



RESEARCH ARTICLE

The Health Communication Effect of Packaging Design: A Systematic Literature Review

Liu Xiaotong^{1*}, Normah Mustaffa², Emma Mirza Wati Mohamad³, Wang Jingyao⁴

^{1,2,3} Centre for Research in Media and Communication, Faculty of Social Sciences and Humanities, Universiti Kebangsaan Malaysia, Bangi, Malaysia

⁴ Shandong Xiehe College, Jinan City, China.

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***Corresponding Author:**

263854103@qq.com

ABSTRACT

Packaging plays an important role in the dissemination of product information and is the main medium between the consumer and the product. The success of food marketing depends to a large extent on the understanding and acceptance of these packages. With increasing dietary safety concerns and dietary diseases, consumers have raised the health demands of food products. A rapidly growing body of empirical research has recently begun to emerge, emphasising that food packaging, through its specific visual design and symbols, can communicate the healthfulness of a food product through a process of "sensory transmission". This systematic literature review aims to investigate the communication of health concepts on food packaging by evaluating the published literature, focusing on how packaging design elements influence consumers' perceptions of the healthiness of food products. An extensive literature search guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) reporting checklist was performed in four selected databases, namely Web of Science (WOS), SCOPUS, PubMed and EBSCO to identify how this particular topic was previously studied. Exclusion and inclusion criteria were set to ensure that only research papers written in English from 2019 to 2023 were included. Thirty-three articles met the inclusion criteria. Thirty-four articles met the inclusion criteria. The included studies encompassed all element types of packaging design, and the findings support the idea that all design elements of packaging can be effective in communicating symbolic meanings about food health and influencing consumer attitudes toward products. Food companies can consider using this understanding to adapt the design of their packaging in ways that increase sales. In addition, understanding the combination of multiple design elements in food packaging and understanding the differences in impact on consumers with different individual characteristics is critical for future research.

INTRODUCTION

With the rise in dietary safety issues and diet-related diseases due to diet(Chooi et al. 2019; Delvecchio et al. 2018), consumers are becoming concerned about the health and nutritional value of food products (Trivedi et al. 2016). Konuk (2018) showed that consumer demand for healthy foods rapidly increases as health and environmental issues become progressively more relevant to consumers' food decision-making processes. A health survey conducted by the U.S. Fmi (2017) (Food and Marketing Institute) reported that 32% of consumers are now turning to healthier product choices more than ever before. According to the International Food Information Council (2020), more than half of consumers are more health-conscious in their food purchases today than they have been

in the last decade (Chandon & Cadario 2023). Over 80% of UK consumers cite 'health' as the main reason for food consumption (Scarborough et al. 2023). A recent global survey reported that nearly 50 % of consumers in nine developed countries regularly buy green products. It is worth noting that 24 % of them are willing to pay more for such products (Trivedi et al. 2016). This trend is not limited to developed countries. Still, the demand for healthy food is even more demonstrated in developing countries facing serious environmental problems and a significant increase in food consumption (Danish et al. 2019; Mottaleb et al. 2018; Pham et al. 2019). A study through a multilevel meta-analysis methodology concluded that health factors have become the main reason for consumers to purchase food products nowadays (Rana & Paul 2020). However, despite the increased consumer attention to health issues, the consumption of less healthy goods and the increase in obesity rates globally suggest that food consumption habits are far from healthy (Eriksson & Machin 2020).

As consumer demand for healthy food continues to increase, this review will focus on the relationship between packaging design and consumer choice of healthy food. This review will synthesize and elaborate current research findings, provide insights into the impact of visual communication of packaging on consumers' perception of food health attributes, and address future research directions. Packaging communication that shapes food can drive consumers to make healthy choices (Arakawa et al. 2022; Van Der Laan & Orcholska 2022). According to the FCB theory (Vaughn 1980), consumer choices of food products belong to the Satisfaction Decision the FCB theory (Vaughn 1980). Purchases of such products are mainly based on emotional impulses, and the experimental experience is predominantly emotional, following the hierarchy of "doing-feeling-learning". If the emotional or other affective response is positive and satisfying, the activity will be evaluated positively. However, for high-priced goods such as cars, consumers may invest more time in deliberation, comparison and selection. Therefore, advertising campaigns for such goods need to rely on more rational reasons or hard-sell arguments to persuade consumers to buy. However, for goods such as food and beverages, which are relatively low-cost and quick to consume, a more emotional appeal approach is needed to attract consumers. This also means that the packaging and advertising of food products have a significant impact on consumer perception and choice. While consumers do not notice packaging features, they rely on the perceptions provided by packaging cues to make choices (Songa & Russo 2018). Advertisements for such products tend to use heuristic learning strategies that utilise visual, sensory and non-verbal imagery elements to provide consumers with simple decision rules in low-involvement product category choices. Packaging is the closest point of contact between the product and the consumer. Packaging largely determines the consumer's first impression of a product (Orth et al. 2019), guides the consumer's choice (Ampuero & Vila 2006), and has been referred to as the "silent salesman". The role of food packaging has long gone beyond the basic functions associated with protecting food, facilitating transport and increasing convenience (Piqueras-Fiszman & Spence 2015). Packaging is a differentiating factor when purchasing a product (Connolly & Davison 1996) and has tangible, long-lasting communication advantages over the ephemeral messages conveyed by other advertising mediums (Vila & Ampuero 2007) & Ampueroitz, 2008). It is estimated that 73% of purchasing decisions are made at the point of sale, and 64 % of consumers say they choose a new product based on the visual appeal of the packaging (Nielsen 2016). There are also studies investigating the role of food packaging, whether it is an everyday food product or a branded premium food product, with more than 70 % of consumers basing their shopping decisions on food packaging (Kotler & Armstrong 2005; Löfgren et al. 2008). Sasada (2012) found that customers spend only 0.2 seconds browsing each item on the shelf and up to 20 seconds picking up and viewing the item and that if a customer purchases something other than what they originally planned to buy, the driving force behind the purchase is the package design. According to (García et al. 2019), 71 % of e-customers would buy a product with quality packaging online again. There is also a growing body of research that has found that marketing strategies for food packaging have been successful in influencing the consumption of food environments and consumer eating behaviour (Chandon 2013).

Packaging (Zank & Smith 2021) and other types of health advertisements (Kelly et al. 2019) act as delivery mediums for crucial information about food products that can directly engage with consumers and convey information about the health attributes of food products (Aschemann-Witzel 2015). There is a growing body of review studies on the influence of traditional advertising, social media, name-brand effects and celebrity endorsements on consumer purchases of healthy foods (Chung et al. 2021; Krishna & Elder 2021). In contrast, the review studies on the impact of people's food packaging cues on consumers' health perceptions are yet to be deepened. The effect of packaging design on consumer perceptions has been extensively researched throughout the field of visual communication. More precisely, there has been a significant amount of research demonstrating the impact of packaging design on consumer responses and purchase processes and its role in shaping consumer perceptions and behaviours, including the design elements of the package (shape, labels, colours, materials, etc.) (Gil-Pérez et al. 2020; Schnurr 2019; Spence & Velasco 2018). It has been established that packaging visual design elements are effective tools for conveying symbolic meanings; informational elements such as nutritional claims and product labels communicate the nutritional value of food products and reinforce consumers' perceptions (Butkevičienė et al. 2008; Silayoi & Speece 2017); whereas visual elements such as images, typography, and colours rely on metaphors and associations to stimulate consumer perception (Karnal et al. 2016; Mai et al. 2016; Rahinel & Nelson 2016; Sundar & Noseworthy 2016), such as packaging design's influence on taste (Mai et al. 2016), quantity (Madzharov & Block 2010), weight (Deng & Kahn 2009), quality (Yan et al. 2014), calorie content (Koo & Suk 2016) and perception (Biswas et al. 2021). Even peripheral elements unrelated to food quality can be heuristic elements that influence consumer expectations (Capelli & Thomas 2021). With the growing consumer demand for healthy food, several studies have focused on the impact of packaging elements on consumer health perceptions. For example, studies are focusing on prominent nutritional claims (Hall et al. 2020); studies are showing the impact of colour on health perception, with blue and green (as opposed to red and orange) packaging perceived as healthier when consumers need to make heuristic taste expectations (i.e., not being able to taste the product) (Mead & Richerson 2018; Tijssen et al. 2017), and red packaging stimulates negative health impressions (Mai et al. 2016); some studies have found that health images, nature photographs, and food ingredient images increase mental associations with food products, making them seem healthier and tastier (Eriksson & Machin 2020; Rebollar et al. 2017; Thomas & Capelli 2018), and these specific packaging elements can positively communicate health attributes that may motivate people to make choices (Chandon & Cadario 2023).

To summarize the research evidence on packaging design elements and consumer health perceptions, a systematic literature review was conducted in this paper. Van Ooijen et al. (2017) categorized packaging design elements as informational, graphic and structural based on differences in the degree of clarity with which they convey health messages to consumers. The review incorporates all three of these design elements to provide a comprehensive overview of the impact of all packaging elements on consumers' healthy food choices. Specifically, we wanted to address the following questions in the review:

1. What is the impact of verbal elements of food packaging design (nutritional information, health labelling) on consumer health perception?
2. What is the impact of visual elements of food packaging design (colour, typography and graphics) on consumer health perception?
3. What is the effect of structural elements (e.g., shape, size, and material) of food packaging design on consumer health perception?

To answer the above research questions, this paper uses bibliometric analysis to conduct a literature review.

METHODS

A systematic literature review was conducted in this paper, in order to summarise the research evidence on packaging design elements and consumer health perceptions. An exhaustive literature

search was conducted in Four of the most scientific and relevant databases using the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) reporting checklist (Moher et al. 2015) to see how this specific issue was studied in previous publications, namely Web of Science (WoS), Scopus, PubMed and EBSCO. The search was carried out in January-February 2024. There was no systematic review database registration for this review's protocol.

Eligibility criteria and Data sources

To determine whether an article is appropriate for inclusion in the review process, a set of predetermined eligibility criteria were decided upon. The first criterion is that references must be articles, quantitative or qualitative preliminary empirical data studies. Review articles, opinion papers and perspectives, conference papers and abstracts are excluded. The second criterion was all articles with a publication year of January 2019-2023 December. The literature on healthy food purchasing has only begun to emerge in the last decade. Also, to ensure the timeliness and validity of the research, the literature is limited to 5 years of publication. The third criterion was that the language be English. The last and most important criterion was that the research needed to be based not only on food packaging design but more importantly, on the impact of packaging design on consumer's perception of health or the impact of packaging design on the communication of health attributes of food products had to be the main focus of the research. Table 2.1 shows the inclusion and exclusion criteria for the search through the database.

Table 2.1 Inclusion and exclusion criteria for screening and eligibility. Source Own elaboration

Inclusion criteria	Exclusion criteria
Quantitative or qualitative primary empirical data studies. Peer-reviewed journals. Full-text articles published in peer-review journals	Review articles, opinion papers and outlooks, conference papers, proceeding paper and abstracts.
Full-text articles published between January 2019 and December 2023, to ensure the timeliness and validity of the Study.	All studies not published between January 2019 and December 2023.
Full-text articles published in the English language, in order to avoid bias, by confirming that language as a common language.	Full-text articles published in the non-English.
The main topic must be direct to food packaging design and health perceptions.	All studies related where the focus is not on the food package design and health perceptions.

Search Strategy and Selection Process

Firstly, a literature search was conducted for this study on four databases on 18 January 2024 Scopus, Web of Science (WoS), PubMed and Ebsco. The search string covered the selected keywords, i.e., packaging, food and consumer health perception. Advanced search was used for the literature search and the search format was mainly set in TITLE-ABS-KEY mode. After the trial in Scopus, the search strings were fine-tuned and customised search strings were made for searches in the four electronic databases. The details of the search strings are shown in Table 2.2 below.

Table 2.2 Keywords search string. Source Own elaboration

database	keyword
Scopus	TITLE-ABS-KEY(("wholesome" OR "health*" OR "fitness") AND ("Food" OR "Drink" OR "Beverage" OR "Vegetables" OR "fruit*" OR "produce")) AND (ABS (packag*) AND KEY (packag*) AND TITLE (packag*))
wos	AB=(packag*) AND TS=(packag*) AND TI=(packag*) AND ((AB=("wholesome" OR "health*" OR "fitness") OR TS=("wholesome" OR "health*" OR "fitness") OR TI=("wholesome" OR "health*" OR "fitness")) AND (AB=("Food" OR "Drink" OR "Beverage" OR "Vegetables" OR "fruit*" OR "produce") OR TS=("Food" OR "Drink" OR "Beverage" OR "Vegetables" OR "fruit*" OR "produce") OR TI=("Food" OR "Drink" OR "Beverage" OR "Vegetables" OR "fruit*" OR "produce"))))
PubMed	((packag*[Title]) AND(packag*[Abstract]) AND (Wholesome[Title/Abstract] OR health*[Title/Abstract] OR Fitness[Title/Abstract])) AND (Food[Title/Abstract] OR

	drink[Title/Abstract] OR beverage[Title/Abstract] OR vegetables[Title/Abstract] OR fruit*[Title/Abstract] OR produce[Title/Abstract]
Ebsco	AB=(packag*) AND SU=(packag*) AND TI=(packag*) AND ((AB=("wholesome" OR "health*" OR "fitness") OR SU=("wholesome" OR "health*" OR "fitness") OR TI=("wholesome" OR "health*" OR "fitness")) AND (AB=("Food" OR "Drink" OR "Beverage" OR "Vegetables" OR "fruit*" OR "produce") OR SU=("Food" OR "Drink" OR "Beverage" OR "Vegetables" OR "fruit*" OR "produce") OR TI=("Food" OR "Drink" OR "Beverage" OR "Vegetables" OR "fruit*" OR "produce"))))

Then, with the help of automated tools in the web database, non-English literature and articles such as proceeding papers (conference papers), book chapters and literature reviews were deleted, generating 2,101 hits. The ENDNOTE tool deleted 1081 copies, leaving 1083 articles to be further screened. Considering the recommendations given by the PICO criteria, article titles and abstracts were screened according to the inclusion and exclusion criteria (Table 2.1). Then, the full text of each article was assessed for eligibility for final review. Two authors (LXT, WJY) performed the full title and abstract screening and identified potentially eligible articles. Two undergraduate students helped with the initial title and abstract screening. Full-text review and final inclusion protocols were conducted independently by two reviewers (LXT, WJY), and other team members were consulted if disagreements arose. The abstracts of 1803 research papers were reviewed, and 177 articles were identified as potentially eligible for full-text review. After further review, this review included 36 reviews. Data extraction descriptive results were compiled into an Excel spreadsheet to calculate the frequency and percentage of problems associated with the study findings, and the data were checked for accuracy by two reviewers (LXT, WJY).

Assessment of risk of bias

Included studies had different designs and methods despite similar research questions, so the literature uses criteria developed by the Quality Assessment Tool for Studies of Different Designs (QATSDD) to assess studies that meet all eligibility criteria(Fenton et al. 2015; Sirriyeh et al. 2012). It can review studies with similar research questions but different study designs. The QATSSD has been shown to have high reliability and validity in quantitative and qualitative study designs (Fenton et al. 2015; Sirriyeh et al. 2012). The QATSDD consists of 16 indicators scored on a 4-point Likert scale. The total score ranges from 0 to 3, with higher scores indicating higher study quality. Scores were converted to percentages, with studies scoring >60% rated as high quality and those scoring ≤60% rated as low quality (Sirriyeh et al. 2012). The risk of bias was assessed independently by the first and fourth authors (LXT, WJY), and disagreements were discussed to reach a consensus. The total score for each paper had considerable internal rating reliability (k= 78.5%), and Cohen's Kappa coefficient was used to calculate inter-rater agreement (Landis & Koch 1977). The results indicated good agreement between the two coders regarding the quality of the papers, and discussion among all members of the group after the papers were independently rated resolved the remaining differences in agreement.

Data analysis

Each included study was synthesised according to the structured data extraction form described earlier. Panel members read and labelled each paper independently with one or more open codes and then discussed them. Meta-analysis was not considered appropriate given the considerable heterogeneity of the studies above the study design and methodology.

RESULT

All 1083 documents were reviewed for relevance and eligibility.

As shown in Figure 3.1, 1083 articles were initially identified, and all abstracts were analyzed. According to the PRISMA guidelines (Page et al. 2021), 905 records were excluded. About 82.6% of the records were excluded because they were related to other research areas (e.g., nutrition, effects of packaging chemicals on the health of the food itself, social policy issues of packaging, environmental protection issues of packaging materials, etc.). One hundred seventy-seven records

were read for the full text to be analysed, and we read the entire article and then excluded 145 studies. Figure 3.1 shows a flowchart of the selection process, adapted from the PRISMA guidelines (Page et al. 2021). Of these 145 excluded reports, two were excluded because they did not lead to any conclusions; 143 dealt with the wrong topics, e.g., policy statements about packaging rather than the content of the package design; and topics such as the package's perception of the flavour and nutrition of the food and the intention to purchase, while not including the content of the perception of health. Thirty-three reports were eventually analysed (for an overview, see Table 3.1).

After carefully reading the full text of the included studies, it was found that despite the differences in the specific research objectives of each research paper, they all shared some common characteristics, summarised in Table 3.1 for each study. Eleven articles were reported involving more than one packaging design element. The studies dealt with the informational elements of packaging packages (n=18, 53%), which included Claims (n=9) and labels (n=11), followed by the visual elements (n=13, 38%), which included images (n=5) and colours (n=8). Finally, the structural elements (n=11, 32%), which included shapes (n=5) and materials (n=6), and the three types of studies studied the highest number of information elements.

Fourteen studies were explicitly adult-only. One was of children, two were of college students and young consumers, and two was specifically of female consumers. The population of the studies ranged from 25 to 2,139 people. The majority of the studies (n=28, 82%) were based in developed countries, including the USA (n=10), Germany (n=3), the UK (n=3), and France (n=2), and included literature on studies conducted in multiple countries (n=2). In addition to this, there were no articles that explicitly stated the country of experimentation (n=2), and a few other studies were conducted in what are considered to be developing countries, mainly Brazil.

Thirty-four studies used different research methods, including quantitative studies (n=31), qualitative studies (n=3). Thirteen studies conducted multiple studies; all other studies had 1 study and cross-sectional studies (n=2). Seventeen studies explicitly referred to surveys conducted on the web, and the others were conducted in the laboratory and the field (supermarkets, shopping centres, universities and kindergartens, etc.)

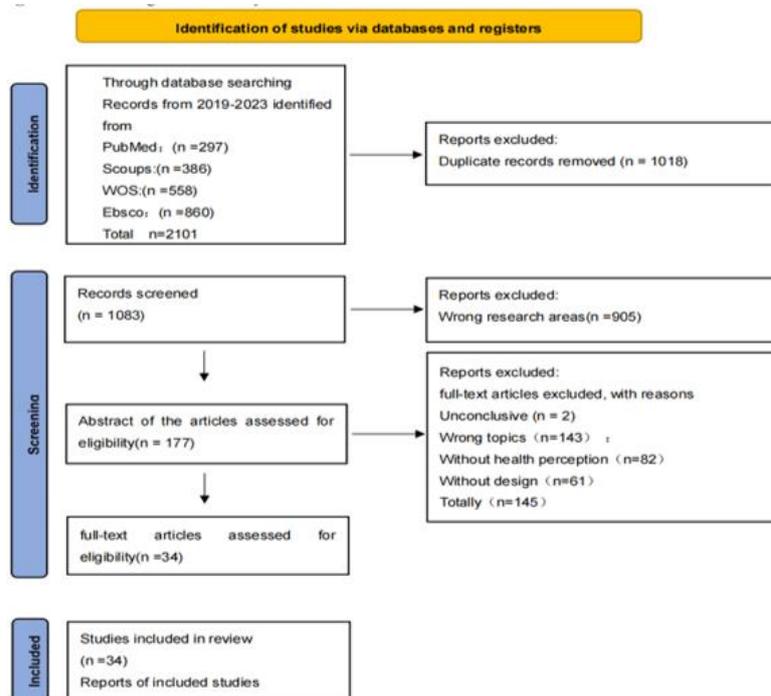


Figure1: Flow diagram of the study selection

Table 3.1 Study characteristics

Type of elements		Number of Studies	reference	Study Design	Main Objectives	Sample Size	Sample Characteristics	Methods of analysis	Sample selection of food products	Key Results
Information Elements n=18	Claim (Health warnings, nutrition claims, Traffic light, choice logo)	N=9	Chu et al. (2022)	in-depth interviews	to investigate packaging features that may promote healthy eating	25	adults	qualitative thematic analysis	typical meals and snacks	Packaging elements that can promote healthy behaviour include on-pack energy (kcal) content with clear numbering, front or back of pack nutrition and energy content, and traffic lights indicating high or low energy content.
			André et al. (2019)	online survey	to examine the association between claim type and the perceived healthiness, tastiness, and dieting properties of the food	443	adults	regression analyses logistic regression models	breakfast cereals	They find that the claim type is completely uncorrelated to actual nutrition quality yet influences inferences consumers make about taste, healthiness, and dieting.
			Bou-Mitri et al. (2021)**	A cross-sectional study a questionnaire	to assess the impact of the packaging functionality, characteristics, material, colour and informative cues on consumers' perception of the food quality, safety, healthiness and preference	553	Lebanese adults	T-test logistic regressions	Cheese juice	Among the consumers, 87% considered that nutrition and health claims were among the most essential informative cues. Around 73.1% (n = 399) were willing to pay more for a better packaging with health claims.
			Hall et al. (2020)**	online experiment and randomized experiments	to examine the impact of claims, fruit images, and health warnings on consumers' perceptions of fruit-flavoured drinks with added sugar (i.e., "fruit drinks")	2139	adults	two-tailed tests linear regression models	fruit drinks	Nutrient content claims would lead to greater perceived product healthfulness and consumption interest, whereas health warnings would lead to lower perceived product healthfulness and consumption interest. We also predicted that nutrient content
			Ricci et al. (2020)	online survey	to investigate whether different forms of nutritional information displayed on a food stuff's front panel packaging affect perceptions of healthiness and purchase intention in Brazilian retail	399	adults	t-test	cereal cookies/biscuits	Presenting complete nutritional information on the front panel of food packaging consistently improved consumers' perception of the product's healthiness and increased their purchase intention, compared to incomplete nutritional
			Schifferstein et al. (2022)**	online survey	to evaluate the usefulness and effectiveness of these three mediums	59-92	adults	Regression analysis ANOVA	Orange juice muesli bar plain yogurt	Health claims had positive effects in communicating healthiness and environmental friendliness but elicited a negative tendency for sensory properties.
			Mediano Stoltze et al. (2021)*	mixed measure experimental	to test the co-occurrence of warning labels and NC claims in breakfast cereal packages on product perceptions and behavioural intentions of Chilean adults	602	unclear	ANOVA F-test	Fictitious cereal package	Benefit-related "high in fibre" and "wholegrain" claims on breakfast cereal packages generated a positive health halo effect on consumers' perceptions of the product's overall healthiness, vitamin content, naturalness, and quality and
			Prates, Reis, Rojas, Spinillo and Anastácio (2022)*	experimental cross-sectional study carried out using an online questionnaire	to evaluate the influence of nutrition claims on the efficacy of FOPNL models in the understanding of nutritional information, healthfulness perception, and purchase intention of Brazilian consumers	720	adults	chi-square test ANOVA	cereal bars whole grain cookies snacks	The presence of nutrition claims influenced the three outcomes, decreasing the probability of understanding information about food composition by 32% and significantly increasing average healthiness perception.
			Hallez et al. (2023)**	two online experiments	to investigate how visual, i.e., colours and textual, i.e., claims packaging elements shape perceptions of product healthiness, sustainability and tastiness	202	young consumers	the multilevel analyses	beverages snacks	A simple nutrition/ecological claim made products seem overall healthier and more sustainable.

	N=11	Mediano Stoltze et al. (2021)*	mixed measure experimental	to test the co-occurrence of warning labels and NC claims in breakfast cereal packages on product perceptions and	602	adults	ANOVA F-test	cereal package	warning labels can mitigate but not eliminate the effects of nutrient content claims on a package,
		Prates, Reis, Rojas, Spinillo and Anastácio (2022)*	experimental cross-sectional study carried out using an online questionnaire	to evaluate the influence of nutrition claims on the efficacy of FoPNI, models in the understanding of nutritional information healthfulness	720	adults	chi-square test ANOVA	cereal bars, whole grain cookies, and snacks	The results indicated that FoPNI increased the understanding of the information and reduced healthfulness perception and purchase intention
		Hock et al. (2021)	online survey	to examine the impact of FOP labels (no-label control, Health Star Rating, 'High in' Octagon, Guideline Daily Amount (GDA), 'Traffic Light' or 'Nutri-Score) on	10,762	children 10–17	Chi-square tests	Sugar-sweetened beverage	Front-of-package labelling reduced youths' perceived healthfulness of a fruit drink.
		Schneider and Ghosh (2020)	five experiments online questionnaires laboratory experiments	to examine the role of front-of-package (FOP) labels in guiding consumer preferences toward making healthier choices	1008	adults	Chi-square test ANOVA Mediation analysis Multiple regression analysis	granola bar	This enhanced trust has a downstream positive effect on healthiness perceptions and preferences for foods displaying FOP labels however, because consumers may be suspicious that an unhealthy brand or product displays an FOP label as an attempt to persuade consumers to buy unhealthy products, no comparable
		Bopape et al. (2021)	focus group discussions	to explore adult South African consumers' perceptions of front-of-package warning labels on foods and non-alcoholic beverages (referred to as drinks in this paper) and their insights into features that could influence the effectiveness of the warning label	113	adults	unclear	chips/crisps, fruit juice, yoghurt and cereal box	Almost all participants from all socio-economic backgrounds were positive about warning labels, reporting that warning labels concisely and understandably educated them about the nutritional composition of foods. Other perceived advantages were that warning labels warn of health
		Reinoso-Carvalho et al. (2021)	online survey	to carefully evaluate the effects of packaging transparency and type on expectations in an experiment resembling e-commerce, healthy and taste.	496	general population	MANOVA	cookies	The results suggest that the presence (vs absence) of labelling triggered the highest ratings on most assessed dimensions (product quality, healthiness, lightness, sweetness, crumbliness, price, taste, freshness, for product
		Hoge et al. (2022)	web-based survey	to assess both the perception and objective understanding of three front-of-package labelling (FOPL) formats currently in use on the Belgian market, i.e., the Nutri-Score, Reference Intakes, and Multiple Traffic Lights, among	2295	students of tertiary education	Univariate and multivariate mixed logistic regression models with random intercepts Chi-square tests	dairy product, and pizza	Overall, the findings supported the Nutri-Score as particularly effective in guiding students' food choices. Of particular importance is the fact that the summarized and graded color-coded nutritional label would be a useful strategy for those
		Saavedra-Garcia et al. (2022)	Control experimental	to assess, using an experimental design, whether WIs influence the purchase intention of processed foods and identification of the healthiest products among	449	adolescent	Chi-squared tests a conditional logit regression analysis	snacks	Front-of-package WIs did not influence purchase intention or identification of healthier products among adolescents from public schools in Peru
		Li et al. (2022)	Laboratory experiment	to examine how people might be affected by nutrition labels and consuming contexts when making choices about healthy foods	51	college-age volunteers	unclear	unclear	Traffic light label is advantageous in terms of both the efficiency of and preferences regarding nutrition judgment, especially with time
Schwalb Helguero et al. (2023)	survey	to examine the effects of front-of-package (FoP) labels on the healthy evaluation of Peruvian consumers.	628	youngsters	t-test MANOVA and	Cereal bar	The Nutritional Warnings and GDA-Semaphore and Traffic Light FoP labels had a significant and positive effect on the healthy evaluation of the cereals at a 95%		

			Shin and Park (2023)	two online experiments	to examine how the degree of nutrient content on the label influences consumer perceptions and behavioral intention	424	consumers	MANCOVA	bread	The presence of a front-of-package label in the ad increases ad responses involving perceived healthfulness of the product, ad attitude, brand attitude, healthy brand image and purchase intention.
Visual Elements N=13	Picture	N=5	Di Cicco et al. (2021)	online experiment	to address this gap by investigating how the visual perception of the juiciness of an orange shown on the package of orange juice affects the inferred properties of the product	359	consumers	A one-way ANOVA A MANOVA	orange juice	A significant effect of the highlights on juiciness. The presence of highlights, both in isolation and in interaction with the peeled side, also significantly increased the expected quality, healthiness and tastiness of the juice.
			Hall et al. (2020)**	experiment	to examine the impact of claims, fruit images, and health warnings on consumers' perceptions of fruit-flavoured drinks with added sugar (i.e., "fruit drinks")	2139	adults	two-tailed tests linear regression models	fruit drinks	Fruit images would lead to greater perceived product healthfulness and consumption interest, whereas health warnings would lead to lower perceived product healthfulness and consumption interest. We also predicted that fruit images would weaken the effect of health
			Schifferstein et al. (2022)**	online survey	to evaluate the usefulness and effectiveness (a) health; (b) environment; and (c) other benefits) of these three mediums text, images, or stylistic features.	1000+	adults	Dummy regression analysis ANOVA	orange juice, muesli bar, plain yogurt	The images we used indicated a positive effect for communicating worker conditions but a negative impact for healthiness.
			Dial and Musher-Eizenman (2020)	experiment	to examine how different types of packaging (i.e., healthy, fun, plain, un-packaged) of fruits and vegetables influence children's health and taste evaluations.	30	children	Repeated measures ANOVA	fruits and vegetables	Children were influenced by aspects of the packaging; they rated healthy and fun packaging more favourably in most cases, suggesting that children respond more positively to visually appealing packaging than to
			Schnurr (2019)	online survey	to systematically examine how cute packaging designs might affect product perception	459	student	ANCOVA ANOVA	snacks	Cute packaging designs increase perceptions of product tastiness and, at the same time, decrease perceptions of product healthiness.
	colour	N=8	Lunardo et al. (2021)	experiment and survey	to examine the effect of the colour red on consumer responses to food packages, unhealthy, guilty	240	individuals	ANCOVA	chocolate, a cereal bar and chips	Highlight the moderating role of perception of the food product as unhealthy, with the color red leading to stronger negative associations and guilt for unhealthy (vs healthy) products.
			Bezaz and Kacha (2021)	experiment	to determine how packaging colour (hue, saturation and brightness) for a healthy food product might influence children's evaluation of the packaging and their attitude towards the brand	157	Children 7–12	ANOVA	orange juice	Each colour dimension on packaging impacts children's evaluation of the packaging and attitude towards the brand. Therefore, the colour featured on the packaging can be an effective lever for action to ensure and
			Chu et al. (2022)**	in-depth interviews	to investigate packaging features that may promote healthy eating.	25	adults	qualitative thematic analysis	varies of food	Research has found that design elements such as colour, shape and labelling of food packaging can influence consumers' attention and perceptions of food healthiness, as well as their ability to control their
			Marques Da Rosa et al. (2019)**	online survey	to assess any associations between packaging shape, colour and tastes, perceived healthfulness	152	adults	A factor analysis	buttery vs. cereal cookies	The healthiness of the product was rated higher for the round and red-to-yellow packaging containing a buttery product.

			Kunz et al. (2020)	online experiment	to test how manipulation of one specific dimension of colour, namely saturation, simultaneously affects healthiness and tastiness perceptions, thus demonstrating	469	Undergraduate	correlation analysis and linear mixed-effect model analysis linear mixed-effect	snacks	Presenting pictures of products as grayscale images weakened the healthy-tasty correlation. Products with increased compared with decreased colour saturation were
			Marozzo et al. (2020)	online survey	to advance the understanding of the role of a frequently used element in packaging design—natural colours—in consumer purchase decisions	1056	adults	ANOVA t-test	Varies of food	Packaging featuring natural hues vs. other hues increases consumer WTP for healthy food products.
			Zhang et al. (2023)**	Online survey	the scope of this study is the health perceptions of obese urban Chinese women regarding the design of visual elements of weight loss health product packaging	357	female	Linear regression analysis	Weight loss health product	With colorless weight loss supplement packaging having greater health perceptions for female consumers
			Hallez et al. (2023)**	two online experiments	to investigate how visual, i.e., colours and textual, i.e., claims packaging elements shape perceptions of product healthiness, sustainability and tastiness	202	young consumers	the multilevel analyses	beverages snacks	Cool packaging colors, i.e., green and blue, increased perceptions that food and drinks were healthy and sustainable.
structure elements N=11	Package shape	N=5	Marques Da Rosa et al. (2019)**	online survey	to assess any associations between packaging shape, colour and tastes, perceived healthfulness	152	adults	A factor analysis	buttery cereal cookies	The angular-shaped packaging was related to the sweet taste. In which the product types were identified, packaging shape influenced evaluations of how healthy a product category appears to be, identifying angular packaging as
			Sheehan et al. (2020)	experiment	to examine if elongation activates a health mindset for consumers and influences the perceived healthiness of food products	856	consumers	ANOVA	drinks	The elongated containers activate a health mindset that influences both consumers' perception of the packaged food product and their health perceptions of subsequently encountered food. The activation of a health mindset by the elongation of food product packages polarizes consumers' health perceptions of the packaged product, such that healthy products are considered healthier and unhealthy products are
			Bettels et al. (2020)	online experiment	to examine the effects of rectangular packaging (vertical vs horizontal) on consumer perception in the context of organic food product	700	students and full-time employees	ANOVA	organic food sesame crackers	A horizontal, vs vertical, packaging alignment leads to a higher utilitarian value perception. Including perceived health attributes of organic foods, which leads to a higher willingness to pay for an organic food product.
			Zhang et al. (2023)**	Online survey	the scope of this study is the health perceptions of obese urban Chinese women regarding the design of visual elements of weight loss health product packaging	357	female	Linear regression analysis	Weight loss health product	Anthropomorphic weight loss supplement packaging being more effective in bringing the perception of weight loss effects to female consumers.
			Yarar et al. (2019)	online experiment	to show how and when mimicking humanoid shapes in a package design can impact food healthiness perception to aim at corroborating the effect of package shape slimness on healthiness with women with a larger sample	222	adults; female	MANOVA	yogurt	Both experiments showed that slim (vs. less slim) human-shaped packaging shapes enhance (decrease) consumers' perceptions of food healthiness.

Package Material	n=6	Ye et al. (2020)	Online survey	to see whether consumers associate healthier snacks, such as crackers with matte packaging, and less healthy snacks, such as potato chips with glossy packaging	717	consumers Undergraduates	ANOVA	potato chips	The earned associations between matte packaging and healthy foods and between glossy packaging and unhealthy foods, as predicted.
		Bou-Mitri et al. (2021)**	A cross-sectional study, an interviewer-based questionnaire	to assess the impact of the packaging functionality, characteristics, material, colour and informative cues on consumers' perception of the food quality, safety, healthiness and preference to buy	553	adults	T-test logistic regressions	cheese and juice	Regarding the juice, most of the participants thought that the glass bottles have the highest quality, were the safest, the healthiest and the most frequently bought. Those who reported that safety is the most essential characteristic for food packaging have selected transparent
		Reinoso-Carvalho et al. (2021)**	online survey	to carefully evaluate the effects of packaging transparency and type on expectations in an experiment resembling e-commerce, healthy and taste	496	general population	MANOVA	cookies	Transparent (vs. opaque) packaging tends to yield higher expectations concerning this product's quality (i.e., product liking, package liking, greediness), though it has an opposite effect on the expected
		Nascimento et al. (2022)	an online survey-based experiment	to investigate the influence of packaging design on Brazilian consumers' perceived quality and purchase intention of honey	343	consumers	Promax rotation method with Kaiser normalization	honey	The package design influences the perceived quality of honey. Glass jars were perceived as healthier, tastier, with higher quality, and authentic.
		Peng et al. (2023)	two experiments	to investigate the effect of smooth/rough packaging on food healthiness perception	40	adults	T-test	unclear	Food in smooth packaging was perceived to be healthier than that in rough packaging. BIAT results showed the smooth packaging-healthy food link was moderately strong. ERP results supported that food is perceived to be healthier in smooth packaging.
		De Temmerman et al. (2023)	five studies online survey between-subjects laboratory study	to identify whether and how structural package design elements affect consumption health perception and choices	1182	students	a multilevel analysis t-test ANOVA	snack	Packaging material appears to signal a certain healthiness perception to the consumer, where the use of paper packaging is more strongly associated with healthiness than the use of plastic packaging. As such,

Note : * Indicates that this article includes different specific elements of the same packaging element. ** Indicates that this article includes different types of packaging elements

Information elements of packaging

Eighteen studies investigated the impact of informational cues on people's assessment of the healthfulness of foods. Nine studies included informational elements such as package labels, and ten studies included nutritional claims, with three of these studies examining the role of labels and nutritional claims in comparison. The majority of these studies were conducted on the Internet, with one additional survey in local supermarkets and shopping malls and one in the laboratory study. Most of the studies had samples of adults; one examined adolescents of varying health literacy, and one surveyed a sample of children aged 6-12. The results of these studies all demonstrate the vital role those textual elements play in observing the health expectations and associations evoked by product packaging.

3.2.1 labels

Eleven (61%) studies found front-of-package labelling to have an impact on people's assessment of the healthiness of food. The presence of front-of-package (FOP) labelling increases advertising response, including the product's perceived health and a healthy brand image. Three of these studies (Prates, Reis, Rojas, Spinillo & Anastácio 2022; Schneider & Ghosh 2020; Shin & Park 2023) focused on front-of-package nutrition labelling (FOPNL). Shin and Park (2023) found through two experiments that healthier nutrients listed on labels positively impacted consumers' perceived health. However, front-of-pack labelling on product packaging increased perceived health and decreased people's assessment of food health attributes and willingness to purchase (Prates, Reis, Rojas, Spinillo & Anastacio 2022; Schneider & Ghosh 2020). Especially for unhealthy foods, FOPNL can have a negative effect on health assessment. For unhealthy foods displaying FOP nutrition labels, consumers may suspect that the company is trying to convince them to buy unhealthy products (Schneider & Ghosh 2020). Three of these studies (Bopape et al. 2021; Mediano Stoltze et al. 2021; Saavedra-Garcia et al. 2022) found that warning labels highlighting over-labelled key nutrients convey the message that the food is unhealthy, thus lowering people's health perceptions. This is consistent with the findings of a previous global comparative experimental study conducted in 12 countries (Schuldt 2013). Bopape et al. (2021) investigated South Africa and found that warning labels warning of the health effects of unhealthy foods improved consumer understanding of nutritional information and reduced consumer health perceptions, particularly favouring children's understanding. Warning labels alert people to unhealthy information about food, while nutrition claims communicate nutritional information about a food, and when both nutrition claims and warning labels are present on a package, it may give consumers confusing information about the overall health of the food. Mediano Stoltze et al. (2021) identified this problem by testing the effects of warning labels and carbohydrate-free claims on communicating health information about food on the package. They found that Warning labels, with or without nutrition claims, mitigated consumers' health perceptions but did not eliminate the effect of NC claims on consumers' perceptions of product health. However, Saavedra-Garcia et al. (2022) conducted a study on adolescents in Peru. They found that WL on the front of the package did not affect health recognition and purchase intention, which is consistent with a previous study that found that for children and adolescents, warning labels do not have a significant effect on them. For children and adolescents, warning labels do not affect them as much because the health attributes of the food are much smaller than their taste preferences (Effertz et al. 2014). Two studies have examined multiple types of FOP labels (Hock et al. 2021) (Hoge et al. 2022). Hock et al. (2021) researched several different types of FOP labels in six countries and found that each type of label significantly reduces adolescents' perceived healthiness of Sugar-sweetened beverages. Of these, the easily recognisable high-content octagonal label had the most significant effect on the perceived health of communication in adolescent diets. A comparative study of three different FOP labels, the Nutri-Score, Reference Intakes, and Multiple Traffic Lights, found that the Nutri-Score had a superior effect to all other types of fob labels, while colour-coded FOP labels (such as Multiple Traffic Lights in England or Nutri-Score in France) were more effective in selecting healthy foods in groups with poorer health literacy (Hoge et al. 2022). Traffic light labelling, which assesses crucial nutrient scores by assigning colours on a scale from green (good) to

red (bad), gives this particular label an advantage in terms of efficiency in perceived health when consumers have a time constraint to choose (Li et al. 2022). Reinoso-Carvalho et al. (2021) focused only on general labelling, and its presence allowed consumers to assess food products based on the highest ratings for most of the dimensions, such as product quality, healthiness, flavour deliciousness and packaging preferences.

3.2.2 Claims

In nine studies (50%), the impact of claims was investigated. Of these, Four studies (André et al. 2019) (Schifferstein et al. 2022) (André et al. 2019) (Chu et al. 2022) investigated both informational cues, nutritional and health claims, and all indicated that both types of claims enhance consumers' perceived healthiness of food products. Simple, salient and clear statement messages can help consumers choose healthier foods (Chu et al. 2022; Hallez et al. 2023). People are willing to pay more for such packaging (André et al. 2019). André et al. (2019) also found that the effect of packaging statements on consumer perceptions and choices is also influenced by consumer goals, such as whether they are on a diet or are seeking hedonic pleasures. Mediano Stoltze et al. (2021) and Prates, Reis, Rojas, Spinillo and Anastácio (2022) investigated the effect of packaging labelling on the perception of nutritional claims healthiness. FOPNL and warning labels could reduce the perceived health effects of nutrition claims on packages but could not completely eliminate their effects. Ricci et al. (2020), which compared complete and incomplete nutrition claims, found that nutritional information in numerical form was more helpful than textual presentations to increase consumers' perceived healthiness of the product and their intention to purchase it. But they may also mislead consumers into overestimating the healthiness of the food products (André et al. 2019; Ricci et al. 2020). Consumers' perceptions of the food product were more influenced by the textual information than the actual value of the food product. Hall et al. (2020) focused on the impact of health warnings and found that they can weaken health perceptions and consumer interest in food.

3.3 Visual elements of packaging

Thirteen of the reports dealt with the association of visual elements of packaging with consumer health perceptions. The main categories were image elements (n=5), colour elements (n=8), and investigating multiple packaging elements (n=5). Each study found an effect of at least one packaging element on health perception. There were also studies (n=5) that investigated the impact of visual packaging elements on attention, flavour perception, quality perception and purchase intention. These studies were conducted in various settings, primarily web-based online, in laboratories, and in public places, with sample sizes ranging from 25 to 2139.

3.3.1 Picture

All studies have shown the importance of image elements in food packaging perceptions and expectations. When packaging images contain real or descriptive pictures of the food itself or the food's raw material, it enhances consumers' health perceptions of that product. This link stems from the potential psychological connection between food raw materials and health that consumers have established beforehand (Sheehan et al. 2020). Musicus et al. (2022) investigated fruit imagery on the front of fruit juices. They found that its presence could also increase consumers' health perceptions and interest in consuming juice beverages, especially among children and parents. Di Cicco et al. (2021) investigated in more detail the imagery of fruits on the packages according to seventeenth-century paintings theory (Di Cicco et al. 2020) to design images that contribute to the perception of the juiciness of oranges and by adding a little highlight to the surface of the flesh of peeled oranges triggered the perception of more juiciness of the orange juice, which in turn enhanced the health perception of the product. The packaging of such products can be designed to trigger the perception of juiciness through visually communicated images, thus enhancing the perception of health. Cute pictures on packages can communicate food tastiness but reduce perceptions of food health (Schnurr 2019). However, for children, cute packaging can attract their visual attention and can influence children's evaluation of the food as much as packaging with healthy pictures (Dial & Musher-Eizenman 2020). Meanwhile, previous studies have also found a significant positive correlation

between the health attributes displayed in the images of the product packaging and the consumers' liking of the product as well as their willingness to buy it (Lidón et al. 2018). In other words, the higher the consumers' perception of the health attributes contained in the product, the more willing they are to purchase the product.

3.2.2 Colour

Eight out of 14 studies (n=8,62%) have found that packaging colour can influence consumers' expectations of how healthy food is. Chu et al. (2022) found that the colour of food packaging not only affects attention and perceptions of the healthiness of food but also has a role in controlling people's food intake. Lunardo et al. (2021), which focused on the colour red in packaging, found that red packaging, as an implicit signal of unhealthiness, increases consumers' perception of the unhealthiness of food, increasing their feelings of guilt. Cold packaging colours, such as green and blue packaging can increase perceptions of the healthiness of food and drink (Hallez et al. 2023). Marques Da Rosa et al. (2019) found through two research trials that warm colours (red to yellow) of biscuit packaging containing butter were rated higher regarding healthiness. Contrary to the finding of Lunardo et al. (2021) and Hallez et al. (2023), cooler colour schemes are more likely to be perceived as healthy by consumers. However, its research is consistent with a previous study that concluded that when the colour of a product or product ingredient is consistent with the colour of the packaging, it increases consumer perceptions of health (Karnal et al. 2016). Marozzo et al. (2020) proposed a new concept about colour, natural colour. It is defined as non-artificial and untreated colours, such as shades of beige. Packaging using natural colours can increase the health perception of healthy food products, but this health communication effect will not be applied to unhealthy foods. In his study of health perceptions of packaging design for diet pills, Zhang et al. (2023) found that colourless packaging enhances health perceptions among female consumers. The other (n=3, 37%) focused on colour saturation, with the results of Marques Da Rosa et al. (2019) and Kunz et al. (2020) all showing that food packaging with less saturated colours appeared to have an advantage over more saturated colours in communicating health and that there was an equivalence between brightly coloured food packaging and unhealthy. Also, Marques Da Rosa et al. (2019) found that packaging colour elements affected product preference, and taste associations and that this effect was more significant than the effect on food health expectations (Kunz et al. 2020). Another study on colour saturation (Bezaz & Kacha 2021), which was conducted on children, differed from the results of the previous two studies on adults in that he found that colour packages with higher saturation and shorter wavelengths were found to make children perceive such food products as being healthier. At the same time, Bezaz and Kacha (2021) found that of the three dimensions of colour (brightness, chroma and purity), brightness had the most significant impact on children's product preferences, with brighter packaging attracting children's preferences regardless of colour saturation. The differences between the results of the Bezaz and Kacha (2021), Marques Da Rosa et al. (2019) and Mead and Richerson (2018) studies revealed that adults and children perceive packaging differently, a possibility that reflects the fact that differences in consumers' experiences and perceptions affect their perception of packaging cues. Moreover, the findings of Marques Da Rosa et al. (2019) are based on Conceptual fluency and Acquired association theory. The findings may not apply to consumers from other countries or cultural backgrounds, and the effect of saturation on consumers' health perceptions needs to be further investigated.

3.4 Structural elements of packaging

Eleven studies investigated the expected role of packaging structural elements on healthiness, and each showed that at least one structural cue had a significant impact on consumers' perceived health. Two of the experiments were conducted on female consumers only, and one study was conducted on child consumers. Six of these studies (n=6, 66.6%) conducted the survey online, and the others in different settings, including laboratories and public places, with sample sizes ranging from 152 to 856 subjects.

3.4.1 Shape of the packaging

In five out of eleven studies (45%), the shape of the packaging was found to moderate expectations of how healthy the food was regarding health perceptions. Three (n=3,60%) focused on slimmer packaging. Foods in slimmer packages were perceived as healthier compared to fatter and wider packages. Sheehan et al. (2020) asked for a choice between extended vs. short food packages to measure subjects' perceptions of health and found that extended packages activated associations with health-related concepts. Moreover, this mindset also influences people's perceived healthiness of the packaged products they encounter in the future. Yarar et al. (2019) and Zhang et al. (2023) found similar results. They proposed that package shapes that mimic the slender human figure can implicitly communicate the healthiness of food products, especially to female consumers who are more concerned about their body shape. To test this conjecture, Yarar et al. (2019) and Zhang et al. (2023) investigated only female consumers. They found that slimmer package shapes would be associated with a thinner body shape and would be perceived to have less calorie content, thus activating health inferences. In another study (Bettels et al. 2020), horizontal rectangular and vertical rectangular organic food packages were compared. The study results showed that organic foods packaged in horizontal rectangles were more advantageous in conveying more health attributes and increasing consumers' willingness to buy. Marques Da Rosa et al. (2019) compared the effect of round and prismatic packaging on the healthiness of butter biscuits. The results of the study showed that butter biscuits in prismatic packaging were perceived as healthier compared to round packaging. This phenomenon aligns with the previous findings of Becker et al. (2011), who found that yoghurt with angular packaging was rated as denser in terms of taste and healthiness. This finding may be because rounded shapes tend to enhance the expectation of sweetness in food, even if the food is not high in sugar Spence (2014).

3.4.2 Material

Of the studies (n=5) on packaging materials, (n=2,33%) found that glass was considered more practical and healthier packaging. Bou-Mitri et al. (2021) and Nascimento et al. (2022), examined the packaging of fruit juice and honey, respectively, and obtained consistent findings that food packaged in glass jars would be perceived as healthier, tastier and of higher quality. De Temmerman et al. (2023) found higher levels of health perceptions for paper versus plastic packaging through several studies, suggesting that paper-based packaging could be considered a health-related cue. Bou-Mitri et al. (2021) also explored other packaging materials. The results of the study showed that the majority of respondents considered vacuum packaging to be of the highest quality, while it was seen as the healthiest and most frequently purchased option. Comparatively, tin packaging was seen as the safest packaging option. Reinoso-Carvalho et al. (2021) comparatively assessed transparent and opaque biscuit packaging in a 2D digital environment and found that biscuits packaged in transparent packaging reduced the expectation of biscuits' healthiness. This is consistent with the results of Simmonds and Spence (2017) (previous study) that although transparent packaging facilitates consumers to perceive the natural attributes of the food products directly, it does not lead consumers to believe that the food products are healthier and of a higher quality than those in opaque packaging. There are even some foods for which transparent packaging has a negative effect on the evaluation of healthiness, especially those that are less aesthetically pleasing (Riley et al. 2015; Simmonds & Spence 2017) (previous study). Bettels et al. (2020) found a link between matte packaging and healthy foods and between glossy packaging and unhealthy foods, such as crisps that tend to be sold in smooth packaging as predicted. Experimental results from Peng et al. (2023) found that consumers intuitively perceive smooth-packaged foods as healthier and explain the underlying neural mechanisms.

3.5. Risk of bias in studies

Overall study quality was high, high (n=31) and low (n=3), with scores ranging from 24 to 35 (57.14-83.33%). Of the 16 QATSDD items, the highest scoring item was a Specific statement of aims/objectives (item 2), followed by a reasonable justification for the analytic method selected (item

13). In contrast, the lowest scoring item was the Use of explicit theoretical framework (item 1). Despite not explicitly including a theoretical framework, most authors explained why their research question was important in their particular context. A detailed overview of all the research quality assessments can be found in Table 3.3.

Table 3.3 Quality assessment of eligible studies

NO	Authors	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Total score	%	Rate
1	André et al. (2019)	1	3	2	2	2	3	2	2	3	2	N/	2	2	N/A	0	2	28	66.67	high
2	Bezaz and Kacha	3	3	2	1	1	2	2	2	3	2	N/	3	2	N/A	0	1	27	64.29	high
3	Bettels et al. (2020)	3	3	1	2	1	2	2	2	1	3	N/	2	2	N/A	1	2	27	64.29	high
4	Bopape et al.	0	3	3	1	2	3	3	2	N	N/A	3	2	2	2	2	1	29	69.05	high
5	Bou-Mitri et al.	0	3	2	3	3	2	2	2	2	2	N/	2	2	N/A	1	0	26	61.90	high
6	Chu et al. (2022)	1	3	1	1	1	2	3	1	N	N/A	3	3	3	3	1	3	29	69.05	high
7	De Temmerman et	2	3	1	3	3	1	2	2	3	3	N/	2	3	N/A	1	2	31	73.81	high
8	Di Cicco et al.	2	3	2	2	2	3	2	3	3	3	N/	3	3	N/A	2	2	35	83.33	high
9	Hall et al. (2020)	2	3	2	3	3	2	2	3	2	3	N/	3	3	N/A	2	0	33	78.57	high
10	Hock et al. (2021)	0	3	3	3	2	2	2	2	2	2	N/	2	2	N/A	1	2	28	66.67	high
11	Hallez et al. (2023)	1	3	1	2	2	2	2	2	3	3	N/	3	3	N/A	3	2	32	76.19	high
12	Hoge et al. (2022)	0	3	3	2	2	2	2	2	3	3	N/	3	3	N/A	2	0	30	71.43	high
13	Kunz et al. (2020)	1	2	3	2	2	2	3	2	3	2	N/	2	2	N/A	0	1	27	64.29	high
14	Lunardo et al.	3	3	2	1	1	3	2	2	2	2	N/	3	3	N/A	1	2	30	71.43	high
15	Lunardo et al.	0	3	2	1	1	2	2	1	3	3	N/	3	3	N/A	3	2	29	69.05	high
16	Li et al. (2022)	0	3	2	1	1	3	3	2	3	3	N/	2	1	N/A	2	2	28	66.67	high
17	Marques Da Rosa et	0	3	2	1	1	2	2	2	3	2	N/	2	2	N/A	2	2	26	61.90	high
18	Marozzo et al.	1	3	1	2	2	2	2	1	2	3	N/	2	3	N/A	1	2	27	64.29	high
19	Mediano Stoltze et	0	3	2	2	1	2	2	2	3	3	N/	3	3	N/A	2	2	30	71.43	high
20	Nascimento et al.	1	3	2	2	2	1	2	1	3	2	N/	3	3	N/A	1	0	26	61.90	high
21	Peng et al. (2023)	2	3	2	3	3	2	3	2	3	3	N/	3	3	N/A	1	2	35	83.33	high
22	Prates, Reis, Rojas,	0	3	2	2	3	3	3	2	3	3	N/	3	3	N/A	2	2	34	80.95	high
23	Reinoso-Carvalho	1	3	1	2	2	1	2	2	1	2	N/	2	2	N/A	2	2	25	59.52	low
24	Ricci et al. (2020)	1	3	1	3	2	1	1	1	2	2	N/	2	2	N/A	0	3	24	57.14	low
25	Saavedra-Garcia et	0	3	3	2	1	2	3	2	2	3	N/	3	3	N/A	2	2	31	73.81	high
26	Schnurr (2019)	1	3	2	2	1	1	2	2	1	2	N/	2	3	N/A	1	2	25	59.52	low
27	Schneider and	1	3	2	3	2	2	2	1	2	2	N/	2	2	N/A	1	2	27	64.29	high
28	Schifferstein et al.	2	3	1	2	2	1	2	2	2	2	N/	2	2	N/A	1	2	26	61.90	high
29	Schwalb Helguero	1	3	2	2	2	1	2	2	3	3	N/	2	3	N/A	1	2	29	69.05	high
30	Shin and Park	2	3	1	3	2	1	2	2	2	2	N/	2	3	N/A	1	2	28	66.67	high
31	Sheehan et al.	2	3	2	2	2	1	2	2	3	3	N/	2	3	N/A	1	2	30	71.43	high
32	Yarar et al. (2019)	1	3	2	2	2	1	2	2	2	3	N/	3	3	N/A	1	2	29	69.05	high
33	Ye et al. (2020)	2	3	1	2	2	1	2	2	2	2	N/	2	1	N/A	1	3	26	61.90	high
34	Zhang et al. (2023)	1	3	2	3	2	1	2	2	3	3	N/	2	3	N/A	1	2	30	71.43	high

<p>Quality Assessment Tool for Studies with Diverse Designs (Sirriyeh et al. 2012)</p> <p>Item 1: Explicit theoretical framework</p> <p>Item 2: Statement of aims/objectives in the main report</p> <p>Item 3: Clear description of research setting</p> <p>Item 4: Evidence of sample size considered in terms of analysis</p> <p>Item 5: Representative sample of target group of a reasonable size</p> <p>Item 6: Description of the procedure for data collection</p> <p>Item 7: Rationale for choice of data collection tool(s)</p> <p>Item 8: Detailed recruitment data</p> <p>Item 9: Statistical assessment of reliability and validity of measurement tool(s) (Quantitative studies only)</p> <p>Item 10: Fit between research question and method of data collection (Quantitative studies only)</p> <p>Item 11: Fit between research question and format and content of data collection tool, e.g., interview schedule (Qualitative studies only)</p> <p>Item 12: Fit between research question and method of analysis</p> <p>Item 13: Good justification for the analytic method selected</p> <p>Item 14: Assessment of reliability of analytic process (Qualitative studies only)</p> <p>Item 15: Evidence of user involvement in design</p> <p>Item 16: Strengths and limitations critically discussed</p> <p>Scores: 0 = not at all; 1 = very slightly; 2 = moderately; 3 = complete</p> <p>Total scores > 60% = High quality; scores ≤ 60% = Low quality</p>

DISCUSSION

This review analyses the experimental evidence on the impact of design elements of food packaging on people's health perceptions (34 articles, 69 empirical studies), and the results of almost all the studies highlight evidence of the importance of the design elements of packaging in influencing consumers' perceptions of the health attributes of food. These studies have concluded that packaging can affect consumers' health perceptions.

This review reveals directions for future research. Firstly, informational elements on the front of food packaging (nutrition labelling, health claims) have been the focus of research, while further research is needed regarding the health communication impact of visual and structural elements. Among the three design elements of packaging, the number of studies supporting informational elements (53%) is more significant than visual and structural elements. While the powerful health communication effects of nutrition claims and health labels are undeniable, there are also many previous studies focusing on the effects of visual and structural elements on consumers' perceived product quality and purchasing behaviours. They have found that the communication effects of these visual and structural elements are even more powerful and intuitive than the effects of textual information (Rettie & Brewer 2000; Townsend & Kahn 2014; Vila-López et al. 2017). Because processing informational elements such as labels and nutritional claims requires a higher level of cognitive effort, whereas the communication effects of visual and structural elements are more unconscious influences (Underwood & Klein 2002). Secondly, we did not find any studies that combined all three elements; only (n=8, 23%) of the included studies focused on the communication effects of two or more design elements, while the other studies only focused on and also demonstrated the impact of a single element on the field of health communication. This suggests that studies involving multiple congruencies between colours, shapes, materials, images and message cues of packaging have been severely neglected in the literature. However, the reality is that packaging is an integrated design involving all elements, and future research should focus on the integrated analysis of elemental cues in order to ensure the coordinated and consistent impact of each element.

Moreover, in terms of synthesising the literature included in the study (n=32, 94%), the literature was limited to single-country studies, and further attention needs to be paid to internationalised

cross-cultural studies in the future. Most of the studies were focused on developed countries in Europe and the United States (n=27, 79%), whereas developing and underdeveloped countries have a high prevalence of food problems and dietary illnesses, and there is also a need for health communication studies on packaging in such countries.

Individual consumer characteristics and experiences can also influence the effectiveness of packaging visual communication. Consumers' age, gender, education level, cultural background, and income level all affect the perception of package design. Most of the articles in this review (n=28) focused only on the average consumer. One study examined the impact of packaging information elements on adolescents in a comparative manner across multiple countries (Australia, Canada, Chile, Mexico, the United Kingdom, and the United States), collapsing four continents and encompassing both developed and developing countries (Hock et al. 2021). Hock et al. (2021) found that There is a difference in health perception among groups from different social backgrounds. Still, this difference is moderate compared to the reasons of consumer age and gender. Regarding the effect of packaging on health perception, the impact of packaging was more significant for females and older subjects (14-17 years). This is because relatively older adolescents are likely to have a higher degree of knowledge related to sugary beverages, and females are generally more concerned about the healthfulness of foods than males. Therefore, females and older subjects were correspondingly more sensitive to the health messages conveyed by food packaging. In the three studies on child consumers, we found inconsistent tendencies in the findings for children compared to other studies on adults in the literature. For example, Bezaz and Kacha (2021) found that children are more likely to be attracted to brightly coloured and cute images and thus tend to perceive food as healthy. However, studies with adults have found that these same elements are more often viewed as tasty but unhealthy. (Mead & Richerson 2018) investigated the heuristic that brightly coloured food packaging equates to an unhealthy heuristic through four experiments. Still, the theoretical foundation is based on learned semantic associations, and the results may not apply to all consumers. Festila and Chrysochou (2018) (a previous study) found differences between Danes and Americans in perceiving the colour design of packaging for healthy products. Danes tend to use light and pastel shades to communicate health, whereas Americans are more likely to choose balanced shades of white, green, yellow, and brown. There is also a lot of previous research suggesting that the effectiveness of visual communication of packages varies according to the characteristics of the target consumers and personal factors (including their own gender, age, income, cultural background, education, and religion) (Aday & Yener 2014; Küster et al. 2019; Vila-Lopez & Kuster-Boluda 2016). However, these studies have generally focused on consumer attention and purchase behaviour, and there are fewer studies on the effects of health communication. Future research on such topics could concentrate more on the influence of individual consumer characteristics and experiences (e.g., cognitive needs, health literacy, income level, physical activity, socioeconomic status, and dietary differences) on the effectiveness of packaging in communicating health (see the theoretical framework diagram in Figure 4.1.

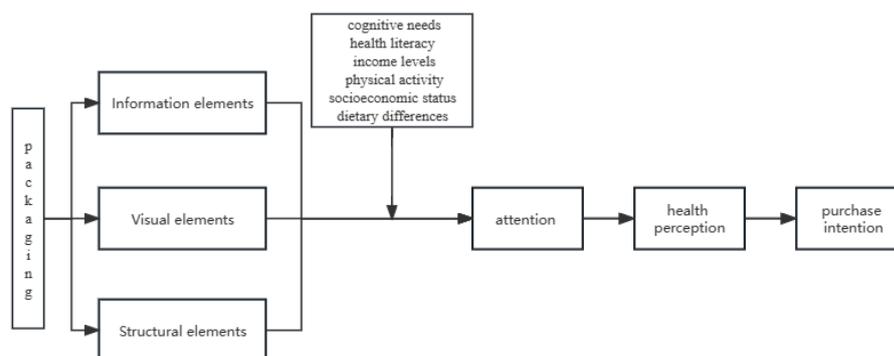


Figure 4.1 Concept Framework

This is the first literature review to address the communication effects of all packaging design elements on consumers' health when choosing food. This review provides a comprehensive overview of the last five years of research on the effects of different packaging elements on consumers' perceived healthiness of food, specifically distinguishing between the communication effects of textual, visual and structural elements. Most reviews on healthy food choices in packaging focus on food nutrition labelling and nutrition claims, whereas the reviews on integrated packaging design focus on audience perceptions of product quality and purchase intentions. A wide range of study types were considered, providing a comprehensive overview of the literature in this area. The results support the idea that visual cues (colour), textual cues (health-related nutritional claims, labels, etc.) and structural elements (shape, size) are effective in conveying symbolic meanings about the health of food products and consequently influencing consumer attitudes towards them. A contribution to the existing literature is made through our manuscript to highlight the impact of packaging design on health communication and to provide recommendations for packaging design in future theory and practice.

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AUTHORS' CONTRIBUTIONS

1. Liu Xiaotong

Roles Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Resources, Software, Validation, Visualization, Writing – original draft, Writing – review & editing

2. Normah Mustaffa;

Roles: Investigation, Methodology, Supervision, Writing – review & editing

3.Emma Mirza Wati Mohamad;

Roles: Investigation, Methodology, Supervision, Writing – review & editing

4.Wang Jingyao

Roles: Data curation, Formal analysis, Resources, Supervision, Validation, Writing – review & editing