumption and chronic non-communicable diseases-related dietary nutrient profile in the UK (2008–2014). *Nutrients*. 2018;10(5):587.

91. Sandoval-Insausti H, Blanco-Rojo R, Graciani A, et al. Ultra-processed Food Consumption and Incident Frailty: A Prospective Cohort Study of Older Adults. *The Journals of Gerontology: Series A*. 2019;

92. Schnabel L, Kesse-Guyot E, Allès B, et al. Association between ultraprocessed food consumption and risk of mortality among middle-aged adults in France. *JAMA internal medicine*. 2019;179(4):490-498.

93. Srour B, Fezeu LK, Kesse-Guyot E, et al. Ultra-processed food intake and risk of cardiovascular disease: prospective cohort study (NutriNet-Santé). *bmj*. 2019;365:l1451.

94. Vandevijvere S, Jaacks LM, Monteiro CA, et al. Global trends in ultraprocessed food and drink product sales and their association with adult body mass index trajectories 20:https://doi.org/10.1111/obr.12860. *Obesity Reviews*. 2019;

95. Beslay M, Srour B, Méjean C, et al. Ultra-processed food intake in association with BMI change and risk of overweight and obesity: A prospective analysis of the French NutriNet-Santé cohort. *PLoS medicine*. 2020;17(8):e1003256.

96. Montero-Salazar H, Donat-Vargas C, Moreno-Franco B, et al. High consumption of ultra-processed food may double the risk of subclinical coronary atherosclerosis: the Aragon Workers' Health Study (AWHS). *BMC medicine*. 2020;18(1):1-11.

97. Rauber F, Chang K, Vamos EP, et al. Ultra-processed food consumption and risk of obesity: a prospective cohort study of UK Biobank. *European Journal of Nutrition*. 2020:1-12.

98. Monge A, Canella DS, López-Olmedo N, Lajous M, Cortés-Valencia A, Stern D. Ultra-processed beverages and processed meats increase the incidence of hypertension in Mexican women. *British Journal of Nutrition*. 2020:1-28.

99. Lawrence M, Pollard C, Vidgen H, Woods J. The Health Star Rating system-is its reductionist (nutrient) approach a benefit or risk for tackling dietary risk factors? *Public Health Research and Practice*. 2019;29(1):Article number: e2911906 1-5.

100. Baig SA, Noar SM, Gottfredson NC, Lazard AJ, Ribisl KM, Brewer NT. Incremental criterion validity of message perceptions and effects perceptions in the context of anti-smoking messages. *Journal of Behavioral Medicine*. 2021;44:74-83.

101. Baig SA, Noar SM, Gottfredson NC, Boynton MH, Ribisl KM, Brewer NT. UNC Perceived Message Effectiveness: Validation of a brief scale. *Annals of behavioral medicine : a publication of the Society of Behavioral Medicine*. Oct 15 2018;doi:10.1093/abm/kay080

102. Grummon AH, Hall MG, Taillie LS, Brewer NT. How should sugar-sweetened beverage health warnings be designed? A randomized experiment. *Prev Med*. Apr 2019;121:158-166. doi:10.1016/j.ypmed.2019.02.010

103. Noar SM, Bell T, Kelley D, Barker J, Yzer M. Perceived message effectiveness measures in tobacco education campaigns: A systematic review. *Communication methods and measures*. 2018;12(4):295-313.

104. Hall MG, Grummon AH, Lazard AJ, Maynard OM, Taillie LS. Reactions to graphic and text health warnings for cigarettes, sugar-sweetened beverages, and alcohol: An online randomized experiment of US adults. *Prev Med*. Aug 2020;137:106120. doi:10.1016/j.ypmed.2020.106120

105. The World Bank. Data from: Adult literacy rate in India, age 15+. 2018.

106. Houts PS, Doak CC, Doak LG, Loscalzo MJ. The role of pictures in improving health communication: a review of research on attention, comprehension, recall, and adherence. *Patient education and counseling*. 2006;61(2):173-190.

107. Mutti S, Reid JL, Gupta PC, et al. Perceived effectiveness of text and pictorial health warnings for smokeless tobacco packages in Navi Mumbai, India, and Dhaka, Bangladesh: findings from an experimental study. *Tobacco control*. 2016;25(4):437-443.

108. Cantrell J, Vallone DM, Thrasher JF, et al. Impact of tobacco-related health warning labels across socioeconomic, race and ethnic groups: results from a randomized web-based experiment. *PloS one*. 2013;8(1):e52206.

109. Hall MG, Lazard AJ, Grummon AH, et al. Designing warnings for sugary drinks: A randomized experiment with Latino parents and non-Latino parents. *Prev Med*. Jul 2021;148:106562. doi:10.1016/j.ypmed.2021.106562