

Research

Nutritional values of ready-to-eat snacks available in the Indian E-market—a comparative study based on the health star rating system

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Abstract

Background The popularity of ready-to-eat (RTE) foods has increased globally, especially among children, because they are readily available, convenient, tasty, and have attractive packaging designs. The number of packaged foods, drinks, and snacks has risen in the Indian market, and the presence of less-healthy packaged products is a significant cause of overweight and diseases related to diet. The Health Star Rating (HSR) System, initiated by the Australian and New Zealand governments, was designed to rank these packaged products based on fat, sugar, energy, salt, and other nutritional compositions. The study assessed the nutritional value of RTE snacks currently available in the Indian e-market using the HSR system.

Methods This comparative study analyzed the nutritional values of RTE snacks from November 2022 to February 2023. The data were extracted from the Indian e-market, namely Amazon Fresh, Flipkart Grocery, and Big Basket, using specific keywords. The HSR system has been used to evaluate and compare the healthiness of RTE snacks, using a star rating scale of 0.5 stars = bad to 5 stars = excellent. The study assessed 294 RTE products, including chips, cocoa-based snacks, and baked snacks, with a price range of INR 50 and below.

Results The findings revealed that the mean HSR was low (1.46) stars [SD 0.63] out of (5) stars for the studied products, with significant concerns about high levels of energy, sugar, sodium, and saturated fat. Additionally, the study observed a limited utilization of fruits, vegetables, nuts, and legumes (FVNL) in the market products.

Conclusion The study highlights the unhealthiness of snack products available in the Indian e-market due to high levels of sugar, salt, and fat. These snacks also lack FVNL as nutritious ingredients. The data extracted can underscore public health concerns, highlight the importance of consumer awareness, and help snack manufacturers develop healthier snacks for society.

Keywords Nutrition facts · RTE snacks · Indian e-market · HSR system

Abbreviations

RTE	Ready-to-Eat
HSR	Health Star Rating
FVNL	Fruits, vegetables, nuts, and legumes
INR	Indian Rupee

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CVD	Cardiovascular disease
E-market	Electronic market
FSSAI	Food Safety and Standards Authority of India

1 Introduction

The popularity of RTE packaged foods has increased around the world. RTE snacks are defined as foods that can be consumed without any need for cooking or processing [1]. These snacks are known to be readily available, safe and convenient to eat. They can be consumed between regular meals, but they are not necessarily considered to be always healthy options [2]. A wide range of sizes, shapes, colors, and flavors are available on shelves, and many are designed specifically to appeal to children. For instance, many RTE snacks are marketed with cartoon characters and brightly colored packaging, which may tempt children to purchase them [3].

The rise of snacking has coincided with the high prevalence of obesity over the last few decades. High-energy snack consumption has been linked to weight gain, which can lead to diet-related diseases [4]. The availability and accessibility of economical snack options in the market may also contribute to the high obesity rates worldwide [5]. Obesity rates have reached alarming levels globally, with the World Obesity Atlas 2023 estimated that 2.6 billion people suffer from overweight and obesity in 2020 [6]. In India, one out of every four individuals was classified as obese, according to the National Family Health Survey-5 (2019–2021) [7].

Nutritional profile models are considered helpful techniques that can improve the diet nutritional value [8]. Among the most popular nutrient profiling models is the Health Star Rating system. This system was initiated by the governments of Australia and New Zealand, and it is widely implemented to assess the healthiness of packaged foods and beverages, using a star rating scale of 0.5 stars = bad to 5 stars = excellent. The system ranks the packaged products and uses information of nutritional facts like sodium, total sugar, energy, and other variants to rate the products [9]. According to numerous studies, it was observed that market products labeled with the HSR have lower levels of saturated fat, total sugar, and sodium, along with boasting higher fiber content compared to non-HSR-labelled products. So, using the HSR system contributed to the reformulation of packaged food products [10, 11].

Furthermore, a study has demonstrated that front-of-pack labels, like the HSR system, effectively guide consumers towards healthier choices, leading to increased preference for healthier options and a greater willingness to pay for such products [12]. Due to growing concerns surrounding the health effects of RTE packaged snack products, this study attempts to evaluate the healthiness of these products found in the e-markets in India by the means of using the Health Star Rating system.

2 Methodology

A comparative study was conducted on the nutritional values of RTE snacks in the Indian e-market. The analyzed data were collected between November 2022 and February 2023. No approval from Ethics Committee was required because the study did not include animal or human subjects.

2.1 Summary of methods and data sources

2.1.1 Online market search

An online market study was conducted for the available RTE snacks in the three e-markets: (Amazon Fresh, Flipkart Grocery, and Big Basket).

2.1.2 Searching criteria

A search was done in the listed e-markets using the following keywords: chips, biscuits, chocolate, crackers, and cookies.

2.1.2.1 Inclusion criteria Due to the huge number of RTE snacks in the e-markets, the study included snacks costing INR 50 and below. Notably, the customer review section provides 5-star rating options to help customers express their purchase experience, and the number of customer reviews for a product indicates its popularity. In this context, an automatic filtering of the customers' reviews was done to reduce the number of products included in the study, and the most preferred products by customers were only covered. The study considered the snack products with a 3, 4, or 5-star customer review rating only, having at least 10 reviews by customers, and having an available ingredient list.

2.1.2.2 RTE snacks categorization Snacks included in this study were classified into three sets.

The categorization process was done after reviewing a diverse range of RTE snacks available in the Indian e-market and identifying common aspects among them. Due to the huge number of snack products, the snack selection was limited for the sake of narrowing down the sample size. The need to simplify and clarify the analysis process was a reason for categorizing the RTE snacks into three broader sets, as they share distinct characteristics and are easily recognized among consumers, and they are as follows:

Chips snacks including potato chips, banana chips, tortilla chips, and puffed chips.

Baked snacks including cookies, crackers, biscuits, and cream biscuits.

Cocoa-based snacks including chocolate bars, chocolate-covered nuts or fruit, and chocolate truffles.

2.1.2.3 Exclusion criteria Snacks that cost over INR 50, and those with less than a three-star review rating by customers. The snack kits and the frequently existing snack found in multiple sizes. The duplicate snacks with identical name and nutrients (like energy, protein, saturated fat, sugar, and sodium). Snacks with possible data errors. The other types of snacks which are not mentioned in the inclusion criteria. Lastly, snack products in which two or more nutrients are missing in the nutritional facts were excluded.

2.2 Data of food composition

2.2.1 The data required for the analyses were as follows

The density of energy (kilojoules (kJ) per 100g), saturated fat, sugar (in total), sodium, and fiber contents (per 100g) in addition to the FVNL (per cent). Because the values of the FVNL percentage were not documented on the labels of various products, the FVNL points were estimated based on the position of FVNL components in the list of ingredients [13]. The labels of some products lacked one or two nutrients out of the nutritional components required to implement the HSR calculation. Therefore, imputation was utilized to estimate the missing nutrient values of certain products and generate them. This method is used to calculate the average nutrient values of similar products with available data as a reference and assign them to products with missing values. Relevant studies implemented the imputation method within a similar context to tackle the missing values of different products. [14]

2.3 FVNL points calculation

According to the Food Safety and Standards Authority of India (FSSAI), the labeling of ingredients is recorded in a descending order of their composition by size or weight in a product. [15] By considering the arrangement of the components on the ingredient list, the assessment of FVNL components was done [13].

The Calculation of FVNL points was done as follows:

1. The ingredient list of each product was recorded.
2. The classification of the first three FVNL ingredient sets was based on the HSR System [9, 16] whereas the other non-FVNL ingredient sets were classified according to the FSSAI Standardized Food Products—Food Safety Compliance System [17]
3. The FVNL ingredient sets included fruits, vegetables, nuts and legume whereas the non-FVNL ingredient sets included dairy products, fat/oil, cereal grains, salt/spices, cocoa products, sugar/ sweeteners, and food additives. It should be noted that HSR FVNL points cannot be scored for cereal grains, according to the HSR system guidelines. This is because the cereal grains may undergo a process of removal of certain portions, such as threshing (separating kernels

from brans). This can lead to a loss of some nutritious ingredients in the grains, like minerals and fiber, and for that reason, it is not considered an FVNL ingredient. [9, 16]

4. The FVNL points were calculated based on the first three sets of ingredients registered in the ingredients list. [13]
5. The calculation of FVNL points was determined manually using the criteria outlined in Fig. 1.

2.4 HSR calculator

Health Star Rating value was assessed for each RTE snack to identify their healthiness by using the HSR calculator version 4 (which is an excel spreadsheet designed and embedded with a particular algorithm) and it is available along with its instructions on the website within the HSR Guidance for Industry established by the Australian Government. [9] Calculation of the HSR was done as follows:

1. Setting baseline points for the amount of energy, total sugars, sodium, and saturated fat content (/100g).
2. Giving modifying points for protein and fiber wherever possible.
3. The FVNL points obtained from the previous calculations were substituted with HSR calculator values for (% non-concentrated FVNL) and (% concentrated fruits or vegetables).
4. The calculation of the total score by the deduction of modifying points from baseline points.
5. Setting an HSR [between 0.5 stars (bad)—5 stars (excellent)] as per the total score by using the scoring matrix. [9]

2.5 Data extraction

Table 1 shows the overall numbers of chips, cocoa-based, and baked snacks in Flipkart Grocery, Amazon Fresh, and Big Basket.

Table 2 shows the overall number of chips, cocoa-based, and baked snacks in the three e-markets after filtering the price and review rating. It was noticed that in both Tables 1 and 2, BigBasket had more varieties of products, followed by Amazon Fresh and Flipkart Grocery.

Table 3 describes the total number of the analyzed categories of snacks in addition to the number of snacks that were excluded from the study.

An overall of 232 chips snacks were found in the e-market, out of which 104 (44.82%) were analyzed in the study, and 128 (55.17%) of them were excluded.

An overall of 325 cocoa-based snacks were found in the e-market, out of which 33 (10.15%) were analyzed, and 292 (89.84%) of them were excluded.

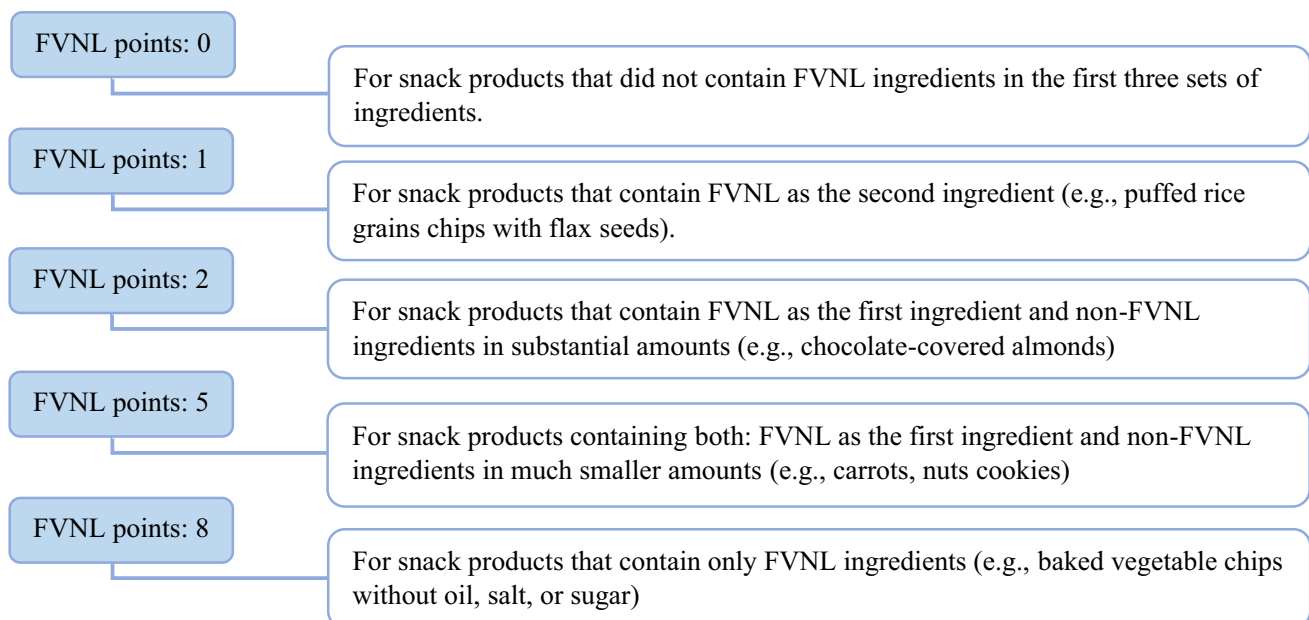


Fig. 1 Criteria for calculating FVNL points for the RTE snacks [13]

Table 1 Total number of ready-to-eat snacks available in every e-market during the study

Snacks	Flipkart grocery	Amazon fresh	Big basket	Total
Chips	48	175	318	541
Cocoa-based	62	434	979	1475
Baked	113	220	1358	1691

Table 2 Total number of ready-to-eat snacks available in every e-market after filtering them

Snacks	Flipkart grocery	Amazon fresh	Big basket	Total
Chips	32	76	124	232
Cocoa-based	15	69	241	325
Baked	42	93	435	570

Table 3 Number of analyzed and excluded ready-to-eat snacks in the study

Snacks	Total found	Analyzed (%)	Excluded (%)
Chips	232	104 (44.82%)	128 (55.17%)
Cocoa-based	325	33 (10.15%)	292 (89.84%)
Baked	570	157 (27.54%)	413 (72.45%)

A total of 570 baked snacks were available in the e-market 157 (27.54%) were included in this analysis, and 413 (72.45%) of them were excluded. The exclusion was done because the data of several necessary nutrients were either missing for the HSR calculation, or they were not found in the specific format, or because of product duplication.

2.6 Statistical analysis

A descriptive analysis was done for every snack category regarding sodium, energy, total sugars, and saturated fat contents. The frequently occurring ingredients in the top three positions on the ingredient list were compared in each RTE snack category. This was done to evaluate the results of FVNL points. All the analyses were conducted using MS Excel Spreadsheet version 2021.

3 Results

3.1 The mean Health Star Rating (HSR)

The mean HSR was (1.46) stars [SD 0.63] out of 5 stars for all RTE snack products. The rating was different for chips snacks, with the highest mean HSR (1.81), followed closely by baked snacks (1.36). Whereas cocoa-based snacks recorded the lowest HSR among all snacks (0.83).

3.2 Levels of nutrients in RTE snack products

Since the nutrient data were not normally distributed, the median was calculated for the energy, saturated fat, total sugars, and sodium content for chips, cocoa-based, and baked snacks, which is demonstrated in Table 4.

Table 4 shows the median of sodium, saturated fat, total sugars, and energy in the snacks covered in this study.

Table 4 Median nutrient levels in ready-to-eat snack products

Nutrients	Chips snacks	Baked snacks	Cocoa-based snacks
Sodium	701.66 mg/100g	375.02 mg/100g	163.89 mg/100g
Saturated fat	9.75 g/100g	9.7 g/100g	14.56 g/100g
Total sugars	3.57 g/100g	25.19 g/100g	49.3 g/100g
Energy	2129.65 kJ/100g	2016.83 kJ/100g	2102 kJ/100g

3.2.1 Sodium

The highest median content of sodium, 701.66 mg/100g, was in chips snacks. The baked snacks followed it with 375.02 mg/100g and the cocoa-based snacks showed the lowest 163.89 mg/100g.

3.2.2 Saturated fat

The highest median saturated fat content, 14.56 g/100 g, was in cocoa-based snacks. Chips and baked snacks were close to each other at 9.75 g/100 g and 9.70 g/100 g respectively.

3.2.3 Total sugars

The highest median total sugar content, 49.3g/100g, was in cocoa-based snacks. Baked snacks followed it with 25.19 g/100g, and chips snacks showed the lowest median 3.57 g /100g.

3.2.4 Energy

Chips snacks had the highest median total energy content, 2129.65 kJ/100g, followed by cocoa-based snacks, 2102 kJ/100g, and baked snacks had the lowest median 2016.83 kJ/100g.

3.3 FVNL points

3.3.1 The assessment of FVNL points

Table 5 shows that the overall mean FVNL score for the sample of 294 products was 0.47, indicating a generally lower presence of FVNL ingredients. The FVNL points ranged between 0 and 5 based on the calculation criteria in Fig. 1 among the included RTE snacks, and no snack received 8 points at all. Among the analyzed snack categories, chips snacks had the highest mean FVNL score of 1.17, followed by cocoa-based snacks with a mean score of 0.27, and baked snacks with the lowest mean score of 0.05. However, it should be noted that in the analysis, a significant number of products did not receive any FVNL points. Adding the FVNL ingredients may affect the customer's sensory acceptance of the product. To gain further insights into this issue, we examined the first three ingredients listed in the products. This analysis aimed to explain the distribution of FVNL and non-FVNL ingredients among the included products, providing insights into the popular ingredients used by RTE snack manufacturers.

Table 5 Distribution of FVNL points for the RTE snacks included in the study, after being calculated manually based on the criteria outlined in Fig. 1, covering statistical measures (mean, standard deviation, minimum, maximum, and quartiles)

Food category	Number of products	Mean (SD)	Min	25th	50th	75th	Max
Chips	104	1.17(1.46)	0	0	0	2	5
Baked	157	0.05(0.30)	0	0	0	0	2
Cocoa-based	33	0.27(0.67)	0	0	0	0	2
Total	294	0.47(1.06)	0	0	0	0	5

Fig. 2 The frequency distribution of the first three ingredients in RTE chips snacks

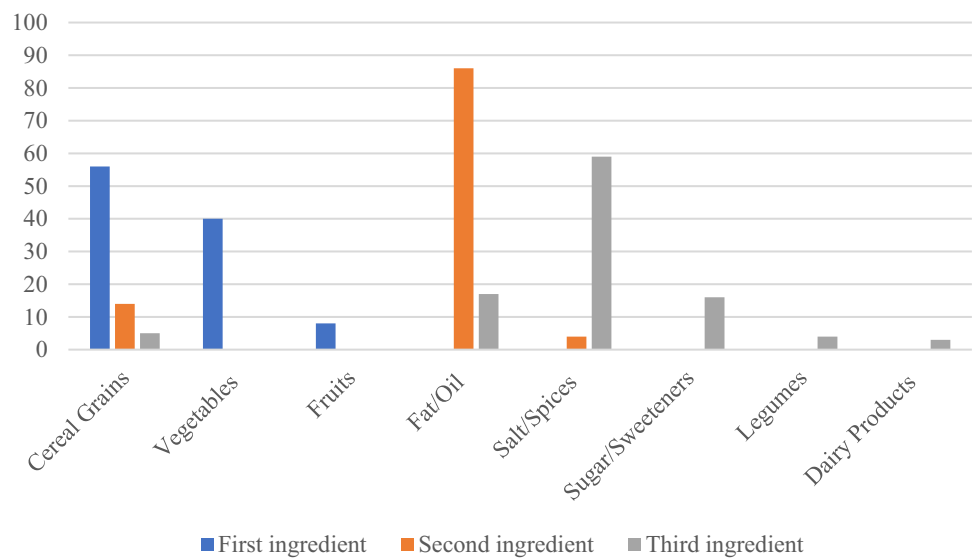
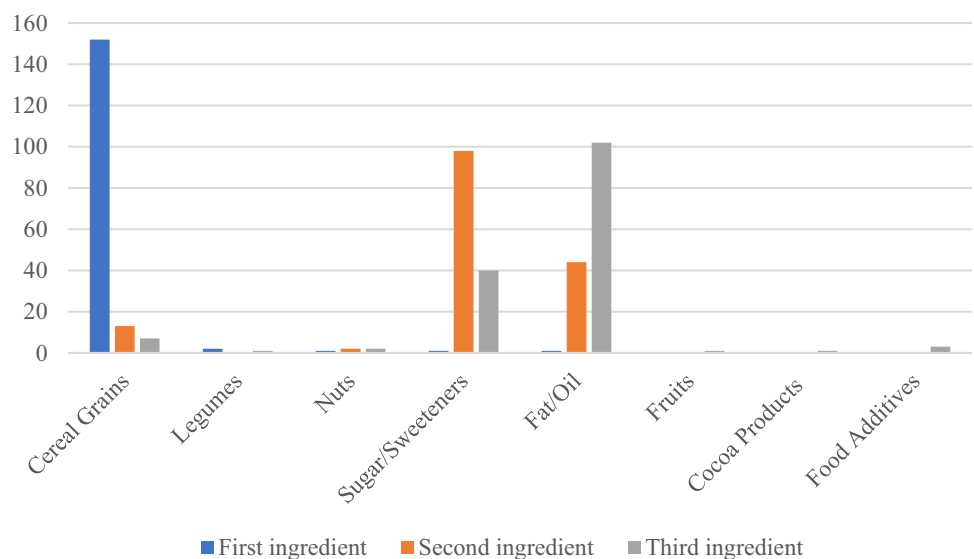


Fig. 3 The frequency distribution of the first three ingredients in RTE baked snacks



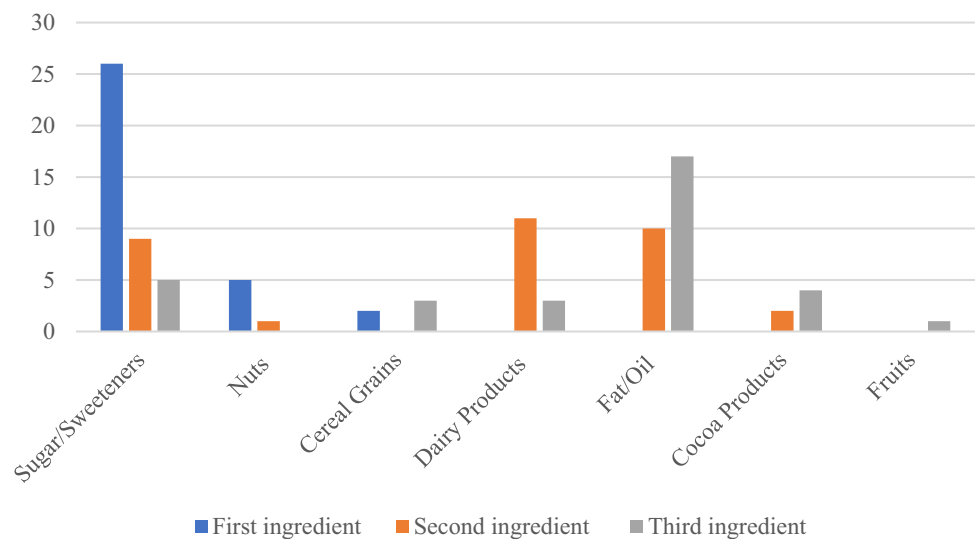
3.3.2 Distribution of the first three ingredients in RTE snack products

Figure 2 displays the most common first three ingredients in chips snacks. Cereal grains are the most common first ingredient (56 occurrences), followed by vegetables (40 occurrences) and fruits (8 occurrences). As for the second ingredient, fat/oil are the most prevalent (86 occurrences). Salt/spices take the lead as the third ingredient (59 occurrences), followed by sugar/sweeteners (16 occurrences).

Figure 3 presents the frequency distribution of the first three ingredients in baked snacks. Cereal grains emerge as the most common first ingredient (152 occurrences). For the second ingredient, fat/oil dominate (44 occurrences), whereas sugar/sweeteners are the second most prevalent ingredient (98 occurrences). The third ingredient is primarily composed of fat/oil (102 occurrences), followed by sugar/sweeteners (40 occurrences). Additionally, fruits, cocoa products, and food additives are less frequently used as a third ingredient.

Figure 4 shows that in cocoa-based snacks, sugar/sweeteners are the most common first ingredient (26 occurrences), followed by nuts (5 occurrences) and cereal grains (2 occurrences). As for the second ingredient, dairy products have the highest frequency (11 occurrences), followed by fat/oil (10 occurrences) and cocoa products (2 occurrences). The third ingredient is dominated by fat/oil (17 occurrences), with some presence of cocoa products (4 occurrences) and fruits (1 occurrence).

Fig. 4 The frequency distribution of the first three ingredients in RTE cocoa-based snacks



4 Discussion

The study revealed important findings regarding the composition and healthiness of different categories of RTE snack products.

Generally, the outcomes showed that the mean Health Star Rating value for the snack products was 1.46 out of 5.00 stars. There was a concern as the overall HSR mean of the products' healthiness was low. In contrast, the median for energy, sugar, sodium, and saturated fat contents was high.

Starting with chips snacks, the cereal grains, followed by fat/oil, and salt/spices are the first three and most common sets of ingredients. On the other hand, there are significant amounts of non-FVNL ingredients which can play a role in enhancing the flavor and texture. However, this affects the nutritional value and healthiness of the product, particularly the levels of energy, sodium, and saturated fat, leading to a low mean of HSR. Chips snacks have the highest energy content (2129 kJ/100 g), approximately a quarter of the RDA amount recommended by FSSAI, which is equal to 2000 cal, or 8368 kilojoules (kJ) [18]. This raises the concern that the high energy density of these snacks and the regular consumption of multiple portions could raise the risk of obesity [19].

Chips snacks also have the significantly highest sodium content (701.66 mg/100 g). The excessive use of sodium in the chips industry raises concerns regarding the potential health implications associated with overconsumption of salt, such as cardiovascular disease and hypertension. This is particularly alarming for individuals who consume multiple portions of chips snacks daily. Notably, the average daily salt intake among Indians is approximately 11 g [20] which significantly goes beyond the recommended limit of 5 g (2000 mg/day of sodium) set by the FSSAI [18]. It is worth considering that the high sodium content in chips snacks in the Indian context may contribute to this elevated sodium intake observed among some individuals.

The baked snacks were not preferred compared to other snacks, primarily due to the high levels of saturated fat, energy and sugars, resulting in low HSR values. This aligns with the analysis of the first three and most common sets of ingredients, which indicates a composition mainly dominated by non-FVNL ingredients such as cereal grains, sugar, and fats/oils. The usage of nuts is limited to few products only, contributing to the lowest mean FVNL score of 0.05 among the RTE snack products.

In cocoa-based snacks, the analysis of the first three and most common sets of ingredients reflects information on the composition of these snacks and emphasizes the limited presence of FVNL ingredients. Sugar/sweeteners are the first most common ingredients among the first three, indicating that many cocoa-based snacks are sugar-based. Dairy products and fat/oil are prominently considered the second and third ingredients, respectively. As a result, the lack of FVNL points is observed in these cocoa-based snacks, with only a small contribution of nuts in some products. This contributes to higher levels of energy, sugar and saturated fat, leading to a low mean of HSR.

Compared to the other two categories, there were not enough cost-friendly and healthy cocoa-based snacks in the three e-markets. Cocoa-based snacks had the lowest HSR mean and, at the same time, the highest median of

total sugar and saturated fat. The lack of affordable, healthy cocoa-based snacks may be attributed to the high costs of raw materials of cocoa around the world [21]. This may explain the food factories' increased usage of sugar and saturated fat contents compared to cocoa. However, the World Health Organization recommends limiting sugar intake to less than 50 g per day. The analysis of the current study revealed that cocoa-based snacks, with a median total sugar content of 49.3 g/100 g [22], contain significant amounts of sugar. However, excessive sugar consumption is associated with a higher risk of obesity [23]. Given that India has the second-highest number of obese children in the world [24], the consumption of large-sized snacks that are high in energy and sugar, such as sugar-based chocolates, may contribute to these alarming statistics.

The findings indicate that RTE snack products, such as the cocoa-based and chips, have considerable levels of saturated fat. Cocoa-based snacks recorded the highest median saturated fat content of 14.56 g/100 g, followed by chips and baked snacks. As recommended by FSSAI, individuals should limit saturated fat intake to less than 22 g per day [18]. These findings raise concerns about consuming multiple portions of RTE snacks per day that have high saturated fat intake and its potential in contributing to cardiovascular health implications. In this regard, it should be noted that India faces a significant burden of cardiovascular disease (CVD), with projected high death rates attributed to CVD [25].

5 Limitations of the study

The Health Star Rating system simplifies the nutritional value of a product by only considering a limited number of factors, such as energy, sugar, sodium, saturated fat, and FVNL points. Furthermore, the system does not consider other important factors, such as portion size and the presence of artificial colors, flavors, or preservatives. Therefore, it is important for consumers to examine the ingredient list of each product to make a more informed judgment.

6 Conclusion

In general, cost-friendly RTE snack products in the three Indian e-markets contain high amounts of energy, sugar, sodium, and saturated fat. The study showed a link between the prevalence of non-FVNL ingredients (i.e., fat/oil, salt, sugar, etc.) and the low healthiness of the products. These results increase concerns about health issues associated with overconsumption of existing snacks that can lead to an increased risk of developing non-communicable diseases in the upcoming years. However, the concerned authorities can create an environment that promotes the development of nutritious snacks by implementing clear labelling requirements and applying a system similar to that of the HSR in the Indian context. This can encourage snack product manufacturers to develop healthier snacking options by incorporating more FVNL ingredients. This would enhance the nutritional profile and offer consumers more nutritious and diverse snacking options. However, the limitations of the HSR system, such as overlooking the portion size and additives, suggest the need for an improved version. Developing a more comprehensive system and making it compulsory could better inform consumers about healthy food choices and encourage product reformulation in the industry, which is one of our future goals. A multifaceted approach combining educational materials, awareness campaigns, and social media engagement reinforced by the concerned authorities, consumer protection associations, and health professionals can effectively help reach and educate a diverse audience on reading and interpreting food labels. Once a rating system, like HSR, is implemented in India in the future, it is important to raise public awareness about the need to understand this system to help identify better food choices. The data reveals the importance of reporting and observing the healthiness of RTE snacks to assist consumers and the concerned authorities.

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Author contributions BA and AJ designed the study. BA performed the literature search, data collection and drafted the manuscript. AJ and PV critically edited and revised the manuscript. All authors approved the final version to be submitted.

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Data availability The data supporting the findings of this study are available upon request from the corresponding author.

Declarations

Ethics approval and consent to participate Not applicable.

Consent for publication Not applicable.

Competing interests The authors declare that they have no conflict of interest.

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