

# ASSESSING EFFECTIVENESS OF FRONT-OF-PACK NUTRITION LABELS (FOPNL) FOR PRE-PACKAGED PROCESSED FOODS IN INDIA - A STUDY ON FORMATS, ACCEPTABILITY AND POTENTIAL USE



Each serving (100g) contains

Energy 1046kJ 250kcal	Total Fat 3.9g	Saturated Fat 1.3g	Sodium 39g	Salt 90mg
	LOW	LOW	HIGH	MEDIUM



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INDIAN COUNCIL OF  
MEDICAL RESEARCH | NATIONAL INSTITUTE  
OF NUTRITION

**ICMR-National Institute of Nutrition**  
Tarnaka, Hyderabad -500 007, Telangana



**REPORT ON**  
**ASSESSING EFFECTIVENESS OF FRONT-OF-PACK NUTRITION**  
**LABELS (FOPNL) FOR PRE-PACKAGED PROCESSED FOODS IN INDIA –**  
**A STUDY ON FORMATS, ACCEPTABILITY AND POTENTIAL USE**

**Supported by:**



**INDIAN COUNCIL OF MEDICAL RESEARCH**

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**2023**

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## **ABBREVIATIONS**

FOPNL – Front-of-Pack Nutrition Label

FSSAI - Food Safety and Standards Authority of India

GDA – Guideline Daily Amount

HFSS – High in Fat, Sugar and Salt

HSR – Health Star Rating

ICMR-NIN- Indian Council of Medical Research – National Institute of Nutrition

MTL – Multiple Traffic Lights

NS – Nutri-Score

NSR – Nutri-Star Rating

WHO – World Health Organization

WL – Warning Labels

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## ABSTRACT


Front-of-pack nutrition labels provide simple, at-a-glance nutrition information on the front display of food packs. Different formats of FOPNL are being used globally either voluntarily or by mandatory implementation. In India, the Food Safety Standards Authority of India (FSSAI) is considering to implement a symbol-based FOPNL. However, context specific evidence on the effectiveness of FOPNL is needed to inform ongoing advocacy and regulatory processes in India. The decision to which type of FOPNL should be used in a country should be based on the local research, along with regional and global evidence, and in consideration of each country's specific objectives for developing a FOPNL policy. Given this background, the current study was carried out with the following objectives: (i) To test the consumer acceptability, likeability, reliability and understandability of five FOPNL formats - namely Nutri-score (NS), Health Star Rating (HSR), Warning Labels (WL), Multiple Traffic Lights (MTL) and Nutri-star Rating (NSR). (ii) To compare the different formats of FOPNL on attributes such as noticeability, comprehensive and cognitive workload, speed, informativeness and objective understanding, legibility and purchase intention to identify the most suitable FOPNL for India.

This was a cross-sectional study with a quasi-experimental design, where in the general food label reading habits of the participants were examined along with their views on acceptability of various formats of FOPNL. Then, they were further randomized to one of the FOPNL formats for further assessment on the usability of format. A total 3231 (Adults – 2616, Adolescent – 615) participants were included in the study, covering five regions of India - North (Delhi); East (Kolkata), West (Pune), South (Hyderabad) and Northeast (Jorhat, Assam). The inclusion criteria for the participant recruitment was adults in the age group of 18-60 years who had sole or shared responsibility of food shopping, and not working in the area of food labelling or food industry, and adolescents in the age group of 10-18 years.

The data collection was completed in a single contact with the participants and the questionnaire administered had three parts. The first part of the questionnaire apart from collecting sociodemographic details, had questions on frequency of consumption of packaged foods, food label usage habits and their practice of reading the nutrition information on the label. The second part of the questionnaire assessed the perceptions of the participants on likeability, attractiveness and perceived cognitive workload of the five different formats of the FOPNL tested. For the third part of the questionnaire, 1/5<sup>th</sup> of the participants were randomized to one of the five FOPNL format and were shown five different variants of the assigned FOPNL format. The questions assessed various parameters of FOPNL such as noticeability, legibility, comprehensive and cognitive workload, speed, informativeness, objective understanding, perceived product healthfulness, purchase intention and willingness to change purchase behaviour of the participants.

It has been observed that majority of the participants claimed to read food label information, but they often check only the manufacturing and expiry dates. In this study basic awareness about the formats and functions of FOPNL were provided to the participants, which helped in better understanding of the FOPNL formats. As seen in the comparative acceptability assessment of the FOPNL, all the formats were understood by the participants, this was evidenced by the fact that very little difference was observed in various attributes such as





likeability, attractiveness and perceived cognitive workload of the FOPNL formats studied. Even illiterate participants understood the FOPNL formats. NS was the most preferred FOPNL and it could be due to the attractive colour coding. Participants randomised to all the FoPNL formats were able to identify healthiest and the least healthy variants of foods. However, for identifying the foods that were in the mid categories (moderately healthy and unhealthy foods), the summary indicator label formats (NS, HSR) seem to have had a halo effect, which appears to have made consumers to hold more positive attitudes about the food. The presence of WL deterred more people from choosing moderately healthy variants, whereas the summary labels seem to have made them look healthier.


Among the labels studied, WL had greater impact in altering the health perception of the food products, as presence of even one octagon or absence of stars (in case of NSR) seem to have prompted more cautious behaviours in choosing the foods. However, among the summary indicators, even presence of 2 stars (in HSR) or Code D (orange shades in NS), prompted higher choice for similar variants of food. In short, to identify healthiest or unhealthiest variants any format of FOPNL can work. However, for promoting healthier food choices among the available variants, summary indicators (NS and HSR) work better, but to deter consumption of even moderately unhealthy foods, warning label formats (NSR or WL) appear to be a better option.

## INTRODUCTION

According to the World Health Organization (2020), roughly 39% of adults worldwide are overweight and 13% are obese. Currently, India is seeing a surge in the prevalence rate of obesity as seen in recent country level surveys. The prevalence rate of obesity and central obesity observed in the ICMR-INDIAB study (2015) in 15 states of India was 11.8-31.3% and 16.9-36.3% respectively (Pradeepa et al., 2015). In the latest NFHS-5 data, the percentage of women and men whose BMI was  $\geq 25.0$  kg/m<sup>2</sup> was 24% and 22.9% respectively (National Family Health Survey, 2019-2021). The rapidly increasing burden of NCDs constitutes a major public health challenge undermining future social and economic development. As unhealthy diet is one of the major drivers of obesity pandemic, scholars, advocates, and policymakers are increasingly calling for policies to discourage consumption of ultra-processed foods and beverages and encourage informed healthy and wholesome food choices. The sales of pre-packaged foods and beverages are increasing globally (Baker et al., 2020). This shift in the food purchasing behaviours of consumers from traditional home cooked foods to pre-packaged processed foods is due to multiple reasons such as increased per-capita disposable income, change in lifestyles, family structure, globalisation, urbanization, modern supermarkets, and aggressive marketing (Sproesser et al., 2019; Popkin et al., 2012; Pingali, 2007). Indian food market space also has been witnessing a surge in the purchase of pre-packaged processed foods (Law et al., 2019). For instance, a study projected that India witnessed an increase from 68% to 84% in a span of four years from 2014 to 2018 (De Moji, 2018). Some pre-packaged processed foods referred to as ultra-processed foods are often high in fats, sugar, salt, saturated fats, trans fats (HFSS) and calories. Regular consumption of ultra-processed HFSS foods has adverse effects on the health of individuals. Research suggests a strong association between higher consumption of processed foods high in fat sugar and sodium with obesity markers such as greater Body Mass Index (BMI) and waist circumference (Machado et al., 2020; Rauber et al., 2021) and many NCD's (Pagilai et al., 2021).

Nutrition Labels (nutrient content declaration on food labels) can serve as a population-based approach and a promising tool for effective nutrition communication that can help consumers make informed and healthy food choices. Nutrition labels may be interpretive or non-interpretive in nature. Interpretive nutrition labels provide simple, at-a-glance information that is easy for all consumers irrespective of ethnicity or socioeconomic position to understand and act on (Maubach, 2014), whereas the non-interpretative labels provide nutrient information, which needs to be interpreted by the consumers by invoking their latent nutrition knowledge.

Nutrition labelling comprises three components - nutrient declarations, nutrition and health claims, and supplementary nutrition information. As of now many countries including India has mandated the declaration of nutrition information on labels (FSSAI, 2011). The supplementary nutrition information is referred to as Front of Pack Nutrition Labelling (FOPNL). FOPNL could be one of the several strategic communication methods which are being implemented to generate awareness and motivate consumers to make healthy choices. Different studies have proved that non-interpretative nutrition labels with detailed nutrient content declarations do influence the buying behaviour of consumers (Vemula et al., 2013; Saha et al., 2015; Kaur et al., 2018; Olatano, 2019; Nagalatha et al., 2019). However, they seem to attract only few motivated buyers like healthy diet seekers, people intentionally combating



their unhealthy food practices, people with disease conditions and aged persons. Limited understanding of nutrition labels among consumers or difficulty in understand the nutrient information may result in poor interpretation of labels for making choices (Vemula et al., 2013). Therefore, there is a felt need among the health advocates, public health professionals, and international organizations for additional policies that require giving simplified nutrition information in the front-of-pack to guide consumers to make healthy choices. The two main objectives of FOPNL are (1) to provide additional information to promote healthier food choices and (2) to stimulate the reformulation of food products towards healthier options by the industry.

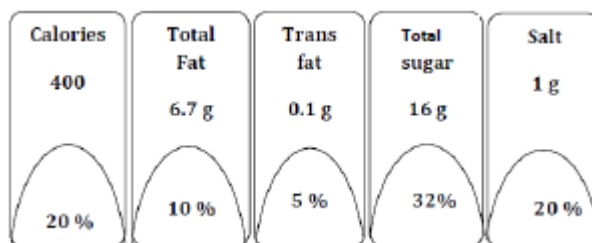
The Codex Alimentarius Commission, have revised their guidelines regarding food labels (Codex Alimentarius Commission, 2017), following which several government regulatory bodies in several countries including FSSAI are revising their food labelling regulations to include FOPLs in processed foods to nudge consumers towards healthy food choices.

The FOPNL's warnings indications can be shapes, text, or colours intended to signal a warning and to discourage consumption. Some of the FOPNL models that are in use across the world include - Traffic light labelling system, Health star food rating system, The Choice Programme Logo, Black hexagon symbol. NutriScore has been implemented in France since 2017 on a voluntary basis. Australia and New Zealand adopted the Health Star Rating for indicating healthfulness of processed foods. Countries like Chile, Peru, Uruguay and Israel have implemented mandatory national Front of pack nutrient warning label policies. According to these policies it is mandatory to indicate high or excess levels of nutrients of concern (frequently referred to as “critical nutrients”), including added sugar, sodium, saturated fat, and in some cases trans fats, energy or non-caloric sweeteners in the front of food packages.

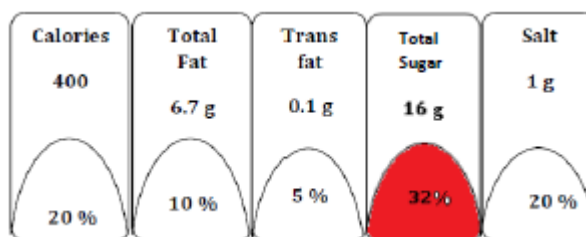
FAO/WHO, classified the FOPNL symbols as- (a) nutrient-specific food label symbol schemes that inform the consumer about the levels of a specific nutrient in a food item; (b) summary indicator food label symbols which help the consumer differentiate between healthy and unhealthy food items; (c) food group information symbols that inform the consumer about the food groups present in the food item; (d) Hybrids of these three types of symbol scheme. Based on the consumer understanding, the FOPNLs can be broadly classified into interpretive or reductive labels. Interpretive labels can be easily understood by the consumers as they provide simple at-a-glance information even for those with minimal education and nutrition knowledge, whereas the reductive labels (e.g., Guideline Daily Amounts) provides nutrient information, which needs to be interpreted by the consumers by invoking their latent nutrition knowledge. Interpretive labels can be further categorized into Interpretive nutrient-specific formats (e.g., Multiple traffic lights, warning symbols) and Interpretive summary indicator formats (e.g., Nutri-Score, Health Star Rating) (Fig 1). Interpretive nutrient-specific labels provide information on the individual nutrients within food, whereas interpretive summary indicator provides an overall evaluation of the nutritional quality of the product.

In India, the Food Safety Standards Authority of India (FSSAI) is considering to implement a symbol-based FOPNL. FSSAI released a draft ‘Food Safety and Standards (Labelling and Display) Regulation’ in 2018 specifying front-of-pack labelling requirements for pre-packaged foods. The FSSAI draft was available to the public online for their

suggestions, views, and comments. In the draft regulation it was proposed that the front of pack portion of pre-packaged foods should have the following information i.e. name of the food, declaration regarding veg or non-veg, and per serve contribution (amount and percentage) of energy, total fat, trans fat, total sugar and salt (sodium chloride) to RDA (Recommended Dietary Allowance). The per serve contribution of the nutrients should be depicted as shown in the below figure:



For pre-packaged foods with high fat, sugar and salt content, the respective nutrient blocks will be shown in RED i.e. if the nutrients of concern exceed the threshold levels it will be depicted in RED thus alerting the consumer. The proposed format for front-of-pack labelling by the FSSAI is depicted below.



However, FSSAI decided to do away with this design.

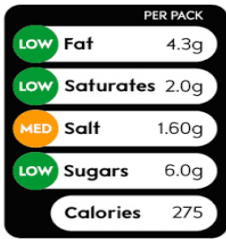



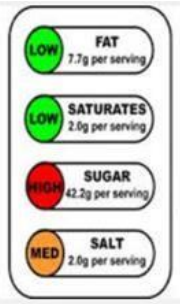




Nutrient-specific	Summary Indicative	Food Group Information	Hybrids															
 <p>PER PACK</p> <ul style="list-style-type: none"> <li><b>Low</b> Fat 4.3g</li> <li><b>Low</b> Saturates 2.0g</li> <li><b>MED</b> Salt 1.60g</li> <li><b>Low</b> Sugars 6.0g</li> <li>Calories 275</li> </ul> <p>Strawberries, raw Each 100g serving contains</p> <table border="1"> <tr> <td>Calories</td> <td>Sugars</td> <td>Fat</td> <td>Saturates</td> <td>Sodium</td> </tr> <tr> <td>32</td> <td>4,9 g</td> <td>0,3 g</td> <td>0,0 g</td> <td>0,001 g</td> </tr> <tr> <td>2 %</td> <td>6 %</td> <td>1 %</td> <td>1 %</td> <td>1 %</td> </tr> </table> <p>of an adult's Guideline Daily Amount www.tiptopglobe.com</p>	Calories	Sugars	Fat	Saturates	Sodium	32	4,9 g	0,3 g	0,0 g	0,001 g	2 %	6 %	1 %	1 %	1 %	 <p>0 POINTS VALUE 50 Calories 0g of Fat</p> <p>USDA ORGANIC NON-GMO PROJECT VERIFIED Certified GF Gluten-Free</p> <p>DRIED nat FRIED GOOD SOURCE OF FIBER GOOD SOURCE OF CALCIUM</p> <p>TRANS FAT 0 VEGAN U</p>	 <p>4 ONE CAN PROVIDES 4 SERVINGS OF VEGETABLES AND FRUIT</p>	 <p>MADE WITH WHOLE GRAINS MADE WITH REAL CHOCOLATE CHIPS TRANS FAT 0g FREE</p> <p>WHOLEGRAIN GRAINS ENTIERS 100% FIBRE 5g FIBRES TRANS FAT 0g GRAS TRANS</p>
Calories	Sugars	Fat	Saturates	Sodium														
32	4,9 g	0,3 g	0,0 g	0,001 g														
2 %	6 %	1 %	1 %	1 %														
Multiple/Single traffic light labelling	Health Star Rating	Negative warning label	Endorsement logo															
 <p>FAT (LOW) 7.7g per serving</p> <p>SATURATES (LOW) 2.0g per serving</p> <p>SUGAR (HIGH) 42.2g per serving</p> <p>SALT (MED) 2.0g per serving</p>	 <p>HEALTH STAR RATING 3.5</p> <table border="1"> <tr> <td>ENERGY</td> <td>SAT FAT</td> <td>SUGARS</td> <td>SODIUM</td> <td>NUTRIENT</td> </tr> <tr> <td>0000kJ</td> <td>0.0g</td> <td>0.0g</td> <td>000mg</td> <td>0.0g</td> </tr> <tr> <td>0% DI*</td> <td></td> <td></td> <td>LOW</td> <td>HIGH</td> </tr> </table> <p>PER PACK</p>	ENERGY	SAT FAT	SUGARS	SODIUM	NUTRIENT	0000kJ	0.0g	0.0g	000mg	0.0g	0% DI*			LOW	HIGH	 <p>ALTO EN AZÚCARES ALTO EN GRASAS SATURADAS ALTO EN SODIO ALTO EN CALORÍAS</p>	
ENERGY	SAT FAT	SUGARS	SODIUM	NUTRIENT														
0000kJ	0.0g	0.0g	000mg	0.0g														
0% DI*			LOW	HIGH														

Figure 1: Different formats of Front of Pack Nutrition Labels in vogue around the world



However, context specific evidence on the effectiveness of FOPNL is needed to inform ongoing advocacy and regulatory processes in India (Pande et al, 2020). A recent review posits a model and suggests that for FOPNLs to be effective, they must first grab attention, be accurately understood and thereafter must elicit a negative affect or perception of risk, which in turn should trigger behavioural intentions, and ultimately behaviour change (Taille, 2020). An understanding of the different types of FOPNL systems is needed for evaluating their inherent benefits and limitations, their performance or potential performance in the marketplace not only to guide food selection among consumers but also to encourage food reformulation and their design and implementation. The decision to which type of FOPNL should be used in a country should be based on the local research, along with regional and global evidence, and in consideration of each country's specific objectives for developing a FOPNL policy. Given this background, the current study was carried out with the following objectives:

- To test the consumer acceptability, likeability, reliability and understandability of five FOPNL formats - namely Nutri-score (NS), Health Star Rating (HSR), Warning Labels (WL), Multiple Traffic Lights (MTL) and Nutri-star Rating (NSR).
- Compare the different formats of FOPNL on attributes such as noticeability, comprehensive and cognitive workload, speed, informativeness and objective understanding, legibility and purchase intention to identify the most suitable FOPNL for India.

## **METHODOLOGY**

### **1. Study Design**

This was a cross-sectional study with a quasi-experimental design, where in the general food label reading habits of the participants were examined along with their views on acceptability of various formats of FOPNL. Then, they were further randomized to one of the FOPNL formats for further assessment on the usability of format.

The data collection was completed in a single contact with the participants and the questionnaire administered had three parts. The first part of the questionnaire apart from collecting sociodemographic details, had questions on frequency of consumption of packaged foods, food label usage habits and their practice of reading the nutrition information on the label.

The second part of the questionnaire assessed the perceptions of the participants on likeability, attractiveness and perceived cognitive workload of the five different formats of the FOPNL tested.

For the third part of the questionnaire, 1/5<sup>th</sup> of the participants were randomized to one of the five FOPNL format and were shown five different variants of the assigned FOPNL format. The questions assessed the objective understanding, perceived product healthfulness, purchase intention and willingness to change purchase behaviour of the participants.

## 2. Study location

The present study was carried out in five regions of India – North (Delhi); East (Kolkata), West (Pune), South (Hyderabad) and Northeast (Jorhat, Assam).

## 3. Study participants

Adults in the age group of 18 to 60 years, who had sole or shared responsibility of food shopping, were included. Individuals who worked in the area food labelling or food industry were not included in the study as they may not represent the general population. In addition, adolescents (10-18 years) were also included in the study.

## 4. Sample size

Assuming that 20% of participants buying pre-packaged foods read nutrition information on labels, taking 95% confidence interval and 5% absolute precision, a non-response rate of 10% and 1.5 design effect, the sample size for quantitative data collection was calculated to be 435.

$$p = 0.2$$

$$q = 0.8$$

$$Z = 1.96 \text{ (for 95\% level of confidence), therefore } Z^2 = 3.8416$$

$$d = 0.05$$

$$\text{Design effect (DE)} = 1.5$$

$$n = \frac{(Z)^2 \times (p) \times (q)}{d^2} \times DE$$
$$n = \frac{(1.96)^2 \times (0.2) \times (0.8)}{0.05^2} \times 1.5$$
$$n = 369$$

Accounting for non-responders [15%]

$$n = \frac{369}{0.85} = 435$$

The required sample was 435 per region. From each study location 500 participants were selected for the study. The total sample size for the study was 2500.

On the advice of the project review committee, an additional sample of 500 adolescents (10-18 years) was included and at least 100 were selected from each region. This was suggested as no other study conducted in India to assess the effectiveness of FOPNL formats has covered this very important consumer population.

## 5. Ethical Clearance

The study protocol was approved by the Institutional ethics committee of ICMR-National Institute of Nutrition (ICMR-NIN), Hyderabad (Adults Protocol number (5/I/2022);






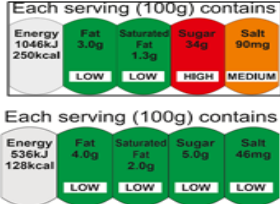

Adolescents Protocol number (RR/1/IV/2022)). Written informed consent was obtained from all the participants. For adolescent participants, consent to participate in the study was obtained from their Parents/Guardian.

## 6. Research Tools

### 6.1. Front-of-pack Nutrition Labels (FOPNLs)

#### Description of formats

In the pretesting stage, six different formats of labels – 5 of which are currently in use globally and a sixth one developed by ICMR-NIN were tested. These were Nutri-score, Health Star Rating (HSR), Warning Labelling (WL), Multiple Traffic Lights (MTL), Nutri-star Rating (NSR) (developed by NIN) and Guideline Daily Amount (GDA). The participants found it difficult to comprehend the GDA as they are non-interpretive and were mainly text based. Therefore, it was dropped for the final study. Therefore, the five FOPNLs that were tested are NS, HSR, WL, MTL and NSR (developed by NIN) and is briefly explained below figure.

<p style="text-align: center;"><b>Nutri-score</b></p> 	<p>NS indicates product healthfulness using five different colours and five letters ranging from Category A (dark green), indicating higher nutrition quality to category E (dark orange) lower nutrition quality.</p>
<p style="text-align: center;"><b>Health Star Rating</b></p> 	<p>HSR front-of-pack label indicates the overall nutritional profile of packaged food and assigns it a rating from ½ a star to 5 stars.</p>
<p style="text-align: center;"><b>Warning Labels</b></p> 	<p>WL black hexagon with the text “high in” followed by saturated fat, salt, sugar or calories when a predetermined threshold is exceeded.</p>
<p style="text-align: center;"><b>Multiple Traffic Lights</b></p> 	<p>MTL in addition to informing the amounts of nutrients and the corresponding percentage based on the recommended daily intake, it uses colours to indicate the healthiness of the food.</p>
<p style="text-align: center;"><b>Nutri-Star</b></p> 	<p>In NSR a golden star is given for each of the categories - total calories and nutrients of concern (sugar, salt, total fat and saturated fat) - if it is within the recommended threshold level in the food product. A product can get a maximum of 5 golden stars.</p>



## 6.2. Preparation Mock-ups

Mock-ups of food packets were printed on cards (two dimensional) for use in the study. The information on the mock up included the usual mandatory information like brand name, quantity, product description, health claim, veg/non veg symbol along with one of the five formats of FOPNL, which were positioned on the right hand upper corner of the packets. The name and image of the food was masked to reduce presumed response from the participants regarding the food packet shown. In order to reduce bias, the participants were shown only a single variety of food pack with different colours for five variants. A fictional brand ‘Delish’ was created for the mock packages to be shown to the participants. The mock food packs were designed using CorelDRAW version X4.

The size of the mock packages was adjusted after pretesting. The size was increased to actual size of market products of similar packaging.

For the second part, all the five formats of FOPNL included in the study were printed on the mock food packs just as they would be printed on the food packs so as to give an idea to the about how FOPNLs are likely to appear on the food packs.

For the third part of the questionnaire, for each of the FOPNL format, a set of five variants with (healthiest to least healthy) mock packages with fictional brand name (‘Delish’) were created.

## 6.3. Questionnaire

Initially, an item pool of 50 questions was prepared. After iteration among the project investigators some questions were deleted and a few were merged and a questionnaire comprising 40 questions was prepared. The questionnaire was content validated by a multi-disciplinary expert panel (psychology, health communication, nutrition and public health). The changes suggested by the panel were included in the questionnaire. The questionnaire was pilot tested among 100 participants drawn from in all the study locations. Revisions such as rewording the difficult questions, removal of redundant and identical questions and rearranging the sequence of questions were made in the questionnaire after pretesting. A copy of the questionnaire can be found in Annexure 1.

The final questionnaire had three distinct parts: 1) Sociodemographic details, frequency of purchasing packaged foods, and food label reading habits, 2) Comparative acceptability and effectiveness of each FOPNL tested and 3) objective understanding and purchase intention of the FOPNL assigned.

In the first part, socio demographic details such age, gender, education, socio economic status, and history of health condition were included, food label reading habits were assessed with options Yes, (if Yes, Always or Sometimes) and No; frequency of purchasing packaged foods of the participants were recorded for which the options were daily, 2-5 times a week, weekly once, fortnightly once or more, and never.

### **i) Comparative likeability, attractiveness and perceived cognitive workload of the five FOPNL format**

Second part of the questionnaire assessed the comparative acceptability, likeability, attractiveness and perceived cognitive workload of each FOPNL format. The participants were shown a mock package and were asked to say the first three-four things they noticed on the food label and their response was recorded.

The participants were briefly explained about the purpose of the FOPNLs and what each format conveys before proceeding with the rest of the questions. The subsequent ten questions (Q2-Q11) in part 2 dealt with likeability, attractiveness and perceived cognitive workload of each of FOPNL formats, the participants were asked to rate on five-point Likert scale (strongly agree to strongly disagree) for each of the statement. Q11 was based on the preferential ranking test to assess the participants' preference towards the five FOPNL formats on a five point scale (starting from 1 for the most preferred and 5 for the least preferred).

### **ii) Objective understanding and purchase intention of the participants (Intention to change the purchase unhealthy foods)**


The third part of the questionnaire was a randomised experiment to assess the objective understanding and purchase intentions of the participants. This part of the questionnaire which consisted of 12 questions assessed the participants' responses on the following indicators: Noticeability, legibility, comprehensive and cognitive workload, speed, informativeness and objective understanding, purchase intentions.

One fifth of the participants were randomised to one of the five FOPNL labels. For questions 1 to 7 the participants were asked to rate on 5-point Likert scale for each of the statements asked under various indicator such as Noticeability (2 statements), Legibility (2 statements), Comprehensive and cognitive workload (1 statement), Speed (1 statement), and Informativeness (2 statements).

Before responding to questions 8 to 12, the participants were shown five variants of mock packages with FOPNL assigned to them. The order in which the mock packages of five variants were shown was randomised. There was no specific order in which five variants were shown to the participants, i.e. the order didn't follow any sequence such as "healthiest to least healthy" or "least healthy to healthiest". The questions assessed the following aspects in participants such as product perceived healthfulness, buying intention, consumption pattern, product choice, and eating behaviour of the FOPNL showed (mock packages of the randomly allotted FOPNL format). The participants were asked to rate their response on 5-point Likert scale, the corresponding options for the various aspects ranged from 'healthiest' to 'Least healthy'; 'buying it for sure' to 'not buying it'; 'definitely reducing' to 'not reducing'; 'definitely choosing another product' to 'not choosing another product', 'definitely stop eating' to 'not stop eating'. For all the question 'Don't Know' option was also given.

## **7. Participant Allocation**

Participants were selected from four geographical locations where people of different income strata, i.e, upper, middle, lower and rural resided. The income group of the participants was determined by the place of residence. Equal distribution of participants recruited from



high, medium, low economic and rural areas within the selected study locations. In each of the study location 125 participants were selected from each income strata (125×4) making it 500 from each study location. All the participants were asked questions from first and second part of the questionnaire.

For the part 3 randomised experiment, 25 participants from each income group were allocated to one FOPNL (25×5 (Five FOPNL) = 125 (participants in each income group)). The total number of adult participants who were randomised to one of the five FOPNL's in each study location was 100. From the overall sample size 500 participants each responded to one type of the FOPNL's studied. In the adolescent population, 5 participants from each income group were allocated to one FOPNL (5×5 (Five FOPNL) = 25 (participants in each income group)). The total number of adolescent participants who were randomised to one of the five FOPNL's in each study location was 20.

## **8. Training of Project research and field assistants**

As this was a multi-centric study, training programme was conducted to the field level investigators to administer the survey tools in a standardized way.

The project research and field assistants were trained on how to approach participants and obtain informed consent. The training was conducted through zoom. Additionally one-on-one session on how to administer the questionnaire was conducted with project assistant and project field assistant from each study location. A manual was developed to guide the staff on the conduct of interview and data collection.

Field supervision in each study location was carried out by PI, Co-PI and Project staff to assess the survey modalities, to ensure quality control of data collection, and to fulfil the gaps in training of the field staff.


























## **9. Data Collection**

Data was collected by administering the questionnaire in an interview mode. The data was collected by conducting door-to-door surveys. Participants were shown the mock ups of food packs for the first part. Before administering of the questions from second part of the questionnaire (Q2-Q11), the participants were given a brief explanation about the five front-of-pack nutrition labels namely NS, HSR, WL, MTL and NSR. Participants were randomised to one of five FOPNL categories for the third part of the questionnaire. The participants were shown five variations of the assigned FOPNL category.

## **10. Statistical Analysis**

Frequencies and percentage were used to summarize categorical variables. The second part of the questionnaire which evaluated the comparative acceptability of the labels, the proportion of participants agreeing to each of the 10 acceptability statements was estimated. For the third part of the questionnaire also the proportion of participants agreeing and disagreeing to the statements pertaining to various aspects of the FOPNL label was estimated.

Figure 2. Mock-ups of food packs

	Healthiest	Healthy	Moderately Healthy	Unhealthy	Least healthy
NS					
HSR					
WL					
MTL					
NSR					

## RESULTS AND DISCUSSION

The result of the study is discussed under the following heads.

### 1. Participants' profile

#### Socio demographic and lifestyle characteristics.

The socio demographic profile of the participants (N=3231) is presented in table. 1. A total of 3231 (Adult – 2616, Adolescents – 615) participants participated in the study, out of which 43.1 percent were male and 56.9 percent were female. The illiteracy percentage was 5.6, with 2.2 percent knew to read and write without formal education. The percentage of participants who were married was 63.5. The percentage of participants who had sole responsibility of shopping was 84.1.

**Table 1: Socio-demographic profile of the study participants**

Particulars	Frequency (percent) (N=3231)
Gender	
<b>Male</b>	1394 (43.1)
<b>Female</b>	1837 (56.9)
Education	
<b>Illiterate</b>	181 (5.6)
<b>Read &amp; write</b>	72 (2.2)
<b>Primary</b>	289 (8.9)
<b>Secondary</b>	985 (30.5)
<b>Intermediate</b>	566 (17.5)
<b>Graduate &amp; above</b>	1138 (35.2)
Marital Status	
<b>Married</b>	2052 (63.5)
<b>Unmarried</b>	1097 (34)
<b>Widow</b>	75 (2.3)
<b>Separate/Divorced</b>	7 (0.2)
Responsibility of shopping	
<b>Sole</b>	2718 (84.1)
<b>Shared</b>	513 (15.9)

**Table 2: Label reading practices**

Read food labels	Frequency (percent)
<b>Yes</b>	2396 (74.2)
<b>No</b>	835 (25.8)


With regard to label reading behaviour 75.4 percent reported that they read food labels. The information checked on the food label is presented in table. 3.

**Table 3: Food label information reading practices among the participants**

Particulars	Percent (N=3231)		
	Always	Sometimes	No
1. Brand name	1969 (60.9)	519 (16.1)	743 (23)
2. Manufacturing date	1863 (57.7)	548 (17)	820 (25.4)
3. Expiry date	2396 (74.2)	418 (12.9)	417 (12.9)
4. Ingredients	476 (14.7)	879 (27.2)	1875 (58)
5. Storage	443 (13.7)	747 (23.1)	2041 (63.2)
<b>6. Nutrient Information</b>			
<b>a) Calories</b>	307 (9.5)	956 (29.6)	1968 (60.9)
<b>b) Total Fat</b>	307 (9.5)	967 (29.9)	1957 (60.6)
<b>c) Saturated Fat</b>	256 (7.9)	887 (27.5)	2088 (64.6)
<b>d) Transfat</b>	255 (7.9)	865 (26.8)	2111 (65.3)
<b>e) Carbohydrates</b>	295 (9.1)	879 (27.2)	2052 (63.7)
<b>f) Sugar</b>	331 (10.2)	903 (27.9)	1997 (61.8)
<b>g) Protein</b>	314 (9.7)	881 (27.3)	2036 (63)
<b>h) Salt</b>	299 (9.3)	881 (27.3)	2051 (63.5)
<b>i) Cholesterol</b>	288 (8.9)	836 (25.9)	2107 (65.2)
7. Allergen	<b>242 (7.5)</b>	<b>661 (20.5)</b>	<b>2328 (72.1)</b>
8. Veg and Non veg symbol	<b>656 (20.3)</b>	<b>617 (19.1)</b>	<b>1958 (60.6)</b>
<b>9. Quality symbols</b>			
<b>a) ISI</b>	785 (24.3)	658 (20.4)	1788 (55.3)
<b>b) AGMARK</b>	642 (19.9)	531 (16.4)	2058 (63.7)
10. FSSAI License	740 (22.9)	614 (19)	1877 (58.1)

Most of the respondents reported that they checked expiry date (74.2), Over 60 percent of the participants also read the brand name and 57.7 percent saw the manufacturing date. A small proportion of participants reported that they also considered nutrition information. Most commonly checked nutrients were calories, total fat, sugar, salt and protein. Over 39 percent of





the participants reported that they look for the symbols indicating vegetarian and non-vegetarian foods. Among the quality symbols ISI symbol was the most checked one.

In comparison with some earlier studies conducted in metro cities, (Saha et al., (2013) and Sudershan et al., (2013)), fewer number of participants reported that they read the label information in the current study. However, it should be noted that participants in the current study were drawn from different regions of the country and unlike in the earlier studies two-thirds of the participants were from rural areas and urban slums. As indicated in the previous studies, the current study also found that the food labels were mostly read for checking manufacturing and expiry date. However, higher proportion (39.1 percent Vs 20 percent) of respondents reported to read the nutrition information on the label compared to our earlier study (Sudershan et al., (2013)). Previous studies on nutrition label use among Indian population suggest that symbols on food labels (indicating vegetarian and non-vegetarian) have better uptake and recall value (Saha et al., (2013)).

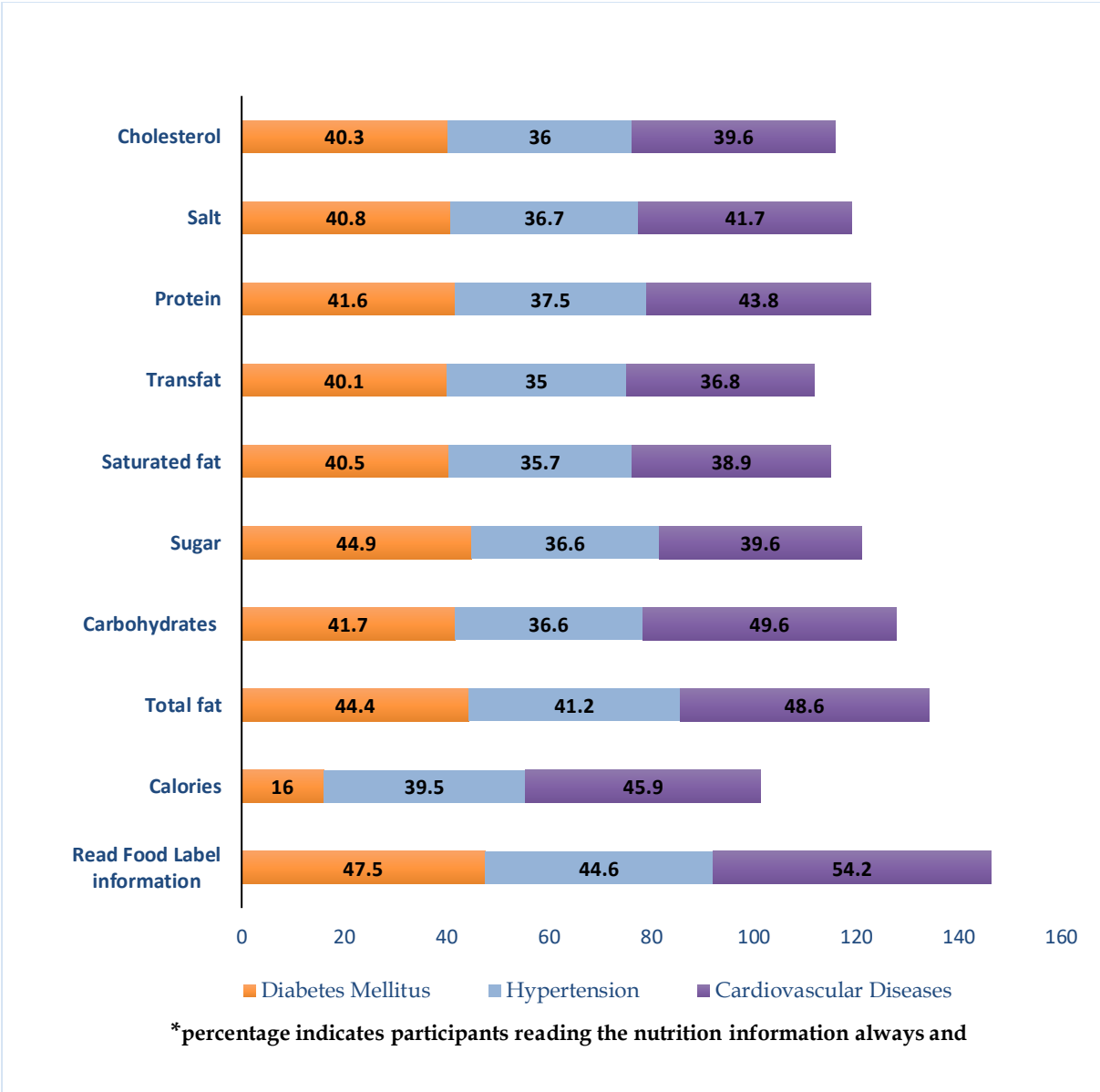
**Table 4: Non communicable diseases and reading food labels (N=3231)**

Food Label Information	Non communicable disease		p value	Non communicable disease		p value	Non communicable disease		p value
Checking food label	Diabetes			Hypertension			CVD		
	Yes (705)	No (2526)		Yes (869)	No (2362)		Yes (144)	No (3087)	
<b>While buying any product</b>	335 (47.5)	1129 (44.7)	0.337	388 (44.6)	696 (29.5)	0.422	78 (54.2)	1386 (44.9)	<b>0.028</b>
<b>Don't Check</b>	161 (22.8)	634 (25.1)		205 (23.6)	1076 (45.6)		23 (16)	772 (25)	
<b>Only while buying new product</b>	209 (29.6)	763 (30.2)		276 (31.8)	590 (25)		43 (29.9)	929 (30.1)	
Nutrient Information									
Calories									
<b>Always</b>	85 (12.1)	222 (8.8)	<b>0.011</b>	86 (9.9)	221 (9.4)	0.894	22 (15.3)	285 (9.2)	
<b>Sometimes</b>	218 (3.9)	738 (29.2)		257 (29.6)	699 (29.6)		44 (30.6)	912 (29.5)	
<b>No</b>	402 (57)	1566 (62)		526 (60.5)	1442 (61)		78 (54.2)	1890 (61.2)	
Total fat									
<b>Always</b>	90 (12.8)	217 (8.6)	<b>0.001</b>	97 (11.2)	210 (8.9)	0.131	23 (16)	284 (9.2)	<b>0.011</b>
<b>Sometimes</b>	223 (31.6)	744 (29.5)		261 (30)	706 (29.9)		47 (32.6)	920 (29.8)	
<b>No</b>	392 (55.6)	1565 (62)		511 (58.8)	1446 (61.2)		74 (51.4)	1883 (61)	
Saturated fat									
<b>Always</b>	73 (10.4)	183 (7.2)	<b>0.002</b>	80 (9.2)	176 (7.5)	0.234	19 (13.2)	237 (7.7)	0.057
<b>Sometimes</b>	212 (30.1)	675 (26.7)		230 (26.5)	657 (27.8)		37 (25.7)	850 (27.5)	
<b>No</b>	420 (59.6)	1668 (66)		559 (64.3)	1529 (64.7)		88 (61.1)	2000 (64.8)	
Transfat									
<b>Always</b>	72 (10.2)	183 (7.2)	<b>0.001</b>	79 (9.1)	176 (7.5)	0.283	20 (13.9)	235 (7.6)	<b>0.020</b>
<b>Sometimes</b>	211 (29.9)	654 (25.9)		225 (25.9)	640 (27.1)		33 (22.9)	832 (27)	
<b>No</b>	422 (59.9)	1689 (66.9)		565 (65)	1546 (65.5)		91 (63.2)	2020 (65.4)	
Carbohydrates									
<b>Always</b>	86 (12.2)	209 (8.3)	<b>0.001</b>	83 (9.6)	212 (9)	0.880	21 (14.6)	274 (8.9)	0.066
<b>Sometimes</b>	208 (29.5)	671 (26.6)		235 (27)	644 (27.3)		36 (25)	843 (27.3)	
<b>No</b>	411 (58.3)	1646 (65.2)		551 (63.4)	1506 (63.8)		87 (60.4)	1970 (63.8)	



Sugar									
<b>Always</b>	109 (15.5)	222 (8.8)	<b>0.000</b>	105 (12.1)	226 (9.6)	0.105	25 (17.4)	306 (9.9)	<b>0.013</b>
<b>Sometimes</b>	207 (29.4)	696 (27.6)		242 (27.8)	661 (28)		40 (27.8)	863 (28)	
<b>No</b>	389 (55.2)	1608 (63.7)		522 (60.1)	1475 (62.4)		79 (54.9)	1918 (62.1)	
Protein									
<b>Always</b>	90 (12.8)	224 (8.9)	<b>0.002</b>	91 (10.5)	223 (9.4)	0.681	21 (14.6)	293 (9.5)	0.084
<b>Sometimes</b>	203 (28.8)	678 (26.8)		235 (27)	646 (27.3)		42 (29.2)	839 (27.2)	
<b>No</b>	412 (58.4)	1624 (64.3)		543 (62.5)	1493 (63.2)		81 (56.3)	195 (63.3)	
Salt									
<b>Always</b>	87 (12.3)	212 (8.4)	<b>0.002</b>	89 (10.2)	210 (8.9)	0.463	21 (14.6)	278 (9)	0.072
<b>Sometimes</b>	201 (28.5)	680 (26.9)		230 (26.5)	651 (27.6)		39 (27.1)	842 (27.3)	
<b>No</b>	417 (59.1)	1634 (64.7)		550 (63.3)	1501 (63.5)		84 (58.3)	1967 (63.7)	
Cholesterol									
<b>Always</b>	85 (12.1)	203 (8)	<b>0.000</b>	83 (9.6)	205 (8.7)	0.646	21 (14.6)	267 (8.6)	0.050
<b>Sometimes</b>	199 (28.2)	637 (25.2)		229 (26.4)	607 (25.7)		36 (25)	800 (25.9)	
<b>No</b>	421 (59.7)	1686 (66.7)		557 (64.1)	1550 (65.6)		87 (60.4)	2020 (65.4)	

There was a significant association between presence of non-communicable diseases and checking nutrition information on food products. The percentage of participants with NCD's reading nutrition information on food packet labels is presented in Figure 1.



**Figure 3. Percentage of participants with NCD's reading nutrition information**

The frequency of buying processed foods among the participants is given in table. 5. The buying frequency among adolescent is also separately given in table. 6.

**Table 5: Frequency of buying packed foods**

Food item	Percent (N=3231)				
	Daily (%)	2-5 times a week (%)	Weekly once (%)	Fortnightly once or more (%)	Never (%)
<b>Rice</b>	0.2	0.4	9.9	<b>54.6</b>	32.9
<b>Dal</b>	0.3	0.7	12.3	<b>53.5</b>	31.1
<b>Atta</b>	0.2	0.5	14.3	<b>54.4</b>	28.6
<b>Cooking oil</b>	0.5	1.1	22.7	<b>68.1</b>	5.6
<b>Milk</b>	<b>61.4</b>	12.8	4.3	3.8	15.5
<b>Instant Noodles</b>	0.9	4	18.2	<b>50.9</b>	24
<b>Pasta</b>	0.3	1.9	8.9	39.1	<b>47.7</b>
<b>Breakfast Mixes</b>	0.3	0.9	3.3	16	<b>77.4</b>
<b>Breakfast Cereals</b>	0.2	1.1	4.6	26.1	<b>66</b>
<b>Cake Mixes</b>	-	0.4	3.2	9.5	<b>84.8</b>
<b>Soup Mixes</b>	0.1	0.9	2.3	17.9	<b>76.9</b>
<b>Bread</b>	7.2	13.6	<b>26.2</b>	<b>29.3</b>	21.6
Cake	1.4	3.5	10.1	<b>46.7</b>	36.2
Chocolates	5.1	8.7	22.8	<b>40.4</b>	20.9
Biscuits	11.6	15.1	<b>35.7</b>	29	6.6
Ice-cream	3.7	6.1	10.4	<b>41.6</b>	36.2
<b>Sandwich</b>	0.6	0.6	2.6	17.6	<b>76.4</b>
<b>Nutella</b>	0.2	0.2	0.8	8.2	<b>88.5</b>
Chips	6.9	10.4	<b>23.6</b>	<b>40.3</b>	16.8
Mixtures	1.6	3.8	<b>15.3</b>	34.8	<b>42.5</b>
Savouries	2.3	5.8	<b>20.1</b>	<b>42.8</b>	26.9
<b>Wafer</b>	1.1	1.9	4.9	16.9	<b>73.2</b>
<b>Jams</b>	1.1	1.5	5.8	<b>44.3</b>	<b>45.2</b>
Aerated drinks	2.1	5.5	11.5	<b>42.5</b>	36.3
Health drinks	1.7	1.1	4.6	<b>40.2</b>	<b>50.4</b>
Fruit juices	1.4	2.6	5.8	<b>32.2</b>	<b>56.1</b>

Processed foods like instant noodles, pasta, bread, cake, chocolates, ice-cream, chips, mixtures, savouries aerated drinks, health drinks and fruit juices were consumed by most participants on a weekly to fortnightly once basis.

**Table 6: Frequency of buying packed foods among adolescents**

Food item	Percent (n=615)				
	Daily (%)	2-5 times a week (%)	Weekly once (%)	Fortnightly once or more (%)	Never (%)
<b>Instant Noodles</b>	1.8	6.0	18.2	<b>50.6</b>	12.4
<b>Pasta</b>	0.5	3.3	7.5	37.6	<b>40.5</b>
<b>Breakfast Mixes</b>	0.8	1.3	3.6	12.2	<b>71.4</b>
<b>Breakfast Cereals</b>	0.5	2.3	4.6	21.3	<b>60.7</b>
<b>Cake mixes</b>	-	-	3.3	8.5	77.6
<b>Soup mixes</b>	-	0.8	1.6	15.4	71.4
<b>Bread</b>	9.4	12.2	<b>21.8</b>	<b>31.9</b>	14
Cake	1.8	5.5	7.2	<b>41.8</b>	33
Chocolates	8.6	15.8	18.4	<b>36.4</b>	10.1
Biscuits	<b>18.7</b>	<b>14.1</b>	<b>25.5</b>	<b>24.6</b>	6.3
Ice-cream	5.5	9.4	12.8	<b>37.2</b>	24.2
<b>Sandwich</b>	1.8	0.7	2.6	15.8	<b>68.5</b>
<b>Chocolate spread</b>	1.0	0.3	0.8	6.7	<b>80.5</b>
Chips	<b>13.5</b>	<b>15.3</b>	<b>20.3</b>	<b>32.4</b>	<b>7.8</b>
Mixtures	4.2	5.5	<b>14.5</b>	24.9	<b>40.2</b>
Savouries	5.0	7.6	<b>18.4</b>	<b>30.2</b>	28
<b>Wafer</b>	1.6	4.2	5.5	13.2	<b>64.7</b>
<b>Jams</b>	3.1	2.4	8.8	<b>41.3</b>	<b>33.7</b>
Aerated drinks	2.6	8.5	11.5	<b>38.5</b>	28.1
Health drinks	1.8	1.5	4.2	<b>39</b>	<b>42.8</b>
Fruit juices	2.6	4.4	7.0	<b>28.3</b>	<b>47</b>

The consumption of processed foods like cake, chocolates, biscuits, ice cream, chips, mixtures, savouries, and aerated drinks were higher among adolescent participants. Law et al., (2019) in their studies indicated that the purchasing trend of ultra-processed foods is increasing among urban Indian participants. It was noted that there was 17% increase in per capita sweet snacks purchase and 9% increase in salty snacks purchase from the year 2013 to 2017. A 22% increase was observed in 'other processed foods' purchase 2013 and 2017, while 73% of the respondents in the study informed that they purchased 'other processed foods' at least quarterly. In a study by Vemula et al., 2014 found that about 12% of the respondents in the super market exit surveys in Delhi and Hyderabad reported buying pre-packaged foods every day, with the highest among adolescents (15.7%) and lowest among the elderly (7.1%). Pre-packaged foods which were reported to have been purchased on the date of survey were milk (51.7%), biscuits (40.0%), snacks and savouries (28.1%), beverages (27.0%), oils (27.0%), bakery foods (23.5%), confectionery (23.4%), cereal products (23.7%), pulses (22.3%). The graphical representation of the frequency of pre-packaged processed consumption among adolescents in the current study is presented in Figure 2.

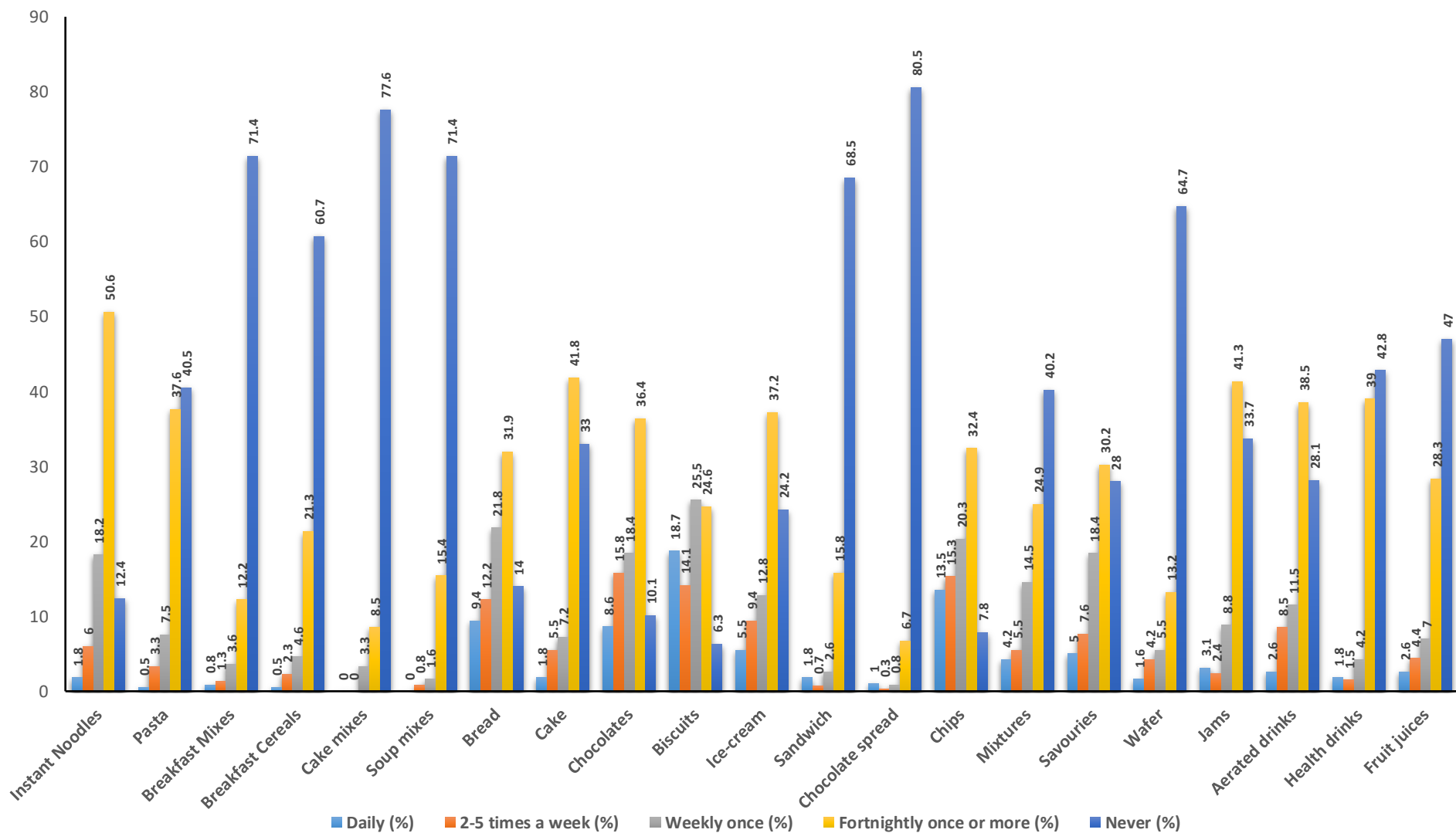


Figure 4. Frequency of pre-packaged processed foods consumption among adolescents (n=615)

## 2. Comparative likeability, attractiveness and perceived cognitive workload of the five FOPNL format/ Subjective assessment of the participants about the five FOPNL formats

Initially all the participants (N=3231) were shown mock food packages and were asked to mention the details which attracted their attention.

**Table 7. Information attracting consumer's attention in the front of pack**

Label information on the front	Frequency (percent) (N=3231)	
	Yes, it is attracting attention	No, it is not attracting attention
<b>Brand name</b>	2106 (65.2)	1125 (34.8)
<b>Health Claims</b>	971 (30.1)	2260 (69.9)
<b>Quality symbol</b>	313 (9.7)	2918 (90.3)
<b>Veg/Non Veg symbol</b>	1486 (46)	1745 (54)
<b>Quantity</b>	1027 (31.8)	2204 (68.2)
<b>Product description</b>	872 (27)	2359 (73)

The information mostly noticed by the participants was FOPNL, brand name, vegetarian and non-vegetarian symbol.

The comparative likeability, attractiveness and perceived cognitive workload of the five FOPNL formats studied is given in table. 8 and Figure 3.

**Table. 8: Comparative likeability, attractiveness and perceived cognitive workload of the five FOPNL format (N=3231)**

FOPNL	Likeability			Attractiveness			Perceived Cognitive Workload			
	Easy to judge the nutrient quality	Want to see this label	Label preference (1 <sup>st</sup> preference)	Identify healthy food	Identify unhealthy foods	Reliability	Easy to understand	Complex to understand	Think about food	Helps quickly decide what to buy
Nutri-score	92.1	86.2	41.3	94.9	91.7	50.4	97.3	2.3	85.3	87.5
Health Star rating	89.5	76.2	17.1	90.9	88.7	47.3	96.9	2.5	77.7	81.9
Warning Labels	77.2	61.2	6.7	76.9	76.9	70.5	82.8	13.3	66.4	65.3
Multiple Traffic Lights	85.1	70.2	16.1	85	83.4	78.3	89.9	7.8	73.9	73.4
Nutri-star Rating	90.7	80.8	19.4	91.6	90.4	51.3	97.4	2.8	81.8	84.2

\*The percentage of participants who said they ‘strongly agree’ or ‘agree’ for the statement are combined

The subjective understanding of the FOPNL formats were evaluated under three indicators namely likeability, attractiveness and perceived cognitive workload.

## 1. Likeability

### Easy to judge nutrients

With regard to the statement whether the label is helping the participants to easily judge the nutrient quality of the food pack, 92.1 percent ‘strongly agreed’ or ‘agreed’ for NS label. The next label with highest percent agreeing to the statement was NSR, followed by HSR, MTL and least was WL.

### Want to see this label

86.2 percent of the participants responded that they want to see NS on the front of pack. However only 61.2 percent of participants responded that they wanted warning label on the front of the pack.

### Preferential ranking

The most and the least preferred label is presented in table. 9.

**Table. 9: Preferential ranking test**

Front of pack labeling	Most preferred	2 <sup>nd</sup> preferred	3 <sup>rd</sup> preferred	4 <sup>th</sup> preferred	Least preferred
NS	41.3	22.8	19.5	9.8	6.6
HSR	17.1	24.5	24.7	21.5	12.3
WL	6.7	9.6	14.9	19.9	49
MTL	16.1	19.1	19.4	30.8	14.6
NSR	19.4	24.2	21.7	17.6	17.1

Among the labels shown, most of the participants’ first preference was NS followed by NSR, HSR, MTL and WL.

## 1. Attractiveness

### Identify healthy foods

About 95 percent participants strongly agreed or agreed that NS label will help them identify healthy foods. For the labels HSR and NSR 90.5 and 91.6 percent of participants strongly agreed or agreed to the statement. While the percentage of participants who agreed or strongly agreed for WL and MTL were 76 and 85.

### Identify unhealthy foods

About 92 percent participants felt that NS label would help them to identify unhealthy foods, closely followed by NSR (91.6 percent) and HSR (90.5 percent). While the percentage of participants who felt that WL and MTL help them identify unhealthy foods was 76.9 and 83.4 percent respectively.

**In terms of likeability, NS was ranked as the preferred first choice of FOPNL by most respondents. Among the FOPNL formats studied the least preferred was WL.**



## Reliability

When asked about the reliability of the label, a higher percent of respondents felt MTL (78.3) and WL (70.5) were reliable than NS (50.4 percent), HSR (47.3 percent) and NSR (51.3 percent).

## 2. Perceived Cognitive Workload

### Easy to understand

NSR (97.4) and NS (97.3) were considered to be the easiest formats to understand followed by HSR, MTL (89.9 percent) and WL (82.28 percent)

### Complex to understand

Over 13.3 percent strongly agreed or agreed to the statement that WL are complex to understand and about 8 percent felt MTL was difficult to understand. However, smaller proportion of participants felt that the summary indicators (such NS, HSR, and NSR) were complex to understand.

### Think about food

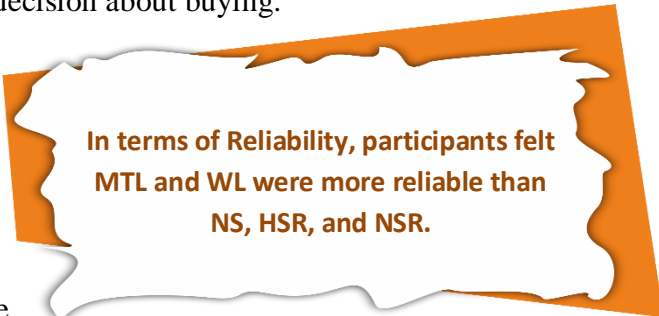
When asked about the FOPNL format that makes them to think about the food, 85 percent strongly agreed or agreed that NS label will make them think about the food. However, 81.8, 77.7 and 73.9 percent felt that NSR, HSR and MTL, made them think about the food. While the least percent of participants agreeing to this statement on whether ‘the label will make them think about food’ was for warning label.

### Helps quickly decide what to buy

The highest percent (about 88%) of participants felt that NS would help them to quickly decide what to buy, whereas the least proportion felt so in case of WL.

When asked about likeability, NS was the most preferred and warning label was the least preferred. In terms of identifying healthy and unhealthy foods NS, HSR and NSR scored better than WL and MTL. However, with regard to reliability (which assessed whether the participant trusted the information provided by the FOPNL), nutrient specific labels WL and MTL scored better than NS, HSR and NSR. For ease of understanding the NS, HSR and NSR score better than MTL and WL. For the FOPNL to work better, participants should be able to correctly understand it. Participants found the WL and MTL bit difficult to understand. Among the formats studied, participants perceived that NS, HSR and NSR will make them think about the product and will help them quickly make decision about buying.

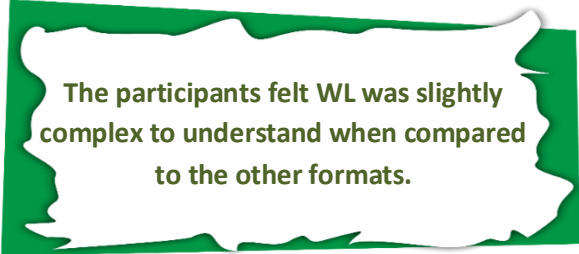
Similar results were observed in a study by Aguentaou et al., (2021) which assessed the Moroccan consumers’ perception on NS, HSR, MTL, WL and Reference intakes, found that NS scored highest number of positive responses on ease of being spotted and understood, and provide



**In terms of Reliability, participants felt MTL and WL were more reliable than NS, HSR, and NSR.**

rapid information. NS was found to be the most preferred label of the participants. NutriNet-Santé French cohort (n = 3,751) also found that NS, with a summarized graded and color-coded format, using semantic colours, is associated to a higher objective understanding than monochrome and nutrient-specific labels (Egnell et al., 2018). Studies have also observed that after NS, MTL also scored high in likeability and ease of understanding. However in the present study MTL did not score better than HSR.

Although there was not much difference in the acceptability between NS, HSR and NSR, NS is the most preferred label, which has scored the highest percent in all aspects of acceptability. This could be due to the use of colour codes (semantic colours) in NS compared to the monochromatic labels HSR and WL. In case of MTL, the reason for its poor acceptability could be the use of text content to indicate nutrition terms and percent despite colour indicators. Studies have shown that summary indicators fare better than nutrient specific labels since it is associated with a lower cognitive workload (Helfer and Shultz, 2015; Julia et al., 2017). Moreover, in the Indian context, the participants perhaps leaned more towards the HSR and NSR as most of them seemed to be familiar with the star rating used on the energy conserving electrical appliances (BEEI, 2021).



**The participants felt WL was slightly complex to understand when compared to the other formats.**

Comparative Likeability, attractiveness and perceived cognitive workload of the five FoPNL format

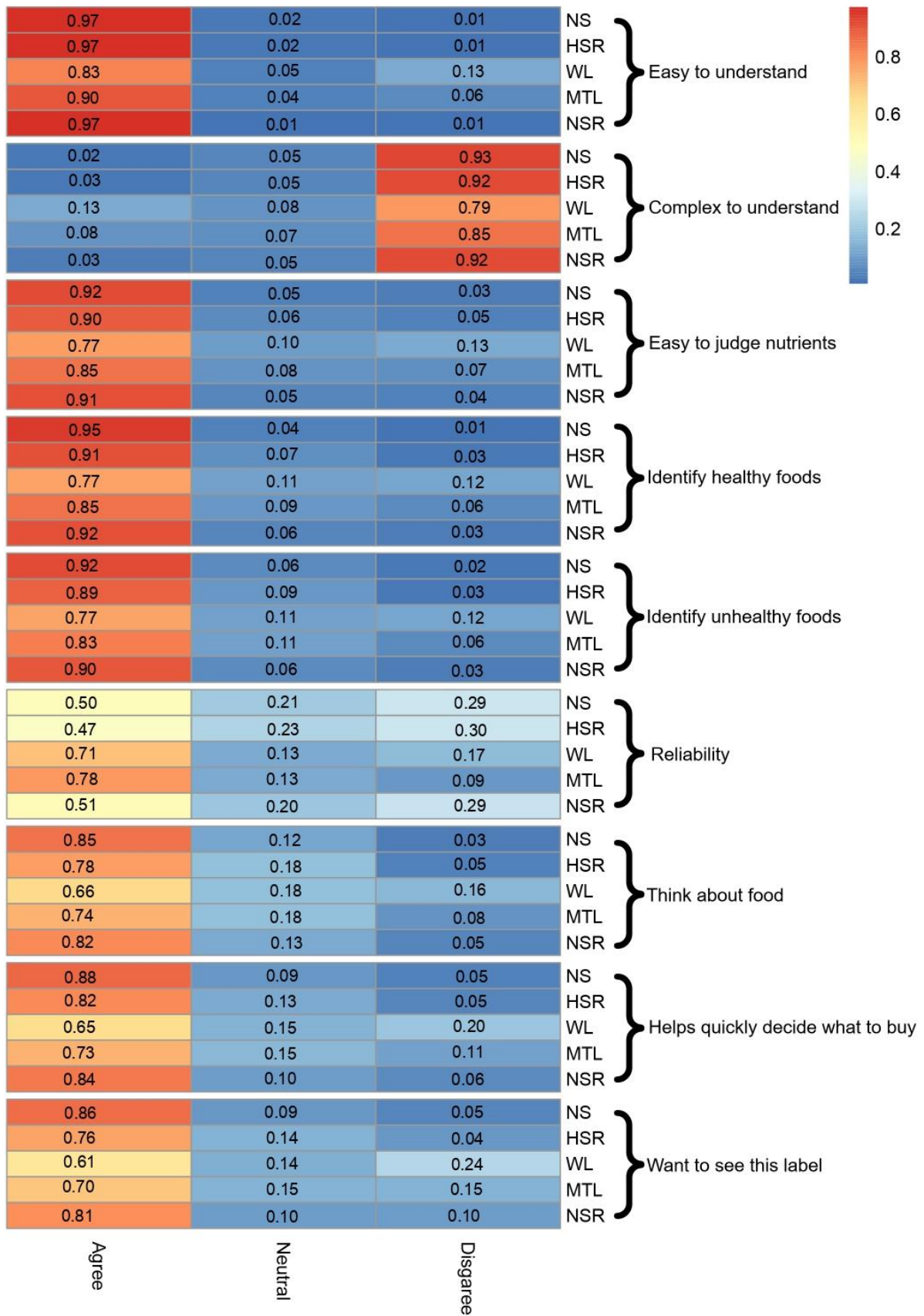



Figure 5. A heatmap of the Comparative likeability, attractiveness and perceived cognitive workload of the five FOPNL formats tested in the current study



The association between NCDs and label preference was seen for HSR, multiple traffic light and warning label. For a majority of the participants with history of NCDs HSR was the third preferred label, MTL were fourth preferred label and WL were least preferred label. The association of FOPNL with age, education, risk of NCDs and habit of reading food labels was not significant.

### **3. Objective understanding and purchase intention of the participants**

The key attributes of the FOPNL i.e., noticeability, legibility, comprehensive and cognitive workload, speed and informativeness were studied and is presented in Table10. The participants were randomly allotted to one of the FOPNL formats.

**Table 10. Key attributes of front-of-pack nutrition labels (N=3231)**

FOPNL (N=3231)	Noticeability		Legibility		Comprehensive and cognitive workload	Speed	Informativeness	
	Visible	Too small to locate on pack	Drawing attention	Big enough to read	Message conveyed is easy to understand	Helps understand healthiness of the product quickly	Provides clear inputs on Nutrients of concern	Gives clear inputs on positive nutrients
NS(n=644)	98.7	9.3	96.3	87.9	95.2	93.5	27.2	25.5
HSR(n=632)	97.3	10.4	94.8	85.9	95.1	93.1	26.7	24.1
WL(n=631)	91.3	16.5	85.9	74.9	77.5	78.7	82.4	18.1
MTL (n=659)	93.3	14.6	91.8	82.2	85.2	83.7	81.6	25
NSR(n=665)	97.7	8.6	94.2	87.4	94.2	91.1	24.2	21.7

\*The percentage of participants who said they ‘strongly agree’ or ‘agree’ for the statement are combined

## 1. Noticeability

More than 90% of the participants in all the FOPNL groups felt that their respective FOPNL format was visible on the mock ups of the food packs used in this study, while the highest and the least percentage of participants who reported their FOPNLs were visible NS (98.7) and WL (91.3) respectively. Similarly, the highest percentage of participants (16.5) among those allotted to the WL group felt that FOPNL was too small to locate on the pack. This could be due to the fact that the octagons in the WL are accompanied by text which invariably appears in small font size.

## 2. Legibility

More than 90 percent of the participants in NS, HSR, MTL and NSR groups felt that the FOPNL was drawing their attention. A fewer number of respondents (74.9%) felt that the WL was drawing attention, however, a higher percentage of respondents (87.9) felt the NSR format of warning labels was drawing their attention.

## 3. Comprehensive and cognitive workload Easy to understand

The highest and least percentage of participants who felt the message conveyed by the FOPNL is easy to understand was in NS group (95.2) and WL group (77.5).


## 4. Speed

More than 90% of the participants in NS, HSR, and NSR felt that the FOPNL helps them quickly understand about the healthiness of the product. Comparatively, in the WL and MTL groups only 78.7 and 83.7 percent respectively felt that the FOPNL helped them understand the healthiness of the product.

## 5. Informativeness

**Gives clear inputs on the Nutrients of concern-** The highest percentage of participants felt that the FOPNL gave clear inputs on nutrients of concern were in the WL (82.4) and MTL (81.6) groups.

The objective understanding of the labels studied assessed product health perception, buying intention, consumption pattern, product choice, and eating behaviour. The pooled data of adults and adolescents is presented in Table 11 and figure 7a-7e.



Over 90 percent of the participants in NS, HSR, MTL and NSR reported that the FOPNL on the food pack was drawing their attention.

**Table 11. Objective understanding, purchase intention, food choice and behaviour of the participants (N=3231)**

FOPNL Attributes	NS (n=644)					HSR (n=632)					WL (n=631)					MTL (n=659)					NSR (n=665)				
	VH	H	MH	UH	LH	VH	H	MH	UH	LH	VH	H	MH	UH	LH	VH	H	MH	UH	LH	VH	H	MH	UH	LH
<b>Product Healthiness</b>	92.2	76.2	28.4	60.6	60.2	93.4	51.1	67.7	58.7	57	78.4	42.5	17.7	41.7	53.7	90.1	59.2	48.4	49.9	61.8	89.6	47.8	61.6	67.4	55.9
<b>Will buy the product</b>	95	86.3	28.4	6.8	3.9	95.5	90.8	66.7	12.6	4.4	84.5	43.1	19.2	8.1	4.3	93.5	84.2	43.7	9.7	3.9	89.2	90.4	60.3	9.8	6.9
<b>Will not buy the product</b>	2.9	9.6	49.1	88.2	93.5	3.2	6.3	24.7	77.6	91.5	6.8	48.8	73.7	87.5	90.5	3.5	9.9	40	79.4	92.3	9.4	6.3	28.4	85	89.8
<b>Reduce the consumption of the product</b>	2.8	7.6	45	84	92.4	3.7	7.1	25.3	74.9	87.8	5.6	40.7	69.1	84.4	86.7	3.3	7.7	39	77.3	90.1	9.3	8.3	29.7	82.9	85.1
<b>Will not reduce the consumption of the product</b>	95.1	88.2	37.7	11.6	5.6	93.5	89	66.7	14.4	8.2	86.5	52.6	24.4	10.8	8.4	93	82.4	46.4	10.9	5.9	89.2	87.7	59.1	12.8	11.3
<b>Will choose another product</b>	2.3	6.5	49.2	84.7	90.9	2.6	5.2	23.4	73.5	86.8	5	40.9	66.5	86	87.3	2.3	7.5	34.5	76.6	87.6	8.9	6.8	30.1	81.1	85.3
<b>Will not choose another product</b>	94.9	89	34.9	9.8	5.6	94.3	90	66.7	14.1	6.8	87.2	51.4	26.8	8.6	6.8	93.8	83.6	48.9	11.2	7.2	89.2	88.8	59.2	13.4	11.2
<b>Will stop eating the product</b>	2.5	4.8	44	83.7	90.2	2.4	4.3	19.8	72	86.5	4.5	36.3	55.3	80.3	83.4	2	5.9	33.7	74.8	88.9	7.3	5.6	23.4	80.8	85.7
<b>Will not stop eating the product</b>	95.2	90.1	38.4	9.9	4.7	94.7	89.7	68.2	14.2	6.3	88.6	51	34.4	11.7	7.9	93.9	83.8	50.3	11.7	4.8	90.7	88.6	63.4	13.6	9.5

VH- Healthiest, H- Healthy, MH- Moderately Healthy, UH- Unhealthy, LH- Least healthy

**NS**= VH-A, H-B, MH-C, UH-D, LH-E; **HSR**= VH=5 stars, H=4 stars, MH=3.5 stars, UH=2.5 stars, LH=1 star; **WL**= VH=No octagon, H=1 octagon, MH= 2 octagon, UH=3 octagon, LH=4 octagon, **MTL**= VH=4 green, H=3 green and 1 orange, MH=2 green, 1 red and 1 orange, UH=2 red and 2 orange, LH=4 red; **NSR**= VH=5 golden star, H=4 golden star, MH=3 golden star, UH=2 golden star, LH=1 golden star



## Product Healthiness

**Healthiest variant** – Among the healthiest variant showed under different FOPNL formats, the highest percent of participants who identified healthiest option as healthiest was for HSR (93.4), whereas, the lowest percent of participants who identified healthiest food as healthiest was for WL (78.4), and over 8 percent of the participants in the WL group did not know which was the healthiest option as no symbol (octagon) was present for the healthiest option.

**Healthy variant** – For uniformity, the second option ‘somewhat healthy’ in the responses was considered to compare this product variant under different label condition. The highest percent of participants who identified healthy variant as ‘somewhat healthy’ was for NS (76.2). The corresponding percentage of participants for labels HSR, MTL, and NSR was 51.1, 59.2 and 47.8. It can be noted that the highest percentage of participants who identified this variant as ‘healthiest’ was in HSR group (43.2) as the stars would have created a ‘halo effect’. The percentage of participants who identified healthy variant (one octagon) as ‘somewhat healthy’ in WL was 42.5, it can be noted that 41.8 percent identified it as ‘unhealthy’ or ‘Least healthy’. Therefore, the WL seem to be alerting the participants even if it is slightly unhealthy.

**Moderately healthy variant** –For uniformity, the second option in the responses ‘somewhat healthy’ was considered to compare for moderately healthy variants shown under different FOPNL formats. The highest and lowest percentage of participants who identified moderately healthy variant as ‘somewhat healthy’ were for HSR (67.7) and WL (17.7) respectively. It can be noted that the highest percentage of participants who considered this product variant ‘unhealthy’ was in WL group (58.2), followed by 32.1 percent in NSR group.

**Unhealthy variant** –The highest and lowest percentage of participants who identified unhealthy product variant as ‘unhealthy’ were for NSR (67.4) and WL (41.7) respectively. The highest percentage of participants who considered unhealthy variants as ‘least healthy’ were those who were assigned WL (47.7).

**Least healthy variant** – Among the least healthy variant showed under different FOPNL formats the highest percent of participants who identified least healthy variant as ‘least healthy’ was for MTL (61.8). The lowest percent of participants who identified least healthy variant as ‘least healthy’ was for WL (53.7).

There was not much difference in identifying the healthiness of healthiest variants between the formats studied except for WL. With respect to healthiest shown in WL format participants got confused since there was no symbol to prompt them about the healthiness of the product.

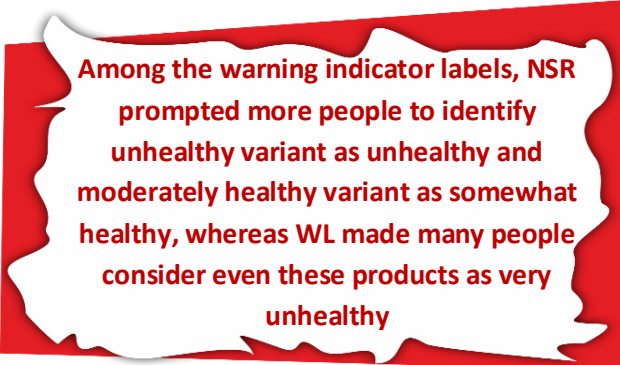
Although HSR performed the best in prompting the participants to identify the healthiest variant as healthiest, even the moderately healthy and unhealthy variants appeared healthy to many participants and motivated them to choose.

WL confused the people in identifying the healthiest variant. A higher number in this group opted for the response 'Don't Know' when asked about healthiness of the pack with no warning label.



A similar observation was seen in a study by Ares et al., (2018) where for identifying the healthiest products, the participants required the longest time when the product package featured the warning system (as it will not carry a warning symbol) compared to the HSR or NS. The healthy variant under HSR, MTL and NSR, was considered healthiest by 1/4<sup>th</sup> of the participants. With regard to moderately healthy foods, the HSR and NSR had higher percentage than other labels, this could be due to the ‘Halo Effect’ of presence of star.

However, in contrast to the present study finding, a study among Australian participants found that respondents were most accurate at evaluating the healthiness of food products with HSR (Talati et al., 2017). From the finding it can be inferred that the mere presence of only one octagon warning label in food packs changes the health perception of food pack to unhealthy. A similar observation was found in a study by Bandeira et al., (2021), where the presence of one octagon reduced the perception of healthiness of products among the participants. With regard to the identification of healthiness of least healthy variants there was not much difference between the labels studied.



**Among the warning indicator labels, NSR prompted more people to identify unhealthy variant as unhealthy and moderately healthy variant as somewhat healthy, whereas WL made many people consider even these products as very unhealthy**

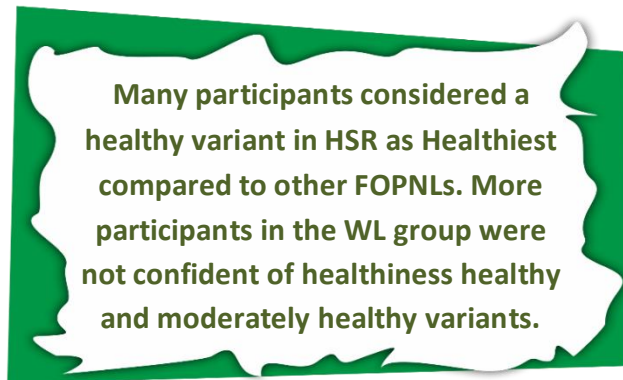
## **Buying Intention**

The buying intention of the participants is discussed under two headings whether the consumer ‘will buy’ and ‘will not buy’ the product variant. For discussion, the options 1 and 2 were combined for the response ‘I would buy the product’ and options 4 and 5 were combined for the response ‘I would not buy the product’.

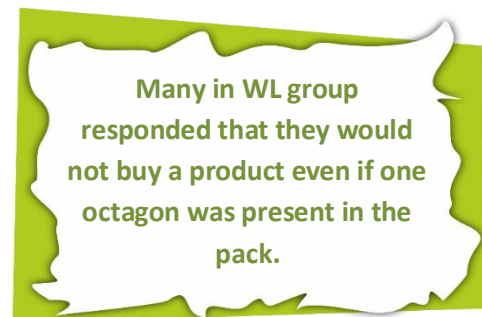
**Healthiest variant** – More than 90 percent of the participants shown the healthiest variant in NS, HSR, and MTL responded that they would buy the product with highest percent for HSR group (95.5). The corresponding percent of participants in warning label and NSR group was 84.5 and 89.2.

**Healthy variant** – For this variant the highest and lowest percent of participants who responded that they would buy the product was for the HSR (90.8) and WL (43.1) group respectively. The highest and lowest percentage of participants who responded that they would not buy the product were in WL (48.8) and NSR (6.3) groups respectively.

**Moderately Healthy variant** –For this variant the highest and lowest percent of participants who responded that they would buy the product was for HSR (66.7) and WL (19.2) groups respectively. The highest and lowest percentage of participants who responded that they would not buy the product was in WL (73.7) and HSR (24.7) group.



Many participants considered a healthy variant in HSR as Healthiest compared to other FOPNLs. More participants in the WL group were not confident of healthiness healthy and moderately healthy variants.



Many in WL group responded that they would not buy a product even if one octagon was present in the pack.

**Unhealthy variant** - The highest and lowest percentage of participants who responded that they would not buy the product was in NS (88.2) and HSR (77.6) group respectively. For this variant the highest and lowest percent of participants who responded that they would buy the product was HSR (12.6) and NS (6.8) groups respectively.

**Least healthy variant**–Over 90 percent of the participants in NS, HSR, WL and MTL shown the least healthy variant reported that they would not buy the product

### Consumption pattern

The consumption pattern of the participants is discussed under two headings whether the consumer ‘will reduce the consumption’ and ‘will not reduce the consumption’ of the product variant. For discussion, the options 1 and 2 were combined for the response ‘I would reduce the consumption of the product’ and options 4 and 5 were combined for the response ‘I would not reduce the consumption of the product’.

**Healthiest variant** – For the healthiest variant shown, more than 90 percent of the participants in NS, HSR and MTL group reported that they would not reduce the consumption of the product. The corresponding percentage for the NSR and WL groups were 89.2 and 86.5 respectively. However, over 9 percent of the participants in the NSR group said that they would reduce the consumption of the product.

**Healthy variant** - For this variant, the highest and lowest percent of participants who responded that they would not reduce the consumption of the product was for HSR (89) and WL (52.6) group respectively. However, the highest percentage of participants who responded that they would reduce the consumption of this variant of the product were among the WL (40.7) group.

**Moderately Healthy variant** –For this variant, the highest and lowest percent of participants who responded that they would reduce the consumption of the product was in WL (69.1) and HSR (25.3) groups respectively. The highest and lowest percentage of participants who responded that they would not reduce the consumption of the product was the HSR (66.7) and WL (24.4) group.

**Unhealthy variant** - For this variant, the highest and lowest percent of participants who responded that they will reduce the consumption of the product were in the WL (84.4) and HSR (74.9) groups respectively.

In terms of reducing consumption the presence of even one octagon was nudging participant to reduce its consumption of even moderately healthy/ unhealthy variants.

The summary indicators like NS, HSR, and MTL were providing positive impression about the products especially on healthy or moderately healthy variants as the participants responded that they will not choose another product over this, which is a cause of concern.

**Least healthy variant** –More than 85 percent of respondents in all the FOPNL format groups have said that they would reduce consumption of this variant.

### Product choice

The product choice of the participants is discussed under two headings whether the consumer will choose or and will not choose the product variant.

**Healthiest variant** – For the healthiest variant, over 90 percent of the participants in NS, HSR and MTL responded that they will not choose another product. The corresponding value for NS and WL are 88.8 and 87.2 respectively.

**Healthy variant** –For this variant, the highest and lowest percent of participants who responded that they will not choose another product were in HSR (90) and WL (51.4).It can be noted that the highest percentage of participants who responded that they will choose another product was in WL (40.9).

**Moderately healthy variant** –For this variant, the highest percent of participants who responded that they will not choose another product was in HSR (66.7), whereas, the highest percentage of participants who responded they would chose another product over this was in the WL group (66.5).

**Unhealthy variant**–For this variant, the highest and lowest percent of the participants who responded that they will choose another product WL (86) and HSR (73.5) group.

**Least healthy variant** – Over 85percent of the respondents in all the groups reported that they would choose another product

NS was found to be performing best in motivating the participants to stop consuming the least healthy variant, because it was color coded in red.

## Eating behaviour

The eating behaviour of the participants is discussed under two headings whether the consumer will stop eating the product and will not stop eating the product variant. For discussion, the options 1 and 2 were clubbed together for the response 'I would stop eating the product' and options 4 and 5 were clubbed together for the response 'I would not stop eating the product'.

**Healthiest variant** – More than 90% of the participants NS, HSR, MTL and NSR groups responded that they would not stop eating the product. However, over & percent of participants in both NSR and WL groups reported that they would stop eating the product

**Healthy variant** –For this variant, the highest and lowest percent of participants who responded that they would not stop eating the product was in the NS (90.1) and WL (51) group respectively. However, the highest and lowest percentage of participants who responded that they will stop eating the product was in WL (36.3) and HSR (4.3) group.


**Moderately Healthy variant** –For this variant, the highest and lowest percent of participants who responded that they would not stop eating the product was in HSR (68.2) and WL (34.4) groups respectively. The highest percentage of participants who responded that they would stop eating the product was in WL (55.3) followed by NSR group.

**Unhealthy variant** –The highest percentage of participants who would stop eating the product was in NS (83.7). However, over 14 percent of the participants in HSR group reported that they would not stop eating this product as there was at least one star present on them

**Least healthy variant** –the highest and lowest percent of participants who responded that they would stop eating the product was in NS (90.2) and WL (83.4).

With regard to the purchase intention of healthiest and Least healthy (extremes) there was not much difference in participants' responses across the FOPNL formats. However for the healthy, moderately healthy, and unhealthy products there was a clear difference in participants' responses. Among the summary indicators, NS was performing better in altering the purchase intention of participants when compared to HSR especially for moderately healthy products. This is in concurrence with an earlier study which reported that the HSR performed poorly when it comes to altering purchase intention of the participants compared to NS and warning label (Ares et al., 2018). With regards to the nutrient specific warnings, the WL are per forming better in discouraging the purchase of food products even with one octagon symbol. The amber colour in MTL was not fully understood by the participants, therefore the performance of MTL was poor compared to WL in discouraging consumption of moderately healthy or unhealthy variants. In the NSR group the presence of golden star did have a Halo effect. Overall, among the label formats studied WL clearly discouraged participants from buying packs with even with a single warning label.

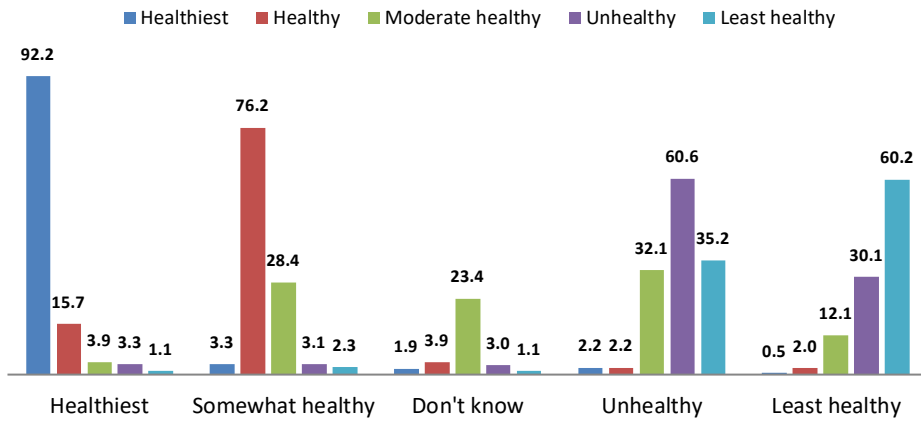
A similar pattern has been observed for reducing the consumption, product choice, and eating behaviour. Among the summary indicators NS performed better in terms of reducing the consumption, choosing another healthier option and even stopping to eat the product of unhealthy variants. In nutrient-specific FOPNL formats the WL performed better for reducing the consumption, product choice, and eating behaviour across the product variants. The new



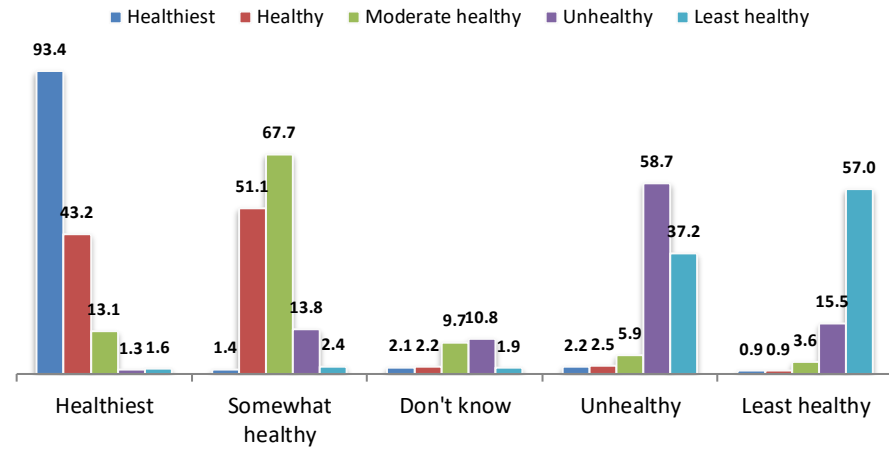
FOPNL proposed by FSSAI is also a summary indicator which is star rating-based symbol similar to Australian Health Star Rating (FSSAI, 2022). As observed in the present study, summary indicator labels are able to help consumers identify healthy foods, but when it comes to discouraging consumers to buy warning symbols-based labels are performing better.

**Figure 6. Graphical representation of the participants response of perceived product healthfulness of product variants showed under different FOPNL formats (N=3231)**

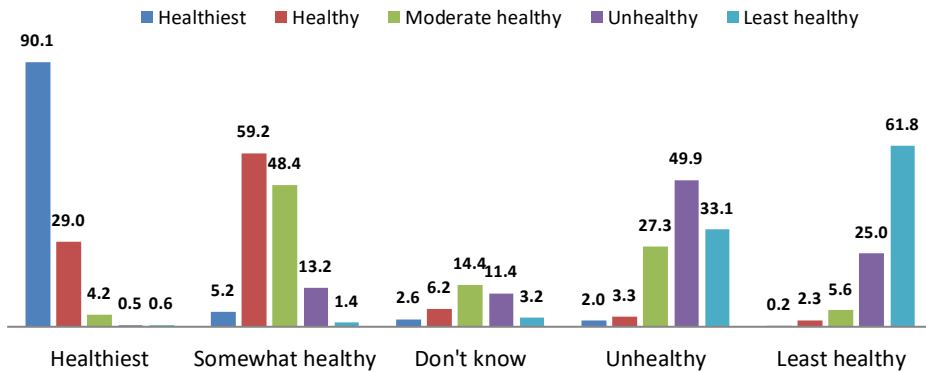
**Figure 6.1. Nutri-Score**



**Figure 6.2. Health Star Rating**



**Figure 6.3. Multiple Traffic lights**



**Figure 6.4. Warning Labels**

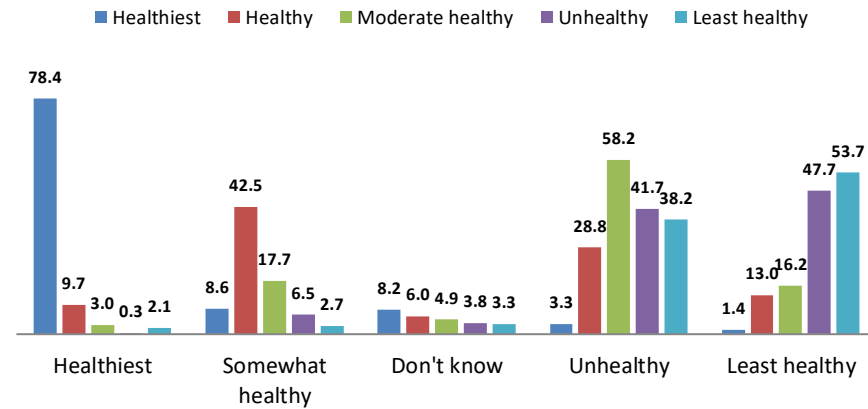
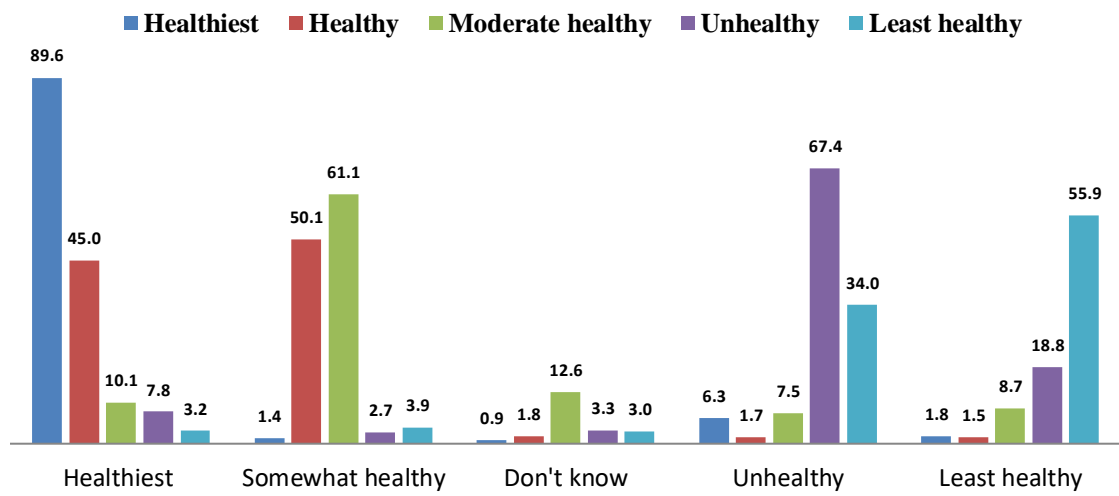


Figure 6.5. Nutri-star Rating



**Figure 7a. Buying intention, consumption pattern, product choice and eating behaviour of participants for Healthiest products (N=3231)**

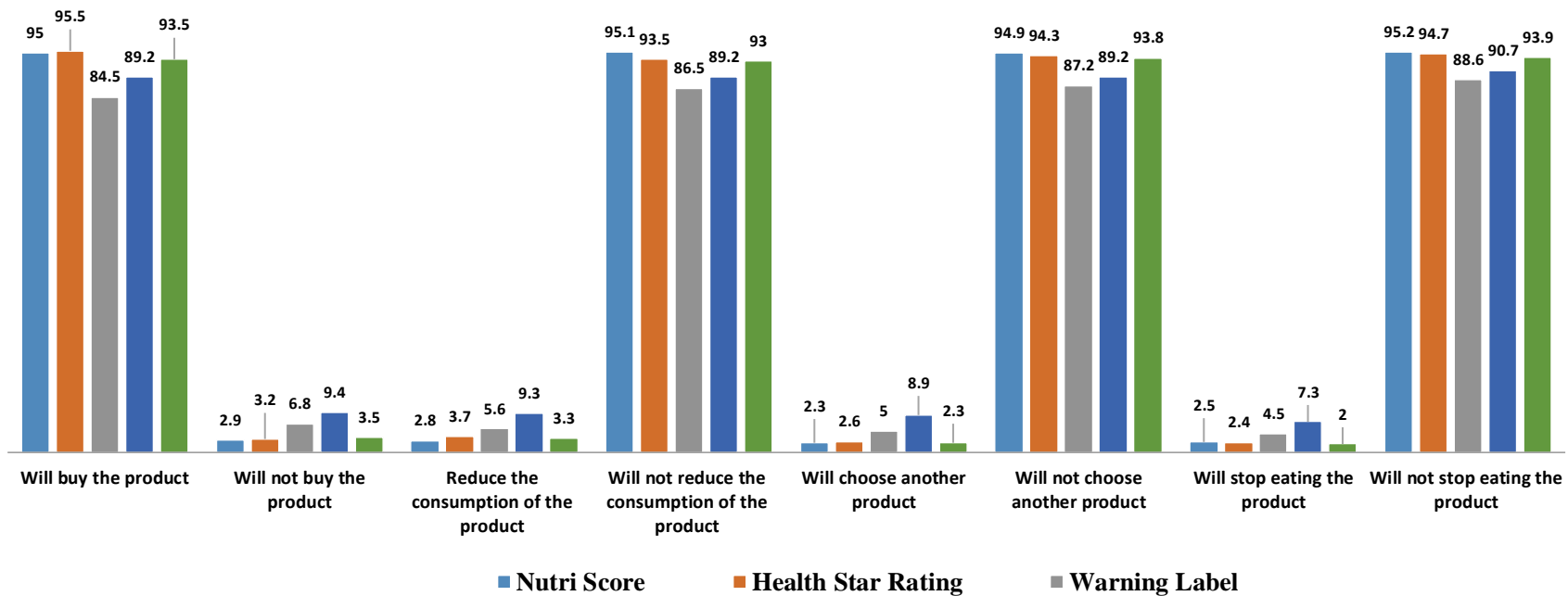
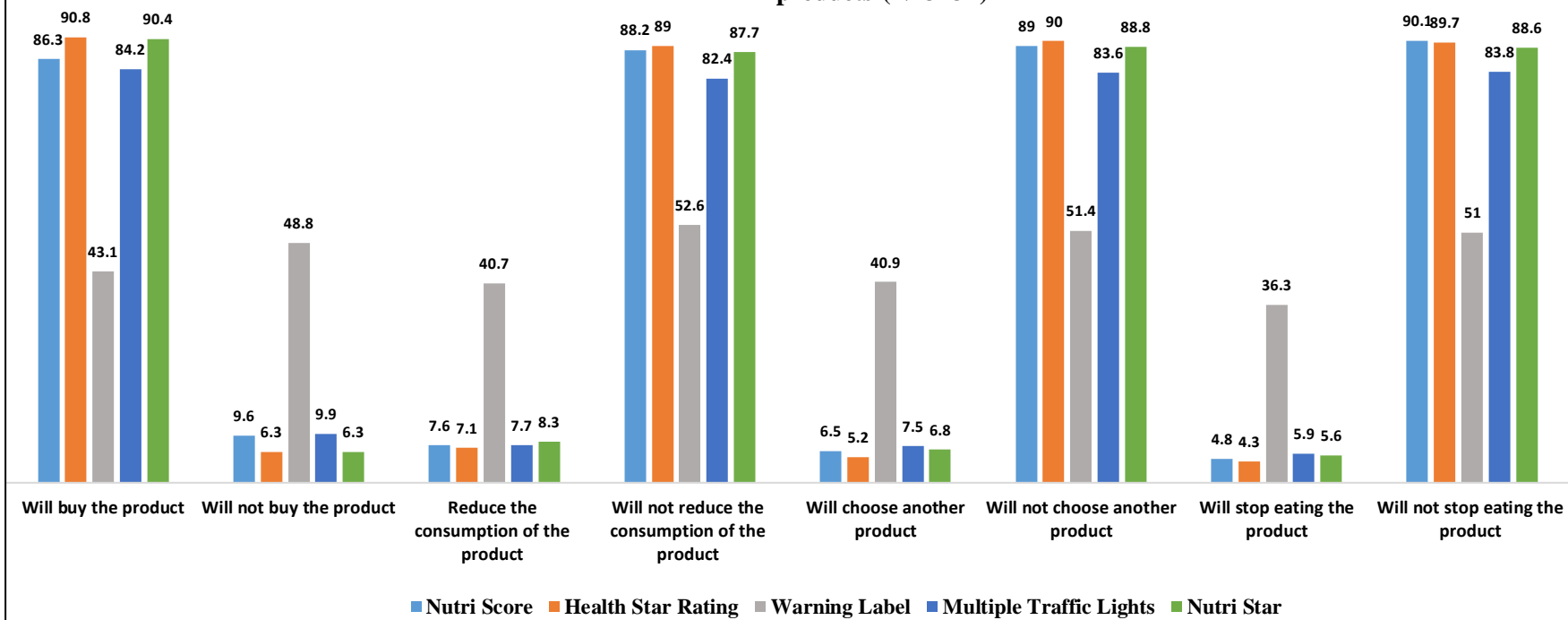
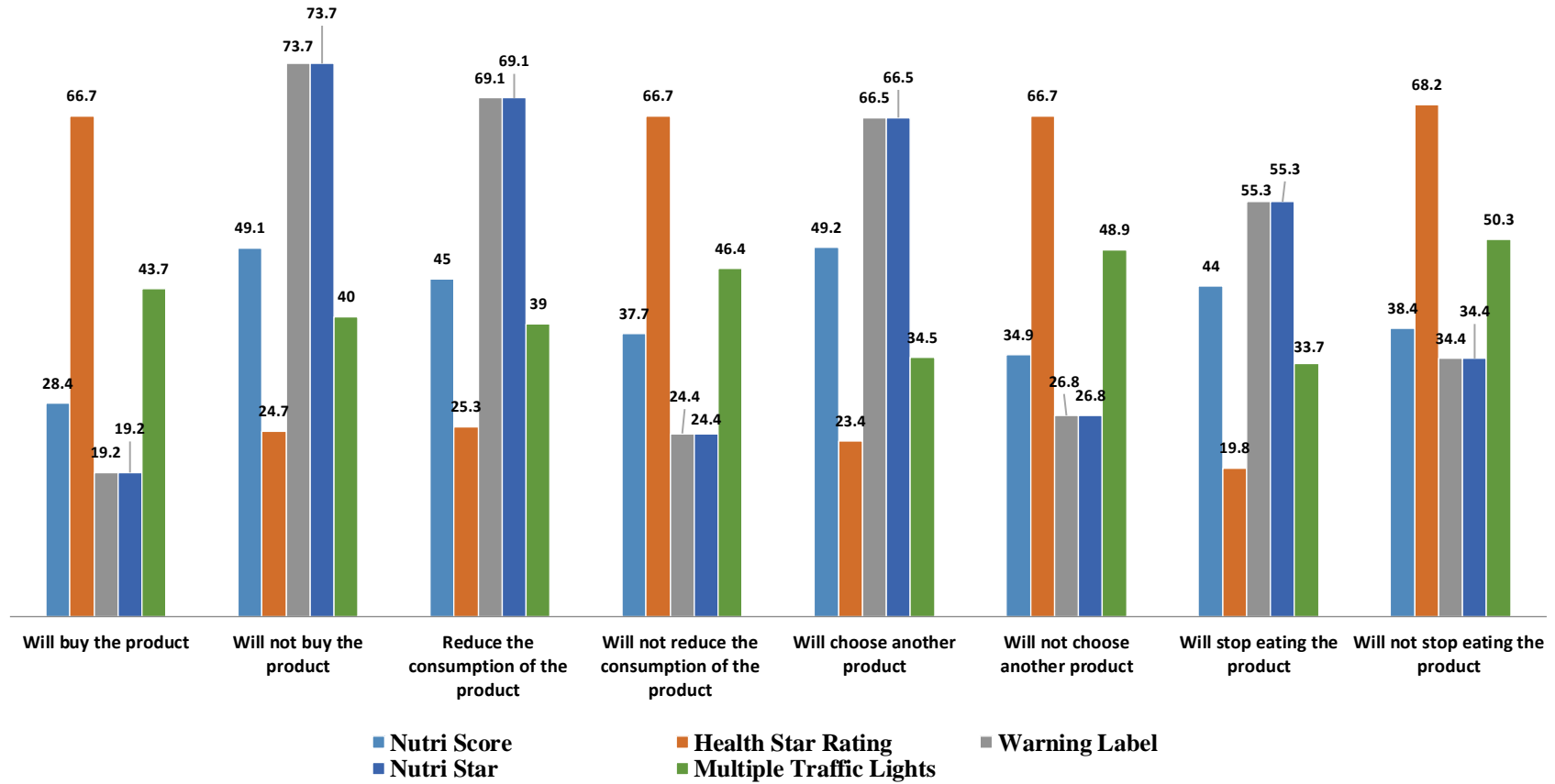




Figure 7b. Buying intention, consumption pattern, product choice and eating behaviour of participants for Healthy products (N=3231)



**Figure 7c. Buying intention, consumption pattern, product choice and eating behaviour of participants for Moderately healthy products (N=3231)**



**Figure 7d. Buying intention, consumption pattern, product choice and eating behaviour of participants for unhealthy products (N=3231)**

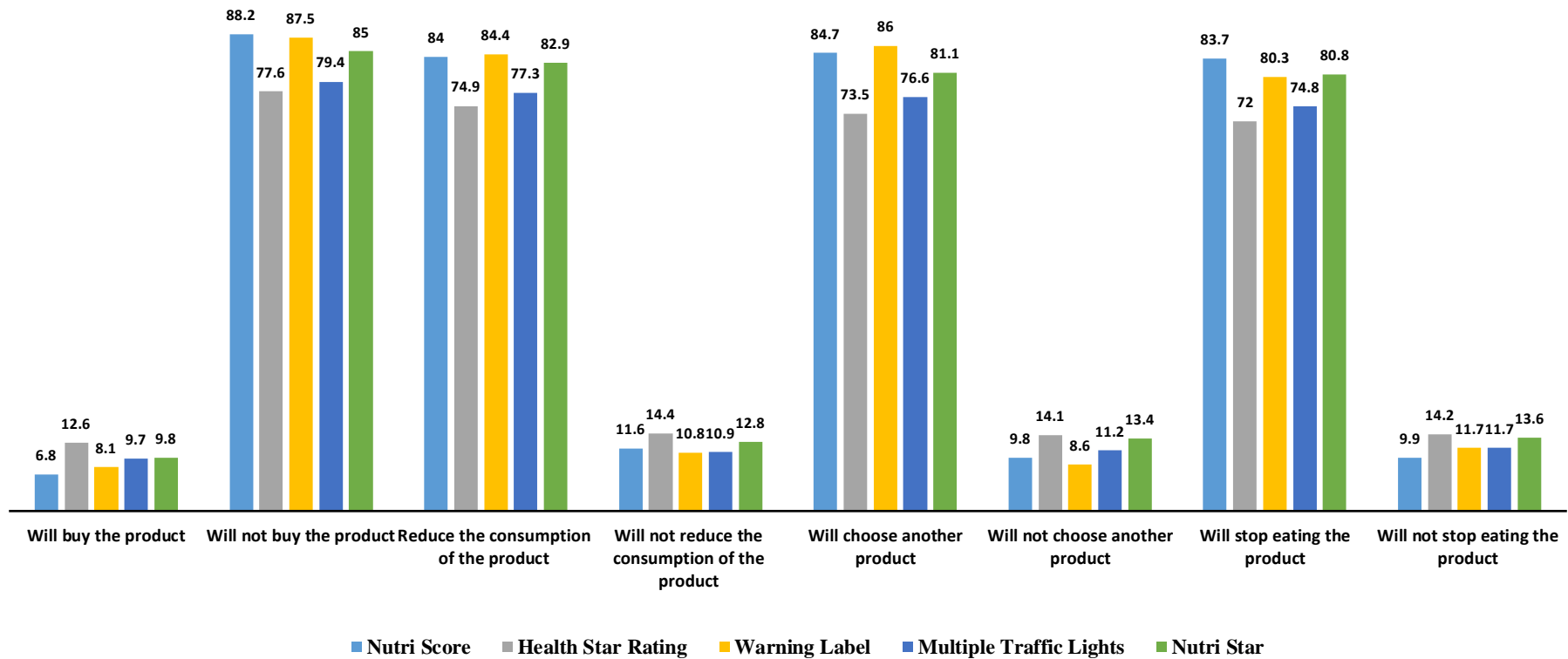
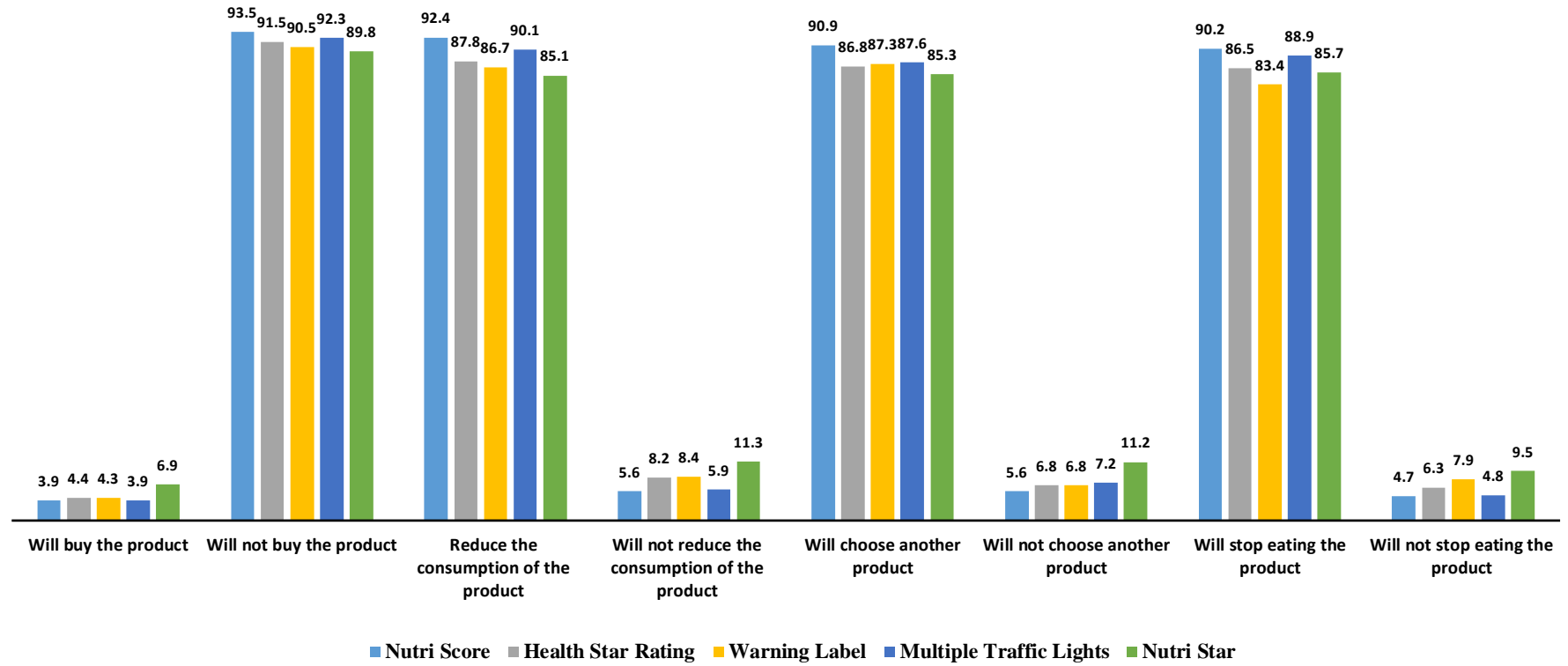


Figure 7e. Buying intention, consumption pattern, product choice and eating behaviour of participants for Least healthy participants (N=3231)



**Table.12. Objective understanding, purchase intention, food choice and behaviour of the participants Adolescents (n=615)**

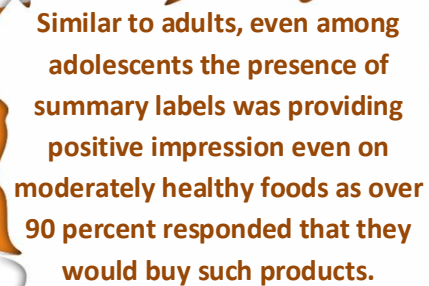
FOPNL Attributes	NS (n=124)					HSR (n=116)					WL (n=112)					MTL (n=134)					NSR (n=129)				
	VH	H	MH	UH	LH	VH	H	MH	UH	LH	VH	H	MH	UH	LH	VH	H	MH	UH	LH	VH	H	MH	UH	LH
<b>Product Healthfulness</b>	96	83.9	29.8	71.8	73.4	95.7	51.7	67.2	56.9	62.9	76.8	38.4	15.2	36.6	60.7	94.8	60.4	45.5	61.9	71.6	89.9	49.6	62	75.2	59.7
<b>Will buy the product</b>	99.2	93.5	33.9	5.6	4.8	97.4	96.6	68.1	14.7	4.3	82.2	45.5	20.6	12.5	6.3	91.1	86.6	42.5	14.1	8.2	88.4	89.9	60.5	10.1	5.5
<b>Will not buy the product</b>	0.8	6.4	40.3	91.9	93.5	2.6	2.6	30.1	73.2	90.5	6.3	45.6	69.6	82.1	85.7	7.5	11.2	43.3	76.1	88.8	11.6	8.5	27.9	83.8	93
<b>Reduce the consumption of the product</b>	1.6	3.2	41.9	90.3	92	1.7	6	31	75	87.9	5.4	39.3	61.6	78.6	79.4	3.7	9.7	43.3	75.4	86.6	12.4	12.4	34.1	81.4	87.6
<b>Will not reduce the consumption of the product</b>	98.4	96.8	39.5	8	6.4	96.5	92.2	66.4	13.8	7.7	83	55.4	30.3	12.5	11.6	94.1	82	47.7	14.9	7.4	86.9	84.5	56.6	13.2	8.3
<b>Will choose another product</b>	1.6	2.4	42.8	83.9	88.8	0.9	3.5	25.8	73.2	90.5	3.6	34.8	57.2	79.5	81.3	3	10.5	38.8	72.4	86.6	10.1	7	27.1	81.4	87.6
<b>Will not choose another product</b>	98.4	97.6	40.3	12.1	8.8	97.4	95.6	71.6	13.8	5.1	83.9	56.2	32.1	10.8	9	95.5	83.6	48.6	16.4	7.4	89.2	89.2	62.8	13.2	9.3
<b>Will stop eating the product</b>	1.6	0.8	41.9	87.9	90.3	0.9	2.6	26.8	71.5	87.9	6.3	32.1	47.4	75.9	78.6	2.2	7.4	38.8	72.4	88.8	8.6	6.2	19.4	79.9	87.6
<b>Will not stop eating the product</b>	98.4	98.3	40.3	8.8	5.6	96.5	94.8	67.3	15.5	5.1	83.1	54.4	38.4	10.8	7.2	94.8	85	51.5	17.9	5.9	90	87.6	68.2	13.2	7.7

VH- Healthiest, H- Healthy, MH- Moderately Healthy, UH- Unhealthy, LH- Least healthy

**NS**= VH-A, H-B, MH-C, UH-D, LH-E; **HSR**= VH-5 stars, H=4 stars, MH=3.5 stars, UH=2.5 stars, LH=1 star; **WL**= VH-No octagon, H-1 octagon, MH- 2 octagon, UH-3 octagon, LH-4 octagon, **MTL**= VH-4 green, H-3 green and 1 orange, MH-2 green, 1 red and 1 orange, UH-2 red and 2 orange, LH-4 red; **NSR**= VH-5 golden star, H-4 golden star, MH-3 golden star, UH-2 golden star, LH-1 golden star

## Product Healthfulness

**Healthiest variant** – Among the healthiest variant showed under different label conditions the highest percent of participants who identified healthiest food as healthiest was in HSR group (96). The lowest percent of participants who identified healthiest food as healthiest was in the WL (78.8). However, in nutrient specific FOPNLs, the highest percentage of adolescents who responded ‘Don’t Know’ was in WL (8.9).



Similar to adults, even among adolescents the presence of summary labels was providing positive impression even on moderately healthy foods as over 90 percent responded that they would buy such products.

**Healthy variant** – For uniformity, the second option in the responses ‘somewhat healthy’ was considered to compare the responses against this product variant under different label conditions. The highest percent of participants who identified healthy variant as somewhat healthy was for NS (83.9). The corresponding percentage of participants for labels HSR, MTL, and NSR was 51.7, 60.4 and 49.6. It can be noted that the highest percentage of participants who identified this variant as ‘healthiest’ was in HSR group (44.8). The percentage of participants who identified healthy variant (one octagon) as ‘somewhat healthy’ in WL was 38.4, it can be noted that 44.4 percent (not shown on table) identified it as ‘unhealthy’ or ‘least healthy’.

**Moderately healthy variant** –The highest and the lowest percentage of participants who identified moderately healthy variant as ‘somewhat healthy’ were for HSR (67.2) and WL (15.2) respectively. It can be noted that the highest percentage of participants who considered this product variant ‘unhealthy’ was in WL group (62.5), followed by MTL group (29.9).

**Unhealthy variant** – The highest and the lowest percentage of participants who identified unhealthy product variant as ‘unhealthy’ were in NSR (65.5) and WL (42.8) respectively. The highest percentage of participants who considered unhealthy variants as ‘Least healthy’ were WL group (46.6).

**Least healthy variant** – Among the Least healthy variant showed under different label condition the highest percent of participants who identified least healthy variant as ‘least healthy’ was in NS (73.4). The lowest percent of participants who identified least healthy variant as ‘least healthy’ was in NSR (59.7).

## Buying Intention

The buying intention of the participants is discussed under two headings whether the consumer will buy and will not buy the product variant.

**Healthiest variant** – More than 90 percent of the participants shown the healthiest variant in NS, HSR, MTL and NSR responded that they would buy the product with highest percent for NS group (99.2). The corresponding percent of participants in WL group was 82.2.

**Healthy variant** –For this variant, the highest and lowest percent of participants who responded that they would buy the product were in the HSR (96.6) and WL (45.5) groups respectively.

The highest percentage of participants who reported that that they would not buy the product was in WL (45.6) group.

**Moderately healthy variant** –For this variant, the highest and lowest percent of participants who responded that they would buy the product was in HSR (68.1) and WL (20.6) groups respectively. However, a considerable number of the participants who responded that they would not buy the product were in the WL (69.6) and NSR (27.9) groups.

**Unhealthy variant** - The highest percentage of participants who responded that they would not buy the product was in NS (91.9) group.

**Least healthy variant** - More than 90 percent of the participants shown the Least healthy variant in almost all the FOPNL variants responded that they would not buy the product with highest percent being in NS group (93.5).

### Consumption pattern

The consumption pattern of the participants is discussed under two headings whether the consumer will or will not reduce the consumption of the product variant.

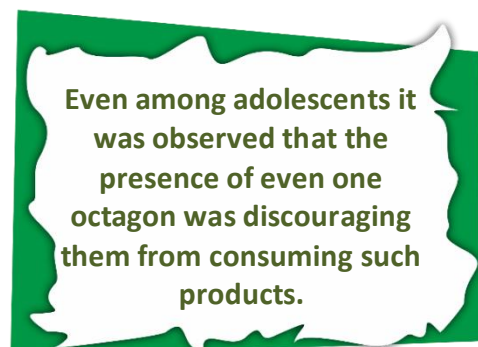
**Healthiest variant** – For the healthiest variant shown, more than 90 percent of the participants in NS, HSR and MTL groups chose the option that they would not reduce the consumption of the product. The corresponding percentage for the NSR and WL groups were 86.9 and 83 respectively. The highest percentage of participants who responded that they will reduce the consumption of the product was in the NSR group (12.4).

**Healthy variant** - For this variant, the highest and lowest percent of participants who responded that they would not reduce the consumption of the product was in NS (96.8) and WL (55.4) groups respectively. The highest and lowest percentage of participants who reported that they will reduce the consumption of the product were in the WL (39.3) and NS (3.2) groups respectively.

**Moderately Healthy variant** –For this variant the highest and lowest percent of participants who responded that they would reduce the consumption of the product was in WL (61.6) and HSR (31) groups respectively. The highest and lowest percentage of participants who responded that they would not reduce the consumption of the product was the HSR (66.4) and WL (30.3) groups respectively

**Unhealthy variant** - For this variant, the highest and lowest percent of participants who responded that they will reduce the consumption of the product was the NS (90.3) and HSR (75) groups respectively.

**Least healthy variant** – The highest and the lowest percent of participants who responded that they would reduce the consumption of the product was in NS group (92) and WL groups (79.4) respectively.



Even among adolescents it was observed that the presence of even one octagon was discouraging them from consuming such products.

## Product choice

The product choice of the participants is discussed under two headings whether the consumer will or will not choose the product variant. For discussion, the options 1 and 2 were clubbed together for the response 'I would choose another product' and options 4 and 5 were clubbed together for the response 'I would not choose another product'.

**Healthiest variant** – For the healthiest variant in the label conditions NS, HSR and MTL more than 90 percent of the participants responded that they will not choose another product. The corresponding value for NSR and Warning Label are 89.2 and 83.9 respectively. The highest percentage of participants who responded that they will choose another product was in NSR (10.1).

**Healthy variant** –For this variant the highest and lowest percent of participants who responded that they will not choose another product was in NS (97.6) and WL (56.2). It can be noted that the highest (34.8) percentage of participants who responded that they will choose another product was in WL group.

**Moderately healthy variant** –The highest and the lowest percent of participants who responded that they will not choose another product was in HSR (71.6) and WL (32.1). The highest percentage of participants who responded that they would choose another product variant was in WL group (57.2), and the least percent who chose the same option was HSR group (25.8).

**Unhealthy variant**–The highest and the lowest percent of the participants who responded that they will choose another product were in NS (83.9) and MTL (72.4) groups respectively.

**Least healthy variant** – the highest and lowest percent of participants who responded that they will choose another product was in HSR group (91.3) and WL (81.3) groups respectively.

## Eating behaviour


The eating behaviour of the participants is discussed under two headings whether the consumer will stop eating the product and will not stop eating the product variant. For discussion, the options 1 and 2 were clubbed together for the response 'I would stop eating the product' and options 4 and 5 were clubbed together for the response 'I would not stop eating the product'.

**Healthiest variant** – More than 90% of the participants NS, HSR, and MTL responded that they would not stop eating the product. The highest and lowest percentage of participants responded that they would stop eating the product was in NSR (8.6) and HSR (0.9) group.

**Healthy variant** –For this variant the highest and lowest percent of participants who responded that they would not stop eating the product was in the NS (98.3) and warning label (54.4) group respectively. The highest and lowest percentage of participants who responded that they will stop eating the product was in warning label (32.1) and NS (0.8) group.

**Moderately healthy variant** –For this variant the highest and lowest percent of participants who responded that they would not stop eating the product was in NSR (68.2) and WL (38.4) groups respectively. The highest and lowest percentage of participants who responded that they would stop eating the product was in warning label (47.4) and NSR (19.4) group.





***Unhealthy variant*** –The highest and lowest percentage of participants who responded that they would stop eating the product as in NS (87.9) and HSR (71.5) group respectively. For this variant the highest and lowest percent of participants who responded that they would not stop eating the product was in MTL (17.9), and NS (8.8) groups respectively.

Least healthy variant –the highest and lowest percent of participants who responded that they would stop eating the product was in NS (90.3) and WL (78.6).

Similar findings were observed in adolescent group like adults where NS performed better compared to HSR, and WL performed better than MTL. Overall, WL was most effective in changing the health perception, purchase intention, food choice and behaviour compared to other labels. A limited number of studies have been conducted among adolescents on assessing the effectiveness of FOPNL. A six countries study among children aged (10 – 17) have indicated that all FOPNL especially Warning label had the greatest impact on perceived healthfulness (Hock et al., 2021). However, another study among adolescents in Peru found that WLs did not influence purchase intention, or identification of healthier products (Saavedra-Garcia et al., 2022).

## SUMMARY & CONCLUSIONS

1. Majority of the participants claimed to read food label information, but they often check only the manufacturing and expiry dates. Although there was a slight increase in percentage of participants reading nutrition information from previous studies, further improvement is warranted.
2. In the present study it was observed that even though the percentage of participants reading nutrition information always or sometimes is low, the participants checking the veg/non veg symbols and quality symbols was higher. Therefore, FOPNL on pre-packaged processed foods are likely to have good uptake among India population as they are symbol-based.
3. Recent studies conducted on FOPNL among Indian population were only among adult population. This is the first study to our knowledge to include adolescents, which is one of the important consumer groups among whom increasing consumption of processed foods is being observed.
4. The uniqueness of the study is also that the FOPNL formats were used on different variants of the mock packs of the same food. Unlike in other studies, different foods were not used to depict different labels. Therefore, the responses could be solely based on the understanding of the FOPNL alone without a preconceived perception about the healthiness of the product.
5. Even illiterate participants understood the FOPNL formats as basic awareness about the formats and functions of FOPNL were provided to the participants.
6. Warning labels (WL and NSR) deterred more people from choosing moderately healthy or unhealthy variants, whereas the summary labels made them look healthier.
7. NS was the most preferred FOPNL. This could be due to the colour coding as it attracts attention and also because it is summary indicator giving quick evaluation about the product's overall healthiness using both positive nutrients and nutrients of concern.
8. Participants randomized to all the FOPNL formats were able to identify healthiest and least healthy variants of foods, however identifying the healthiest food in the WL was a bit confusing as there was no warning label to give a cue about the healthiness of the product.
9. Among the labels studied, WL and NSR had greater impact in altering the health perception of the food products, as presence of even one octagon or absence of stars prompted more cautious behaviors in choosing the foods. However, among the summary indicators, even presence of 2 stars (in HSR) or Code D (orange shades in NS) prompted higher choice of the same variants of food and lesser willingness to opt for others.
10. In short, to identify healthiest or unhealthiest variants any format of FOPNL can work. However, for promoting healthier food choices among the available variants, summary indicators (NS and HSR) seem to work better, and to deter consumption of even moderately unhealthy foods, WL (NSR or WL) appear to be a better option.

## RECOMMENDATIONS


- The choice of the FOPNL format for Indian scenario should not base only on wider acceptability and appeal but on its ability to influence food choice. The key purpose of introducing the FOPNL also drives the choice of the format. If the purpose of FOPNL is to promote healthy food choices (based on the relative healthiness of the foods or the available variants of similar foods) then summary labels may be useful. Alternatively, in the context of growing overweight, obesity and non-communicable diseases if the FOPNL has to serve as a preventive tool and deter the consumers from consumption of nutrients of concern, then warning indicator labels (like WL in NSR in the current study) could be helpful
- The summary labels are partially based on ingredients (Fruit & Vegetable, Legumes, Millets etc) for positive scores and partially on nutrients in the food product. HFSS is related to nutrients of concern present in the food. It might be difficult to enforce the regulation as the validation of star rating at the field level at the time of implementation may be difficult as analytically, it is not possible to quantitate the ingredients (to crosscheck or verify), while it is easier to assess the nutrients in the food product. Therefore, it would be appropriate to opt for a format that makes the validation/verification easier
- National level intensive communication campaigns are needed to promote food label information reading for choices. Any FOPNL format once introduced can be successful in achieving its goal only if nutrition literacy and label education is taken up across the country.
- In the long run, it is recommended that ‘ultra-processed’ foods whose basic edible and nutrient portions are greatly altered and those that have artificial ingredients may be clearly indicated by a symbol or any such indicator right on the front of the pack to specify the food is ‘ultra-processed’. This is very important to promote informed and healthy food choices



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**TO CITE:** Gavaravarapu SM, Priyadarshini S, Hemalatha R, Saha S, Hedao R, Nair S, Das M, Mendu VVR, Mokalla TR, Panda H, Pandurangi R, Menon K, Challa S, Fernandez Rao S. *“Report on assessing effectiveness of front-of-pack nutrition labels (FoPNL) for pre-packaged processed foods in India – A study on formats, acceptability and potential use”*, ICMR – National Institute of Nutrition, Hyderabad. 2023