

Rapid Systematic Literature Review for P1058 – Nutrition Labelling About Added Sugars

Executive Summary

To support proposal P1058, FSANZ undertook a rapid systematic review of the literature relating to consumer understanding of ‘added sugars’ and similar terminologies, and consumer perceptions of ‘added sugars’ in the Nutrition Information Panel (NIP) or international equivalents. This report outlines the methodological approach to the review and summarises the available evidence.

Electronic database searches, hand searching and information from stakeholders identified 36 studies published between January 2003 and July 2022. Peer reviewed articles and grey literature were included. The majority of the evidence was quantitative in nature, with only three qualitative, and four mixed method studies identified. Five studies were undertaken in Australia, one in New Zealand, one across both Australia and New Zealand, and 29 internationally. International findings may not be directly generalisable to the Australian and New Zealand context given different food regulatory systems, cultures and exposure to different messaging around sugar. Studies also used varying definitions of added sugar, and often had a very high proportion of female or highly educated respondents. Not all of the 36 studies provided evidence towards every research question. Thus, in some instances, conclusions are based on only one or two studies. Acknowledging these limitations, there are a number of conclusions that can be made based on the consistency of the evidence. Key findings are summarised below, grouped by research question.

What do consumers understand the terms ‘sugars’, ‘total sugars’, ‘added sugars’, and ‘free sugars’ to mean?

The term ‘free sugars’ is not well understood compared to ‘added sugars’.

- Consumers generally feel they have a reasonable understanding of the concepts of ‘added sugars’ and ‘total dietary sugars’, but are more uncertain in their understanding of ‘free sugars’.

Consumers typically have a literal interpretation of ‘added sugars’.

- Consumers commonly understand ‘added sugars’ to be sugar that is added during manufacturing or food preparation, rather than being inherent or naturally occurring in food.
- The addition of added sugars was often perceived to be done by manufacturers. However, home cooking was also seen as a key way to reduce added sugars intake.
- Consumers commonly identified that sugar was added to enhance flavour, with few highlighting sugar added for other purposes, like preserving or improving shelf life.

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Consumers have more positive perceptions of 'natural' sugars, and may not always view these as 'added'.

- Consumers did not always make the distinction between total sugar and added/free sugar, and some were confused by the difference. Rather, consumers tended to employ a different interpretive frame, wherein sugars viewed as natural or less processed (e.g. sugar naturally present in fruit or brown sugar) were perceived as good, while those found in packaged foods or that were viewed as more processed were seen as bad.
- Some consumers defined added sugars as those that are synthetic, artificial, fake or unnatural. However, it was often unclear how consumers and researchers interpreted the concepts of 'natural' or 'artificial'.
- Several studies demonstrate that sugar sources that are perceived as natural or less processed, including fruit sugar, honey and brown sugar, are generally viewed as healthier.
- Consumers often thought that sugar ingredients that were perceived as natural (e.g. honey or fructose) were 'inherent' rather than 'added' to a packaged food. This perception may be reduced where consumers are more familiar with adding 'natural' sugar ingredients to other foods. For example, consumers demonstrated greater understanding that honey could be both natural and added, relative to sugar types like lactose, which are less frequently used as a sweetener in home cooking.

Some consumers may not understand 'no added sugar' claims.

- The majority of consumers understand that products with 'no added sugar' may still contain sugar.
- However, a sizable proportion (17% - 30%) of consumers did not understand this distinction or were unsure. As this research was undertaken using 'no added sugar' claims, it is unclear whether consumers would perceive zero grams of added sugars in a NIP to mean no sugar was present, if total sugar information was presented in close proximity.

Consumer understanding of the presence of added or free sugars in products varies based on the product type.

- There was less certainty around the presence of added sugars (not defined) in products such as breakfast cereals, yogurts, sauces and condiments, sports drinks and alcoholic beverages, likely reflecting greater variation in the presence or amount of added sugars in those food categories. This was relative to the majority of consumers who understood that products like ice cream and chocolate contain added sugars, while fresh fruit and vegetables do not.
- There were also misconceptions among some consumers that diet soft drinks (which typically contain no sugar) contain added or free sugar.

Level of education appears to relate to consumer understanding of added and free sugars.

- Three studies examining socio-demographic factors related to perceived or objective understanding of added or free sugars found that level of education was related, with those with lower education having poorer understanding.
- In one study, those with lower levels of education were also significantly worse at identifying the presence of added sugars in ready to eat meals, fruit yogurt, breakfast cereals, sauces and condiments, soft drinks, energy drinks, sports drinks and alcoholic beverages.

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Does the presence of ‘added sugars’ information in addition to ‘sugars’ or ‘total sugars’ information in the NIP (or international equivalents) confuse consumers?

Consumers generally do not report being confused by added sugars information in nutrition panels.

- Consumers generally report that added sugars information is helpful, and not more difficult to understand than sugar information alone. However, Brazilian university students reported finding the distinction between total and added sugar to be confusing when viewing NIP presentations.
- These findings reflect consumers’ perceptions, which may not necessarily correspond to their ability to use the information.

Added sugars information in nutrition panels helps consumers to identify added sugar.

- Providing added sugars information in nutrition panels improves consumers’ ability to identify added sugars content, and select products on that basis.
- However, consumers may have difficulty identifying whether a food is high or low in added sugar using only the gram amount listed in nutrition panels.
- The inclusion of a % daily value for added sugars may help consumers to identify if the gram amount represents a little or a lot of added sugars.
- High/medium/low interpretive added sugar labelling may also aid consumer understanding of the level of added sugars in products. However, it did not significantly improve consumers’ ability to compare products and identify those with the highest sugar levels, relative to listing the gram amount of added sugars in a nutrition panel.

Consumers may perceive ‘added sugars’ to be additional to, rather than a component of ‘sugars’.

- Depending on the format of the NIP, consumers may interpret ‘added sugars’ to be additional to, rather than a component of ‘sugars’ or ‘total sugars’, leading them to overestimate sugar content.
- Labelling formats that listed ‘total sugars’ rather than ‘sugars’ consistently reduced these misperceptions. Consumers also appear to find more utility in ‘total sugars’ terminology, relative to ‘sugars’.
- The format implemented in the United States (US), which states ‘total sugars’ with ‘including added sugars’ indented below, reduced the misperception substantially.

It is unclear if consumers will pay less attention to sugars or total sugars if added sugars is listed in the NIP.

- One eye tracking study suggests that consumers may attend less to ‘sugars’ information when ‘added sugars’ is listed. However, this could be due to a novelty effect.
- Consumers generally find ‘total sugars’ information to be more useful and influential than ‘added sugars’ information.
- The importance of sugar terminology appears to depend on product type, with both total and added sugars information (not defined) being more valued on products that consumers perceive to be high in sugar. Consumers were most interested in added sugars information for ‘juices and drinks’.
- It is possible that consumers’ preference for total sugars information could change if they become more familiar with added sugars. For example, in the US, where added sugars labelling is mandatory, consumers in one survey ranked total and added sugars as similarly important. 50% of Americans aiming to reduce their sugar intake

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focused only on 'added sugars', relative to 31% who were trying to reduce 'natural' and 'added sugars'.

Listing added sugars in the NIP is unlikely to interfere with consumers' ability to determine overall product healthiness.

- Knowing or perceiving that a product contains added sugars may reduce how healthy that product is perceived to be.
- However, all other things being equal, the declaration of added sugars on nutrition panels does not appear to interfere with consumers' ability to determine overall product healthiness, to the detriment of other nutrients.

How do consumers understand added sugars information for single ingredient foods?

No research directly studied consumer preferences or responses to added sugars information on single ingredient foods.

- However, broader research may provide some insights into how consumers might react to different options for presenting added sugars in the NIP for single ingredient foods captured by an added sugars definition.
- Declaring added sugars information on single ingredient foods may mislead consumers who perceive added sugars to only be sugar that has been added.
- An interpretation of the results from one US study may suggest that presenting added sugars information as 0 grams for single ingredient foods might create a health halo. However, as the study did not directly examine health perceptions, it is not possible to draw a definitive conclusion.
- Any health halos may exacerbate existing perceptions of honey and fruit sugars as being more healthy than other sugar sources.
- Given the limited evidence, the information in this section should be used with caution.

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Abbreviations and Glossary

Nutrition Panel	A generic descriptor for tables on the back of food labels that present nutrient content information.
NIP	Nutrition Information Panel. Used to refer to the nutrition panel on the back of food labels in Australia, New Zealand and Brazil.
NFL	Nutrition Facts Label Used to refer to the nutrition panel on the back of food labels in the United States.
NFT	Nutrition Facts Table Used to refer to the nutrition panel on the back of food labels in Canada.

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Introduction

FSANZ Proposal P1058 (Nutrition labelling about added sugars) is considering amending the Australia New Zealand Food Standards Code to include 'added sugars' information in the nutrition information panel (NIP), to enable consumers to make informed food choices in support of dietary guidelines. To support this proposal FSANZ has undertaken a rapid systematic review of the literature relating to consumer understanding of 'added sugar' and similar terminologies, and consumer perceptions of 'added sugars' in the NIP or its international equivalents.

This literature review builds on a 2017 FSANZ literature review undertaken on consumer knowledge, attitudes and behaviours relating to sugars in foods and as presented on food labelling (2017 Sugar Literature Review) (FSANZ 2017). Drawing on this and new evidence, the current review seeks to develop a deeper understanding around three specific research questions related to P1058:

- What do consumers understand the terms 'sugars', 'total sugars', 'added sugars', and 'free sugars' to mean?
- Does the presence of 'added sugars' information in addition to 'sugars' or 'total sugars' information in the NIP (or international equivalents) confuse consumers?
- How do consumers understand 'added sugars' information for single ingredient foods?

These research questions were designed to inform the consideration of a regulatory definition of 'added sugars' and the presentation of 'added sugars' information in the NIP. As such, the extent to which consumers value 'added sugars' information in general was considered out of scope. Further, the purpose of P1058 is to *enable consumers to make informed choices in support of dietary guidelines*. This does not necessarily mean that those choices will always be healthier, rather the focus is for consumers to be better informed. As a result, this review looked at consumer understanding and ability to use added sugar information and not its impact on behaviour, which may also be influenced by consumers' preferences in terms of taste, price, or convenience, for example.

Methods

The review includes Australian, New Zealand and international research from 2003 to 2022. Both peer reviewed articles and grey literature, such as unpublished theses, are included. Literature was identified through:

- Searching six online databases for peer-reviewed studies published between January 2003 and June 2022.
- Searching for relevant studies in FSANZ's 2017 Sugar Literature Review.
- Reviewing reference lists and citing studies for all included studies and relevant reviews.
- Information provided by stakeholders.

The literature search, screening process and evidence synthesis was undertaken by one officer, and peer reviewed internally within FSANZ. The final draft was then externally peer reviewed by an independent academic. Peer review comments were considered and incorporated into the final version of the report. Further detail on the review methods are outlined in Appendix 1.

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FSANZ also undertook independent analysis on the raw data obtained from a survey run by the European Food Safety Authority (EFSA 2022). The methods used for this data analysis are outlined in Appendix 2.

Findings

The review identified a total of 36 relevant studies, including five from Australia, one from New Zealand, one undertaken across both Australia and New Zealand, and 29 international studies. Twenty nine studies were quantitative, three were qualitative and four used mixed methods. International evidence was included due to limited research in the Australian and New Zealand context, and because of the specific relevance of studies undertaken to assess consumer understanding and use of 'added sugar' information in NIP equivalents overseas. However, international findings may not be directly generalisable to the Australian and New Zealand context given different food regulatory systems, cultures and exposure to different messaging around sugar.

In addition to having limited generalisability to the Australian and New Zealand population, many studies identified in the review did not use nationally representative samples, and often had a very high proportion of female or highly educated respondents, noting this is less of a concern for experimental designs. Studies also used varying definitions of added sugar. Some definitions were explicit while others were implied, for example, by asking participants to classify sugars as either 'natural' or 'added', implying that they could not be both. Other studies did not define added sugar for participants. As such, results should be interpreted with respect of the definition used, or interpreted with care where a definition was not provided to participants or was not specified by study authors. The definitions of added sugars used by the studies in this review do not reflect FSANZ's position around what could be included in a regulatory definition of added sugars. Not all of the 36 studies provided evidence towards every research question. Thus, in some instances, conclusions are based on only one or two studies. For an overview of the studies that contributed to each research question, see Appendix 3.

Acknowledging these limitations, there are a number of conclusions that can be made based on the consistency of the evidence. Key findings are summarised below, grouped by research question.

Research Question 1: What do consumers understand the terms 'sugars', 'total sugars', 'added sugars', and 'free sugars' to mean?

Research Question 1 sought to explore consumer understanding of specific sugar terminologies, including 'sugars', 'total sugars', 'added sugars' and 'free sugars'.

Twenty three studies were identified that contributed evidence towards this question. Six studies were from Australia or New Zealand, of which one covered both jurisdictions. A further 17 studies were from the United States (US) (six), the United Kingdom (three), Portugal (two), Brazil (two), Switzerland (one), the European Union (one), China (one) and Saudi Arabia (one).

A variety of methods are used in the literature to investigate consumer understanding of sugar terminologies, each of which provide different insights into the research question. This section first looks at consumer understanding of sugar terminologies through self-rated understanding. It then explores quantitative responses to statements about sugar terminologies and qualitative findings, where participants explain their interpretation in their

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own words. It then reports findings about how consumers perceive sugars from products or processes in relation to these terms, and how well consumers understand the presence of added or free sugars in different products. Finally, differences in understanding of sugar terminologies across different socio-demographic groups are outlined.

1.1 Summary – Research Question 1

- When asked to rate how well they understand sugar terminology, consumers generally feel they have a reasonable understanding of the concepts ‘added sugar’ and ‘total dietary sugar’, but are more uncertain in their understanding of ‘free sugar’.
- In broader research about sugar, consumers did not always make the distinction between total sugar and added/free sugar, and some were confused by the difference. Rather, consumers tended to employ a different interpretive frame, wherein sugars viewed as natural or less processed (e.g. sugar from fruit or brown sugar) were perceived as good, while those found in packaged foods or that were viewed as more processed were seen as bad.
- Consumers commonly understand ‘added sugar’ to be sugar that is added during manufacturing or food preparation, rather than being inherent or naturally occurring in the food.
- The addition of added sugars was often perceived to be done by manufacturers. However, home cooking was also seen as a key way to reduce added sugars intake. In one Portuguese study, ‘free sugar’ guidelines were commonly thought to relate only to sugar added by consumers.
- Consumers commonly thought that sugar was added to enhance flavour, with few highlighting sugar added for other purposes, such as preserving or improving shelf life.
- Perceived naturalness also appears to play a key role in how consumers distinguish between sugar types. Some consumers defined added sugars as those that are artificial, fake or unnatural. However, it was often unclear how consumers and researchers interpreted the concepts of ‘natural’ or ‘artificial’.
- Consumers often thought that sugar ingredients perceived as natural (e.g. honey or fructose) were ‘inherent’ rather than ‘added’ to a packaged food. This perception may be reduced where consumers are more familiar with adding ‘natural’ sugar ingredients to other foods. For example, consumers demonstrated greater understanding that honey could be both natural and added, relative to sugar types like lactose, which are less frequently used as a sweetener in home cooking.
- Several studies also demonstrate that sugar sources perceived as natural or less processed, including fruit sugar, honey and brown sugar, are generally viewed as healthier.
- The majority of consumers understand that products with ‘no added sugar’ may still contain sugar. However, a sizable proportion (17% - 30%) of consumers did not understand this distinction or were unsure. As this research was undertaken using ‘no added sugar’ claims, it is unclear whether consumers would perceive zero grams of

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added sugars in a NIP to mean no sugar was present if total sugar information was presented in close proximity.

- A majority of consumers understand that added sugars can be found in savoury products. However, in one study with Portuguese university students, participants reported finding it more difficult to identify added sugars in products that are savoury, or perceived as healthy.
- One Portuguese study found that participants commonly interpreted the World Health Organisation (WHO) free sugar guidelines to be the recommended dietary allowance for sugar.
- There was significant variation in consumers' ability to identify the presence of added or free sugars in food and beverage products, with ability appearing to depend on product type.
- There was less certainty around the presence of added sugars (not defined) in products such as breakfast cereals, yogurts, sauces and condiments, sports drinks and alcoholic beverages, likely reflecting greater variation in the presence or amount of added sugars in those products. This was relative to the majority of consumers who understood that products like ice cream and chocolate contain added sugar, while fresh fruit and vegetables do not. There were also misconceptions among some consumers that diet soft drinks (which typically contain no sugar) contain added or free sugar.
- Consumers were poor at identifying the percentage of juice and the presence of added sugars (not defined) in various fruit beverages, particularly for unsweetened drinks such as 100% juice. This occurred even when these attributes were clearly labelled, for example when '100% juice' or 'no added sugar' claims were on pack. Consumers tended to underestimate sugar content in fruit beverages and smoothies, but overestimate juice content in all products except 100% juice. Recognising the presence of added sugars negatively influenced consumer perceptions of how healthy a fruit beverage was, while overestimating the percentage of juice positively impacted healthfulness perceptions.
- Level of education was consistently related to both perceived and objective measures of consumer understanding of sugar terminologies, particularly for certain products. Improved understanding in women compared to men may reflect broader differences in nutritional literacy and sugar knowledge. The presence of children in the household and the gender of those children may also be related to understanding of sugar terminologies.
- No research investigated consumer perceptions of sugar created through specific processes, such as hydrolysis.

1.2 Self-Rated Understanding

Three studies from Europe, Portugal and China asked participants to rate their level of understanding of different sugar terminologies. These findings reflect consumers' perceived understanding, which may not necessarily correspond to their actual levels of understanding.

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In an online survey of 7,469 adults across the 27 European Union members states, Norway and Iceland, participants were asked to rate their understanding of 'added sugars', 'free sugars' and 'total dietary sugars' out of 10, where 10 indicated the greatest level of understanding (EFSA 2022). The survey sample was nationally representative in each country with respect to age, gender and socio-economic grouping. FSANZ analysis (see Appendix 2) of the survey data found that perceived understanding of 'added sugars' (mean = 7.30, \pm 2.39) was significantly higher than both 'total dietary sugars' (mean = 6.77, \pm 2.57) and 'free sugars' (mean = 5.41, \pm 2.97). Perceived understanding of 'total dietary sugars' was also significantly higher than 'free sugars' (all $p < 0.001$). The mean ratings indicate that participants believe they generally have a reasonable understanding of 'added sugars' and 'total dietary sugars', but had a lesser understanding of 'free sugars', which had a mean only slightly above the midpoint and a broader range of responses (EFSA 2022).

A survey of 1,010 Portuguese adults (Prada et al. 2020) asked participants to rate their ability to comprehend the WHO definition¹ of 'free sugars' and their ability to 'identify free sugars in products' on seven point scales where one = hard and seven = easy. The mean rating for WHO free sugar definition comprehension was 4.15 (\pm 1.95, 95% CI 4.03 – 4.27). This was only slightly above the midpoint, indicating that participants on average felt somewhat uncertain about their ability to understand the definition. Self-rated ability to 'identify free sugars in products' was slightly lower than the midpoint, with a mean of 3.81 (\pm 1.90, 95% CI 3.69 - 3.92), indicating that participants on average thought it was somewhat difficult to identify free sugar in foods.

A survey of 1,136 caregivers of adolescents from Changsha, Hunan Province in China identified very low levels of perceived understanding of the term 'free sugar' (Tang et al. 2020). Just 7.4% of respondents reported knowing the definition of 'free sugar' in a yes/no choice question. This compared to 34.0% of parents who reported knowing the daily sugar intake recommended in the Chinese Dietary Guidelines, and 30.5% of parents who could choose the correct daily sugar restriction recommended by the WHO in multiple choice questions.

Conclusion – Section 1.2

Overall, there is limited research on self-rated understanding of sugar terminologies, especially in Australia and New Zealand. The findings in Section 1.2 suggest that consumers generally feel they have a reasonable understanding of the concepts of 'added sugar' and 'total dietary sugar'. However, the concept of 'free sugar' is less well understood.

1.3 Quantitative Understanding

Three studies delved further into consumer understanding by asking consumers to respond quantitatively to specific statements about sugar terminologies. One study was undertaken across Australia and New Zealand, one in New Zealand, and one in Europe.

In an online survey of 7,469 adults across European Union members states, Norway and Iceland, participants were asked to respond to a series of statements regarding sugars with either 'True', 'False', or 'Don't Know' (see Table 1) (EFSA 2022). The study did not identify which answer was considered correct.

¹ The WHO definition presented was an official Portuguese definition, based on the WHO definition. Exact wording not provided in the study.

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Table 1 - European consumer agreement with sugar terminology statements (n=7,469) (EFSA, 2022*)

Statement	True	False	Don't know
Added sugars are all artificial	24.3%	49.6%	26.1%
Added sugars can be from natural sources	64.2%	13.0%	22.8%
Added sugars are added during food preparation	62.7%	14.3%	23.0%
Added sugars are added during manufacturing	71.4%	6.9%	21.6%
Added sugars can be found in savoury foods	66.4%	9.8%	23.8%
Added sugars are only added to sweet foods	15.7%	64.1%	20.2%
A product with "no added sugars" contains no sugar	13.3%	69.8%	16.9%
A product with "free sugars" contains no sugar	11.4%	54.4%	34.3%
Sugars and added sugars are the same	18.9%	54.7%	26.4%
Free sugars and added sugars are the same	12.6%	49.0%	38.4%

Note: Most frequent result is bolded.

* Results not reported in EFSA (2022). Analysis undertaken by FSANZ on survey data available at <https://zenodo.org/record/6323326>. For analysis details see Appendix 2.

Two statements asked whether participants perceived that 'added sugars are all artificial' and that 'added sugars can be from natural sources'. FSANZ's analysis of the survey data showed that there was variability in how consumers perceived added sugars in terms of being from natural sources vs. being artificial. Half (49.6%) of participants disagreed that added sugars are all artificial, with 26.1% choosing don't know and 24.3% agreeing, while two thirds of participants agreed that added sugars can be from natural sources (64.2%), although more than one-fifth (22.8%) reported being unsure.

Two statements investigated consumer perceptions of whether added sugars are added during manufacturing and food preparation. 62.7% of participants agreed that 'added sugars are added during food preparation', and 71.4% agreed that 'added sugars are added during manufacturing'. Few people disagreed with these statements (14.3% and 6.9% respectively), but there was still a sizable group who were unsure (23.0% and 21.6% respectively).

Two statements considered consumer perceptions around added sugars and sweetness. 66.4% of participants agreed that 'added sugars can be found in savory foods', while a similar proportion (64.1%) disagreed that 'added sugars are only added to sweet foods'. This suggests that the majority of consumers understand that added sugars do not necessarily correspond with the sweetness of a product. However, as in other questions, there was still a reasonable proportion of consumers who were unsure (23.8% and 20.2% respectively).

Several statements investigated whether consumers perceived a difference between sugar and added sugar. 69.8% of participants disagreed that 'a product with no added sugars contains no sugar', with 16.9% unsure, suggesting that the majority of consumers understand that sugar can still exist in products with no added sugar. However, just over half of participants (54.7%) disagreed with the statement that 'sugars and added sugars are the same', with 26.4% unsure, and 18.9% agreeing with the statement. It is unclear whether

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consumers interpreted this statement to mean a chemical, semantic or definitional difference between sugar types, which may have contributed to the greater level of uncertainty.

When considering the difference between sugars and free sugars, consumers demonstrated uncertainty. A slim majority (54.4%) disagreed that 'a product with free sugars contains no sugar', with 34.3% reporting they did not know. Finally, when considering whether 'free sugars and added sugars are the same', around half (49.0%) disagreed, with 38.4% unsure. The greater level of uncertainty may reflect consumers' reported lower level of understanding of the term free sugars, and/or general confusion about whether sugars, free sugars and added sugars refer to the same concepts.

Two further studies demonstrate that participants generally understand that products with 'no added sugars' claims can still contain sugar (FSANZ 2006; Gorton et al. 2010).

In an Australian (n = 506) and New Zealand (n = 501) online experiment (FSANZ 2006), participants were asked to assess the sugar level of six products with 'no added sugar' claims, either with or without a 'contains natural sugar' disclaimer. According to the study, all six of the products (vegetable juice, yoghurt, fruit and nut bar, muesli, apple juice, and canned peaches in fruit juice) contained some level of 'natural sugar' but no 'added sugar'. The study did not define these terms. However, analysis of the ingredient lists of the mock products used suggests that the study equated 'natural sugar' with lactose from milk and sugar from fruit sources. Participants were shown the front label of each product and asked to assess the level of sugar (high, medium, low, or none) in the product. They could click to access the back label of the product, which displayed a NIP and ingredient list. In the absence of the disclaimer ('contains natural sugar'), between 17% and 29% of respondents incorrectly believed the various food items with a 'no added sugar' claim did not contain any sugar. This was despite their ability to view total sugar information on the back of pack. If the disclaimer was present, participants were significantly less likely to report that the six products contained no sugar (range 8-14%, $p < 0.05$ for all products). These results suggest that while a majority of participants were aware that products with 'no added sugar' claims can contain sugar, a sizeable minority did not understand this distinction. It is not clear from this study whether the misinterpretation made by some consumers would persist if 0g added sugars was presented next to total sugar information in the NIP.

A New Zealand study (Gorton et al. 2010) sought to quantitatively assess how consumers interpreted nutrition claims on food packaging. 1,525 New Zealand shoppers from 25 Auckland supermarkets were presented with a mock cereal product with nutrition content claims on the package, one of which was 'no added sugar'. Seventy two percent of shoppers correctly identified that sugar may still be present in a product with a 'no added sugar' claim. However, 27% incorrectly believed that the claim meant the food could not contain any sugar. Sixty one percent of respondents were able to correctly identify that the claim of 'no added sugar' does not mean the cereal is definitely a healthy food. While these results suggest that most consumers understand that a product with 'no added sugar' may still contain sugar, as in FSANZ (2006) and EFSA (2022), a reasonable segment of the sample did not understand this.

Conclusion – Section 1.3

Overall, the studies in Section 1.3 suggest that most consumers perceive that 'added sugars' are added during manufacturing or food preparation and can be found in both savoury and sweet foods. The majority of consumers also understood that products with 'no added sugar' can still contain sugar. However, between 17% and 30% of respondents either interpreted 'no added sugar' to mean the product had no sugar, or were unsure. It is not clear from these

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studies whether this effect would persist if added sugars information was presented alongside total sugar in the NIP. Results were inconsistent around whether consumers understand added sugars to be natural or artificial, and there is greater uncertainty around the term 'free sugar'.

1.4 Qualitative Understanding

Five studies asked participants to explain their understanding of sugar terminologies in their own words. These studies explored perceptions of 'sugars', 'added sugars', and 'no added sugar' and sought interpretations of the WHO 'free sugars' guidelines. One study was from the US, one from Portugal, two from Brazil and one from the United Kingdom. No research was found from Australia or New Zealand. In addition to being international, three of the five studies were undertaken with undergraduate students, and one with females only, which further limits their generalisability to the broader Australian and New Zealand population.

In a survey of 1,156 adults from the US, participants were asked to define the term 'added sugar' in an open-ended question (Khandpur et al. 2020). The study oversampled those with high school or less education (36.6%). 42.1% of responses associated added sugars with being extra, extrinsic, or not naturally occurring. For example, a quote from the study reflecting this theme was "sugary substances added that were not already in the rest of the ingredients" (Khandpur et al. 2020, p. 204). The extra ingredients were sometimes described as synthetic additives, artificial, fake, or unnatural sugars (11.6%), or as syrups (10.9%), table sugar or refined sugar (8.6%). Examples of such responses include, "artificial sugars and sweeteners added to a product", "fructose corn syrup and sugars that are not naturally in the products", and "white sugar poured inside" (Khandpur et al. 2020, p. 204). A small number of responses referred to honey or juice (3.2%), but these products were generally not considered added sugar, for example, "added sugars takes into account essentially table sugar added to a product, it does not take into account added products like fruit juice or honey" (Khandpur et al. 2020, p. 204). These results highlight that consumers may be uncertain around the distinction between sugars perceived to be 'natural' (such as honey or sugars from fruit), and sugars that are inherent or naturally occurring in a food. A small number of responses (1.0%) included low or no-calorie sweeteners in their definition, for example, "probably sweeteners like aspartame or sucralose." Some responses also referred to the time at which the ingredient was added, including during processing, production, manufacture or packaging (4.8%), or who added the ingredient (5.0%). For example, "sugar added to sweeten the product during the manufacturing process" and "manufacturer put more sugar into the product" (Khandpur et al. 2020, p. 204). Some responses referred to the reason why the ingredient was added, commonly to enhance flavour, improve taste or sweeten (18.8%), or less commonly, to preserve or improve shelf life (0.9%). Very few participants (1.1%) defined added sugars as an excess of sugar, for example "a great amount of sugar added to the product" (Khandpur et al. 2020, p. 204).

Another US study (Laquatra et al. 2015) used in-depth interviews to examine how consumers interpreted 'added sugars' on the then proposed US Nutrition Facts Label (NFL). This presentation included a line indented under carbohydrates for 'sugars', with another further indented line under 'sugars' for 'added sugars'. Interviewees were 27 adults from Los Angeles, Baltimore and Atlanta. When asked about their understanding of the 'added sugar' line in the NFL, participants interpreted it in a variety of ways, including that added sugars was in addition to the gram amount shown in the sugars line, or that added sugars meant that the manufacturer had added more sugar to the product. Regarding the latter interpretation, it is not clear whether participants meant a product with added sugars listed had more sugar added by the manufacturer than a product without added sugars listed, or whether the participants understood that added sugars was the component of total sugar

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added by the manufacturer. Participants also raised that the addition of the added sugars line made the product less desirable.

A series of five focus groups with a total of 40 Portuguese undergraduate students aimed to explore attitudes, knowledge and perceptions about sugar intake (Prada et al. 2021a). Participants were primarily female (77%) and the majority did not identify as the main food shopper in their household (75%). One of the five main themes that emerged from the discussions related to students' knowledge regarding sugar sources, including knowledge about the different types of sugar and the distinction between added and naturally occurring sugars. The study found that few participants distinguished between sugars naturally present in food and those added by the manufacturer, cook or consumer, and no participants referred to the latter as 'added sugars'. Instead, they appeared to categorise sugars as either 'good' (e.g. sugars naturally present in fruits or sugars perceived as less processed, such as brown sugar) or 'bad' (e.g. the 'processed' sugars that are added by industry, or by those preparing or eating sugary food and drinks). After they had been presented with a definition of added sugars (exact wording not disclosed in the study), participants agreed that most products available today include added sugars but that this information tends to be concealed, and that even when it is presented on nutrition labels, it is hard to understand. One of the reasons for this raised by participants was that there are many different types of sugar. When looking at ingredient lists to identify sugar, students reported focusing on sucrose, fructose, lactose and maltose. Students had difficulty identifying 'hidden sources of sugar', namely those in foods perceived as 'savoury' or 'healthy'.

Another theme emerging from the focus groups was the motives and strategies used to reduce sugar intake (Prada et al. 2021a). In addition to reducing intake of packaged foods, students identified strategies such as cooking at home and reducing the amount of sugar they added to foods and beverages, or substituting sugar with natural sweeteners, such as honey when baking. Drinking coffee was perceived as a main source of added/free sugars, with many mentioning that avoiding adding sugar to coffee or tea was both an opportunity for and a barrier to reducing added sugars intake. These results suggest that some people view added sugars to be those added by cooks or the end consumer. It also suggests that natural sweeteners such as honey are often perceived to be healthier.

In regard to free sugars, none of the participants in Prada et al. (2021a) were able to identify the daily limit of free sugar identified by the WHO. After presenting the WHO free sugar intake guidelines (exact wording not disclosed in the study), many participants thought that the guidelines only referred to the sugar that is added by the consumer (most often "table sugar"). Some participants thought that the guidelines were actually the recommended dietary allowance for sugar.

In a series of five focus groups with a total of 32 Brazilian university students, Santana et al. (2022) sought to investigate knowledge and perceptions around sugar and added sugars concepts. Students studying nutrition, and those who reported not paying attention to food labels were screened out. In general, students associated the term 'sugars' mainly with sensory characteristics, such as sweetness and tastiness, and their role as energy sources. As in Prada et al. (2021a), many students did not know how to distinguish 'natural sugars' from those added to foods, and had difficulty conceptualising different types of sugars. While some participants distinguished sugars from a chemical point of view, others referred to differences between natural sugars and those present in packaged foods. Also reflecting Prada et al. (2021a), students showed interest in reducing their sugar consumption through reducing sugar added to homemade foods, suggesting they may see this as a key source of added sugar. Participants associated the concept of sugars with carbohydrates, with some students believing that all carbohydrates were sugars. This may be because, until October

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2022, Brazilian nutrition labels were only required to declare carbohydrates and not total or added sugars.

In another series of five focus groups with 32 Brazilian university students (Scapin et al. 2022), most participants reported having never heard of the term 'added sugars', and were confused when both added sugars and total sugar were presented on nutrition labels. Many also demonstrated confusion about the difference between total sugars and carbohydrates. As above, this may be due to previous labelling practices in Brazil. This study also excluded nutrition students and those who reported not paying attention to food labels.

In a qualitative component of a mixed methods study investigating sugar related claims, Patterson et al. (2012) conducted four focus groups, each with 9-10 female main household shoppers from the United Kingdom (total number of participants not provided). Two groups had younger participants (20-45 years) and two groups had older participants (46 years +). Participants associated sugar with sweetness, energy, nice taste, fattening, dental health, hyperactivity (younger age groups only) and diabetes (older aged groups only). Participants expressed views that white sugar is refined and bad for you and that brown sugar is more natural and healthier for you. It was believed that sugar is ok if consumed in moderation, including sugar from fruit, as it gets converted to fat if eaten in excess. When presented with a reduced sugars claim, participants recalled seeing them and were generally positive about them. However they expressed some negativity around expected taste, for example "I really don't like the taste, I'd rather have less of something I enjoy" (Patterson et al. 2012, p.123). When presented with a 'no added sugars' claim, participants assumed that added sugars related to sucrose, rather than total sugars. All participants expected there to be some form of sugars in a product labelled 'no added sugars', and all expected artificial sweeteners to have been added. 'No added sugar' was generally perceived more positively by participants than reduced sugar claims, as not adding sugar was considered more natural than taking something out.

Conclusion – Section 1.4

Overall, these studies highlight that, when considering sugar, consumers do not necessarily make the distinction between total sugars and added/free sugars, and some were confused by the difference. Instead, consumers tended to employ a different interpretive frame, wherein sugars viewed as natural were perceived as good, while those more processed were perceived as bad. When asked specifically about added sugar, the main association was that it was an extra, extrinsic and not naturally occurring sugar added by the manufacturer, cook or consumer. Sugar was commonly identified as being added for the purpose of improving flavour. When asked about the WHO free sugar guidelines, many consumers thought it only referred to sugar added by the consumer, while some interpreted it to be the recommended dietary allowance for sugar.

1.5 Sugar Understanding and Food and Beverage Products

Sixteen studies investigated consumer understanding of sugar terminology in relation to different food and beverage products. This included research on whether consumers classify ingredients as added or free sugar, and consumer understanding of the presence of or amount of added or free sugar in different food products. Studies were from Australia (four), the US (five), the United Kingdom (two), Europe (one), Portugal (one), Switzerland (one), Saudi Arabia (one), and Brazil (one). A significant proportion of this research investigated consumer perception of sugars in non-alcoholic beverages. No studies were found that investigated consumer understanding of sugars resulting from specific manufacturing processes, such as hydrolysis.

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1.5.1 Sugar ingredients and food products

Twelve studies focused on sugar ingredients and food products. Some of these studies also included beverages.

Two surveys of Australian consumers undertaken by Cancer Council Victoria in 2020 and 2022 asked participants which ingredients they identified as a sugar when added to a product. The first survey (Nuss et al. 2020) was completed by a non-representative sample of 2,062 adults aged between 18 and 64 years. The majority of the sample had at least some tertiary education (73.7%) and were the main grocery buyer (89.3%). The second survey was completed by a sample of 2,332 adults aged 16-65 years, that were nationally representative by gender, age and State and Territory (Morley & Ilchenko 2022). When listed from most to least frequently categorised as a sugar (see Table 2), a similar order of ingredients was obtained across years, with cane sugar, golden syrup, and sucrose being the most likely to be identified as sugar, while nuts, oats and milk were infrequently perceived as a sugar. However, in 2022, fewer people categorised ingredients as sugars across the board, except for nuts. This difference may be due to the larger, more representative sample used in the 2022 survey. The greatest variation between the two surveys was seen in fruit products, including dried fruit, fresh fruit, fruit paste and fruit purees.

Table 2 - Australian categorisation of ingredients as a sugar when added to a product.

Ingredient	% of respondents identifying ingredient as a sugar when added to a product	
	Nuss et al. 2020 (n=2,062)	Morley & Ilchenko 2022 (n=2,254)
Cane Sugar	88.2%	79.5%
Golden Syrup	81.0%	75.9%
Sucrose	76.0%	67.8%
Fructose	74.7%	65.5%
Fruit Juice Concentrate	71.7%	63.5%
Honey	70.2%	60.9%
Coconut Sugar	68.3%	59.3%
Fruit Juice	65.1%	57.2%
Rice Syrup	57.5%	48.5%
Fruit Paste	55.1%	42.1%
Fruit Puree	55.0%	44.9%
Maltose	51.8%	44.0%
Dried Fruit	50.3%	36.5%
Fresh Fruit	40.8%	29.4%
Milk	10.7%	9.4%
Oats	4.5%	3.8%
Nuts	2.8%	3.7%

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In a 2015 study of 6,480 adults undertaken by the US Food and Drug Administration (FDA)(FDA 2015b), participants were shown a list of 14 ingredients, seven of which were considered by the authors to be types of added sugars (e.g. honey, corn syrup, brown sugar), and seven of which were not (e.g. strawberries, salt, milk). Participants were asked to indicate which ingredients they would consider to be added sugars, with the sum of incorrect answers subtracted from the sum of correct answers to obtain a total score ranging from minus seven to seven. Participants had a good level of understanding overall, with a median score of five. Thirteen percent had a score of one or less, 28% had a score between two and four and 59% had a score of five or more. While the full list of ingredients presented to participants was not published by the authors, this study suggests that consumers are generally accurate at distinguishing sources of added sugars from non-added sugar ingredients.

However, several studies highlight that consumers are less accurate when asked to identify which sugar sources are added sugars, and which products contain added sugars.

The EFSA (2022) online survey of 7,469 adults across the European Union, Norway and Iceland presented respondents with a series of statements about whether specific products should be considered added sugars and/or sources of free sugars (see Table 3). FSA NZ's analysis of the survey data found that the majority of participants agreed that fructose (68.0%) and honey (71.5%) 'can be used as added sugar'. However, when asked what is 'a source of free sugars', only 53.2% agreed that honey is a source of free sugars, with 36.3% unsure. Similarly, the majority were unsure whether 'syrup is a source of free sugars' (41.5%) compared to 37.3% who agreed and 21.3% who disagreed. These results may reflect a reduced confidence in understanding the definition of free sugars, but may also reflect the slight difference in language between the added sugars (honey can be used as an added sugar) vs free sugar statements (honey is a source of free sugars), where the latter asks the respondent to consider a more abstract concept. The study did not identify which answer was considered correct and did not explore why participants responded in particular ways.

Table 3 - European consumer agreement with sugar terminology statements (n=7,469) (EFSA, 2022*)

Statement	True	False	Don't know
Fruit contains sugars	90.1%	4.5%	5.5%
Fructose can be used as added sugar	68.0%	8.6%	23.5%
Honey can be used as an added sugar	71.5%	9.5%	19.0%
Honey is a source of free sugars	53.2%	10.5%	36.3%
Syrup is a source of free sugars	37.3%	21.3%	41.5%
100% fruit juice contains free sugars	53.3%	12.9%	33.8%

Note: Most frequent result is bolded.

* Results not reported in EFSA (2022). Analysis undertaken by FSA NZ on survey data available at <https://zenodo.org/record/6323326>. For analysis details see Appendix 2.

The EFSA (2022) study also asked participants to indicate whether a list of 17 products contained added sugars (not defined), based on their general knowledge (see Figure 1). The study did not identify the correct answer. FSA NZ's analysis of the survey data found that a

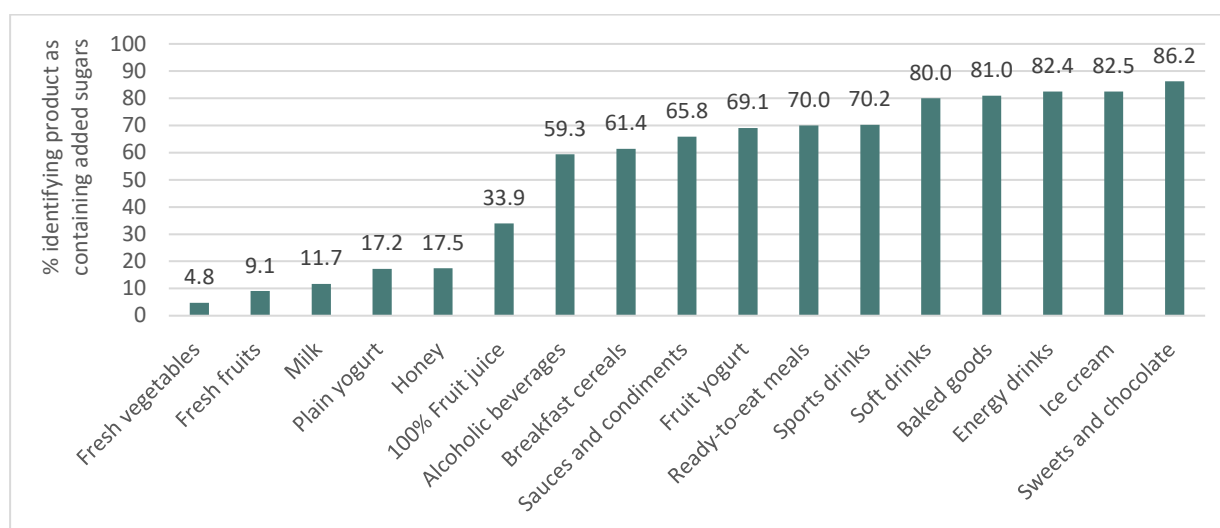
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substantial majority indicated that products like ice cream (82.5%) and sweets and chocolate (86.2%) contained added sugar, while a minority believed fresh vegetables (4.8%) and fresh fruits (9.1%) contained added sugar. However, there were some areas with apparent uncertainty, indicated by a mixture of views around added sugars content. These included breakfast cereals (61.4% of the sample indicated that they contained added sugar), fruit yogurt (69.1%), sauces and condiments (65.8%), sports drinks (70.2%) and alcoholic beverages (59.3%). As participants were relying on their general knowledge, this may reflect that these products typically have more variation in whether and how much added sugar is included.

Approximately one third (33.9%) of consumers thought that 100% fruit juice contained added sugars (see Figure 1). This is lower than the 53.3% of participants that thought 100% fruit juice contained free sugars (see Table 3). This may reflect a general level of confusion around sugar sources in 100% fruit juice, or some level of understanding of the WHO definition of free sugar², which includes fruit juices.

17.5% of participants thought that honey contained added sugars (see Figure 1). This relatively low proportion contrasts with other results from the study, where 71.5% agreed that honey can be used as an added sugar, and 53.2% agreed that honey was a source of free sugars (see Table 2). This aligns with Australian results (Morley & Ilchenko 2022; Nuss et al. 2020), where over 60% classified honey as a sugar when added to a product, and suggests that consumers may generally understand that honey does not include extrinsic sugars, but could be considered added sugars when included in other products.

Figure 1 – Proportion of European sample identifying product as containing added sugars (n=7,469) (EFSA, 2022*)



* Results not reported in EFSA report. Analysis undertaken by FSANZ on survey data available at <https://zenodo.org/record/6323326>. For analysis details see Appendix 2.

In an online survey (Tierney et al. 2017), a convenience sample of 445 adults from the United Kingdom were asked how they would classify 13 commonly used ingredients if they were included in the ingredient list of a pre-packaged food. Choice options included 'natural sugar', 'added/free sugar', 'artificial sweetener' or 'don't know', with only one choice allowed per ingredient. 'Added/free sugar' was defined for participants as 'sugars that are added to

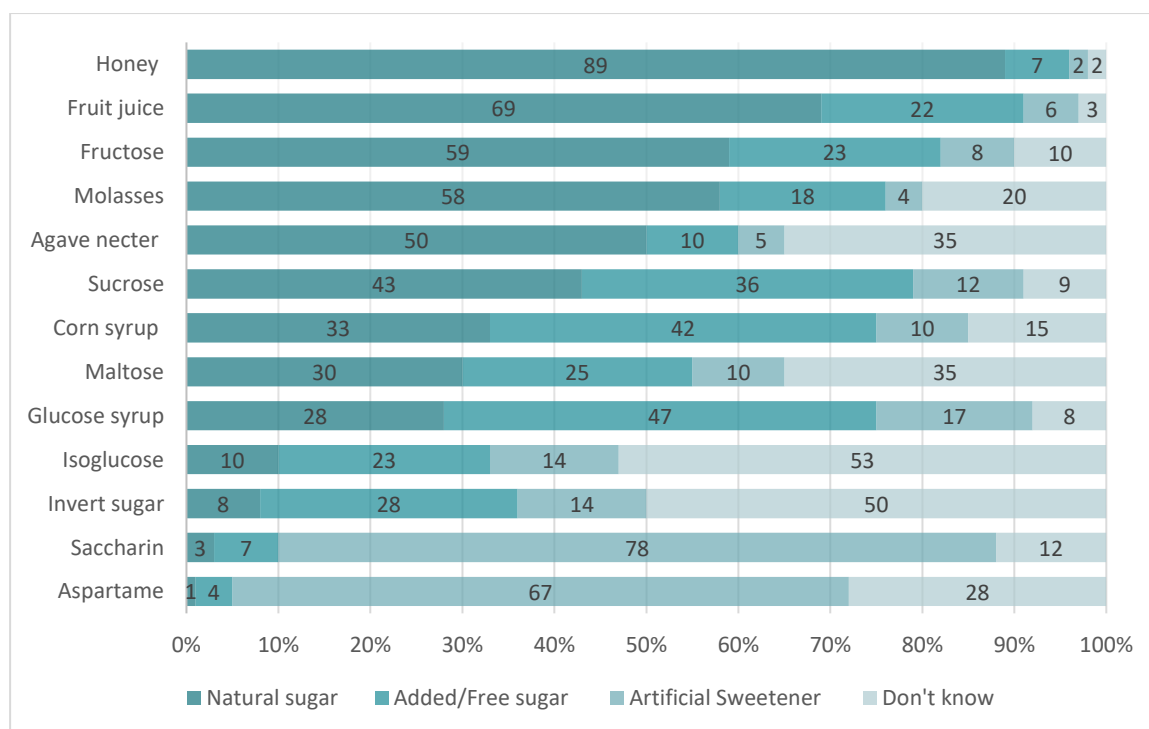
² The WHO define 'free sugar' as all monosaccharides and disaccharides added to foods by the manufacturer, cook or consumer, plus the sugars that are naturally present in honey, syrups and fruit juices.

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foods during manufacturing or cooking’. Other choices were not defined. Honey was most frequently categorised as a natural sugar (89%), followed by fruit juice (69%) (see Figure 2). Fructose and molasses were also categorised as natural by over 50% of participants. Glucose syrup and corn syrup were most commonly categorised as added/free sugars. The study considered that the common ‘misclassification’ of ingredients such as honey and fruit juice as natural when they are actually added to a pre-packaged product may be due to the layman understanding of natural as being “associated with those sugars which are normal ingredients of non-processed foods” (Tierney et al. 2014, p. 9). It may also suggest that consumers still perceive sugars from sources such as honey or fruit juice as being natural, even when they are added to another food. Being natural and added may not be mutually exclusive for consumers, and when forced to choose the most salient aspect, the fact that it is perceived as natural may be more important than the fact that it is added to another product.

In a separate question, respondents were asked to classify ‘sugars present in milk (lactose)’ and ‘sugars in fresh fruit and vegetables’ as either ‘added/free sugars’ or ‘natural sugars’, or declare that they ‘don’t know’. 97% reported that sugars in fresh fruit and vegetables were natural, with 83% of participants reporting sugars found in milk (lactose) as natural. This indicates that most consumers understand that milk, fruit and vegetables contain naturally occurring sugars rather than extrinsic sugars.

Figure 2 – United Kingdom consumer classification of ingredients added to a pre-packaged food (n=443) (Tierney et al. 2017)



Note: Data estimated from Figure 2 in Tierney et al. (2017)

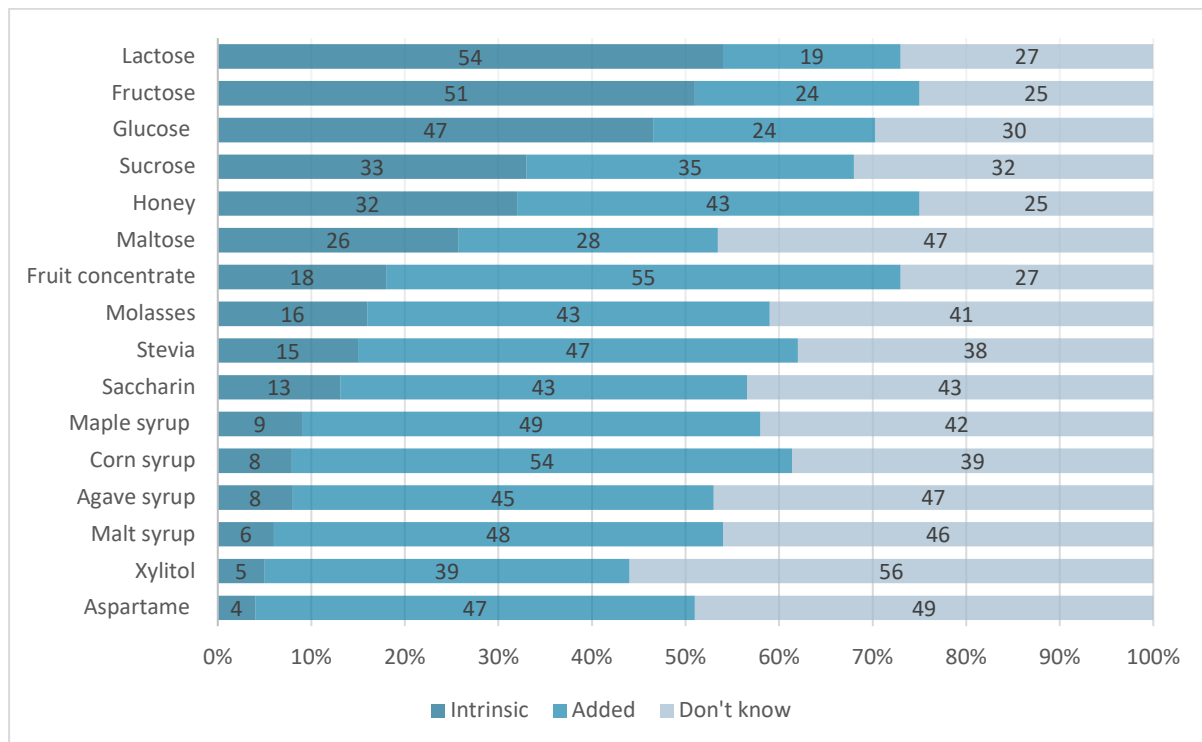
Building on the study by Tierney et al. (2017), an online survey of a convenience sample of 1,010 Portuguese adults also investigated how participants classified common ingredients when they were included as an ingredient in another food (Prada et al. 2020). The survey was based on Tierney et al. (2017), but with some adjustments to investigate potential reasons why consumers may have classified ingredients in a particular way. Instead of being asked to classify ingredients as either natural sugar, added/free sugar or artificial sweetener,

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participants were asked to distinguish them by their composition, being either ‘part of the composition of the product’ (intrinsic), or ‘added by the manufacturer’ (added), and by their origin, being either ‘natural’ or ‘artificial’. This aimed to reduce the potential association of something natural also being seen as intrinsic. Participants could also choose ‘don’t know’. Prada et al. (2020) used a different set of ingredients, which were presented in a randomised order rather than a fixed order. The fact that products were ingredients in another food was also emphasised in the instructions.

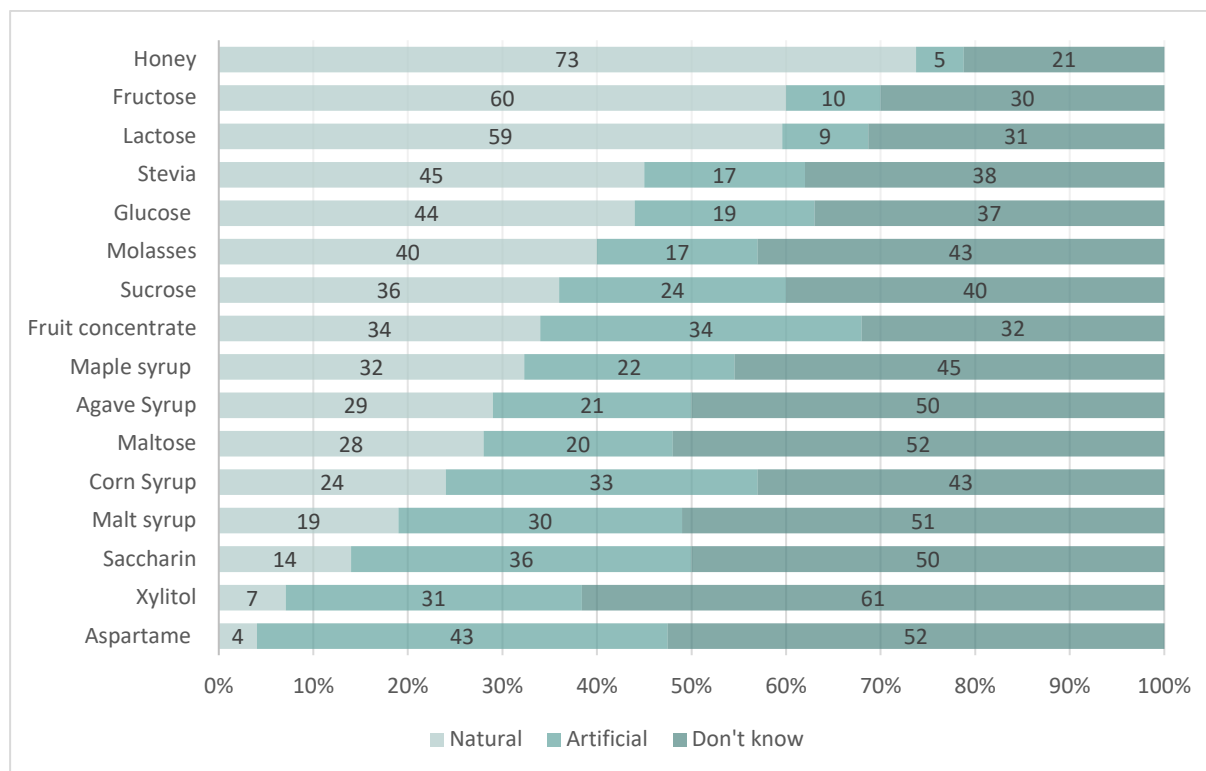
As all ingredients were added to another product (packet of cookies), classifications of ingredients as intrinsic, rather than added, were incorrect. Participant’s overall accuracy when classifying as intrinsic or added was low and highly variable, with a mean of 42.8 out of 100 (95% CI 40.9 - 44.7) and a standard deviation of 30.6 (Prada et al. 2020). The ingredients most commonly misclassified as intrinsic were lactose (54% of sample), fructose (51%) and glucose (47%) (see Figure 3). Honey and sucrose were also misclassified as intrinsic by approximately one third of participants. In contrast, syrups including maple (9%), corn (8%), agave (8%) and malt (6%), and were infrequently misclassified as intrinsic, but had a very high proportion of people responding that they did not know (ranging from 46% for malt syrup, to 39% for corn syrup). In fact, a large proportion of participants were unable to classify ingredients as intrinsic or added across the board, with ‘don’t know’ responses ranging from 56% for xylitol, to 25% for fructose and honey.

Figure 3 – Portuguese consumer classification of ingredients added to a pre-packaged food – added or intrinsic (n=1,010) (Prada et al. 2020)



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Figure 4 – Portuguese consumer classification of ingredients added to a pre-packaged food – natural or artificial (n=1,010) (Prada et al. 2020)



When asked to classify ingredients by origin (natural vs artificial) accuracy was even lower and remained variable, with a mean score of 36.9 out of 100 (95% CI 38.2 – 41.5) and a large standard deviation of 26.2 (see Figure 4). The range of participants reporting that they did not know also remained high when classifying as natural or artificial, ranging from 61% for xylitol to 21% for honey. Of the listed products, only saccharine and aspartame were considered artificial by the authors. Honey was most commonly classified as natural (73%), followed by fructose (60%) and lactose (59%). Only 32% of participants classified maple syrup as natural. Aspartame was most commonly classified as artificial (43%), followed by saccharin (36%), fruit concentrate (34%) and corn syrup (33%). The high proportion of participants classifying fruit concentrate and corn syrup as artificial suggests that the association between naturalness and fruit and vegetable products may not always be present. The uncertainty may also demonstrate that there are multiple possible interpretations of 'natural' and 'artificial'.

The results from these classification tasks (Tierney et al. 2017; Prada et al. 2020) suggest if consumers perceive an ingredient as natural, they may also perceive it to be intrinsic or naturally occurring within a product. Items that were commonly thought to be natural such as lactose, fructose and glucose were also commonly mis-classified as intrinsic. However, for honey, which was most commonly perceived to be natural and had the lowest levels of uncertainty, 43% of participants understood that when added to another product, honey is an added sugar and not intrinsic. This may be due to consumers having greater familiarity with the ability to add honey to products, as they can easily do this in their own food preparation, relative to ingredients like lactose.

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In a quantitative survey of 367 adults from the United Kingdom, Patterson et al. (2012) asked participants which ingredients from a list³ they would expect to see in the ingredient list of products with 'no added sugars' or 'reduced sugars' claims. Participants were primarily female (84%) and were the main household shopper. The study found that respondents were almost four times more likely to expect products with a reduced sugars claim to contain sugars compared with products with a no added sugars claim. Products with reduced sugars claims were expected to contain marginally more sweeteners, saccharin, aspartame, xylitol, gum, stevia and fillers than products with a no added sugars claim. Respondents were almost equally likely to expect fruit sugar or honey to be present in products with no added sugars and reduced sugar claims. However, participants were more than twice as likely to expect products with no added sugars to contain none of the ingredients listed. As the study only reported relativities and not exact proportions it is challenging to draw conclusions from the results. However, they do suggest that consumers are less likely to think sugars are present in foods with 'no added sugar' claims, compared to foods with 'reduced sugar' claims.

In a telephone survey of 424 mothers from Saudi Arabia with children aged between six and 12 years old, Mumena (2021) sought to evaluate maternal knowledge and attitudes towards free sugars. Participant knowledge of 'free sugars' was assessed using 11 yes/no questions, with correct answers aggregated to provide an overall knowledge score. While the median free sugar knowledge score was above the midpoint at seven out of 11 (95% CI 6-8), participant's responses to individual items revealed some confusion in their understanding of free sugars. In the first question, 98.8% of participants agreed that eating too much free sugar is bad for your health. Participants were then asked to identify what was free sugar from a list of options. A majority of mothers (65.3%) incorrectly thought that sugar added to coffee or tea was not free sugar. However, 71.2% correctly thought that sugar added to food during processing or cooking was free sugar. Participants were almost evenly split on whether sugar used to prepare sweets was free sugar, with 54.2% incorrectly responding that it was not. Most participants (93.2%) correctly thought that sugar existing in fruit and milk was not free sugar. For the remaining six questions, participants were asked which of a list of foods contained large amounts of free sugars. The majority of participants correctly identified that cookies (81.1%) and fruit drinks (86.6%) contained high levels of free sugar, while plain milk (96.2%) and toast and bread buns (59.4%) did not. However, many mothers (59.9%) incorrectly believed diet Pepsi contained large amounts of free sugar, and 81.6% incorrectly believed that strawberry flavoured Greek yogurt did not contain large amounts of free sugar. These findings suggest that consumers may have difficulty determining the level of free sugar in some products. However, it may also reflect that added sugar content varies in some food categories more than others (such as strawberry yoghurt). It also reiterates findings from Section 1.3 and 1.4, that consumers perceive free sugar to be added during processing or cooking.

Several studies have also identified that contextual factors may influence the way sugars are perceived in foods (Colles et al. 2014; Timperio et al. 2003; Sütterlin & Siegrist 2015; Santana et al. 2022).

Qualitative Australian research by Colles et al. (2014), which analysed 30 interviews with Aboriginal people in the Northern Territory, found that traditionally gathered honey from wild bees was considered good for an individual's health. Conversely, sugary foods purchased from stores were viewed as having a negative impact on health. This suggests that

³ Ingredients listed included: 'sweeteners', 'saccharin', 'aspartame', 'fruit sugar', 'honey', 'xylitol', 'sugar', 'gum', 'stevia', 'fillers', or 'none of these'.

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contextual factors of naturalness and linkages with traditional cultural practice vs European manufacturing practices may play an important role in how Aboriginal Australians understand sugar.

In a study of 709 Australian adults that included focus groups (n=62) and a survey (n=681), Timperio et al. (2003) found that high sugar content contributed to a food being considered fattening. However, some participants in the focus groups indicated that they believed sugars found in fruit were not as fattening, because they can be “burned quickly” (Timperio et al. 2003, pg. 233). This suggests that consumer evaluations of the effects of sugar may in part be influenced by the food type containing the sugar, with sugar from fruit seen to be healthier.

This association between sugar from fruit and health is also seen internationally. A series of four experiments conducted with Swiss consumers examined perceptions of ‘fruit sugar’ compared to ‘sugar’ (Sütterlin & Siegrist 2015). The experiments, with sample sizes ranging from 162 to 251 participants, consistently found that when participants were presented with either ‘sugar’ or ‘fruit sugar’ as an ingredient, those who were exposed to ‘fruit sugar’ perceived it as healthier than ‘sugar’. This may be due to a health halo elicited by the broader health benefits of fruit consumption. This effect was not influenced by the prominence of the sugar information (e.g. whether fruit sugar was presented as a claim on the front of pack or in a nutrition panel), or the health consciousness of the participants.

Similarly, in focus groups exploring sugar and added sugars concepts with 32 Brazilian university students (Santana et al. 2022), participants in all focus groups raised the different types of sugars found in foods. Participants considered ‘fruit sugar’ to be “the best type of sugar”, and deemed honey to be “as natural as fruit sugar” (Santana et al. 2022, pg. 3). Participants also thought that sugar types differed in nutritional quality, with brown sugar reported to be more nutritional than refined sugar.

Conclusion – Section 1.5.1

Overall, the studies in Section 1.5.1 indicate that while consumers tend to differentiate sources of added sugars from non-added sugar ingredients, they have varying perceptions of whether sugars from different sources are natural or artificial, added or inherent. A key driver of this variability appears to be the association between perceiving a sugar ingredient as natural and perceiving it as an intrinsic source of sugar, even when it is added to another product. Items that were commonly seen as natural were also commonly perceived as intrinsic. However, for products such as honey, which is often used by consumers as a natural sweetener, this perception was reduced. This finding reflects findings from Section 1.4, where some consumers perceived added sugars to be ‘artificial’. The uncertainty may also demonstrate that there are multiple possible interpretations of ‘natural’ and ‘artificial’.

When identifying whether food products contained added sugar, a majority understood that products like ice cream and chocolate contain added sugar, while fresh fruit and vegetables do not. There was greater uncertainty around products like ready to eat meals, fruit yogurt, breakfast cereals and sauces and condiments, likely reflecting greater variation in the presence or amount of added sugars in those products. This suggests that the value of added sugars information may differ by product type. Contextual information, such as whether the food is related to fruit, is perceived as natural, has relationships with traditional cultural practices, or is a packaged food purchased from a store, also impacts consumers’ perceptions of whether the product is or contains added sugar, and overall healthfulness.

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1.5.2 Sugar ingredients and beverage products

Five studies considered the perception of sugar ingredients in non-alcoholic beverages.

In a survey from the US of 3,361 adults (Rampersaud et al. 2014), participants were asked to indicate what sweeteners were present in different beverage types, out of no sugar, natural sugar, added sugars and artificial sweeteners. These terms were not defined for participants. Respondents were not shown food labels for the beverages and so needed to rely on their own prior knowledge to complete the task.

A majority of respondents appeared to understand that 100% fruit and vegetable juices contribute sugar to the diet, with only between 10% (grape juice) and 19% (vegetable juices) of participants believing they contained no sugar. The proportion that considered 100% juices to contain natural sugars ranged between 54% for vegetable juice and 80% for orange juice. In contrast to other studies (see Table 4 at the end of sub-section 1.5.2), few participants thought that 100% juice contained added sugars (between 7% for vegetable juice and 13% for grape juice). However, consumers perceived that fruit and vegetable juice blends were more likely to have added sugars (33%) and less likely to have natural sugar (49%) than 100% fruit juices.

In comparison to fruit juice, consumers had less of an understanding that milk contributes sugar to the diet, with 35% believing that reduced fat milk contained no sugar, and 39% believing fat free milk contained no sugar. 24% and 23% believed these products respectively contained natural sugars, while only 2% believed they contained added sugar.

While a majority of participants were aware that sugar sweetened drinks such as soft drinks (77%), sports drinks (58%), 5% fruit drinks (62%) and cranberry juice cocktails (50%) are a source of added sugar, this majority was slim in some cases. 26% of respondents believed that diet soft drinks contained added sugar. This suggests that many consumers have difficulty assessing whether added sugar is present across a broad range of drink types, based on general knowledge.

An online survey of 1,614 parents of children aged 1-5 years from the US investigated parental perceptions of ingredients in fruit drinks, flavoured waters, 100% fruit juices and 100% juice/water blends (Jensen et al. 2021). Parents were required to be either solely or jointly responsible for what their children ate, and the majority of respondents were female (78.8%). Participants were asked to identify which of the four drink categories they had served to their child in the past month, before being prompted to indicate the specific brands and products they had served from a list of commonly served beverages. They could also select 'other'. For each category parents reported serving, they were asked whether the specific branded product they served most often included 'added sugars' (yes/no), 'diet sweeteners' (yes/no) and the percentage of juice (sliding scale from 0-100%). These terms were not defined for participants. Accuracy was determined based on actual ingredients in the specific products raised. Participants were not shown product labels, so were working from memory based on the product name. The study did not consider fruit juice to be an added sugar. Only 52.7% of the 1,435 parents serving 100% fruit juices accurately identified that the product did not contain any added sugars (range 41.0% to 74.6% accuracy across six 100% juice products). There was also very low accuracy in identifying the percentage juice in 100% fruit juices (47.0% accurate, range 35.8% to 53.6% across six 100% juice products), despite this fact often being included in the product name, e.g. 'Mott's 100% juice'. Similarly, only 53.9% of the 930 parents serving 100% juice/water blends accurately identified that they did not contain added sugars (range 36.5% - 69.8% across four

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juice/water blend products). 58.0% accurately believed the flavoured waters contained added sugars, whereas knowledge of added sugars in the fruit drinks was much higher, at 79.9%.

Jensen et al. (2021) also asked parents to rate the perceived healthfulness of different beverages on a scale of 1-10, where 10 was the healthiest. 100% fruit juice was rated the third most healthy (mean 7.8 ± 2.3) behind plain water (9.3 ± 1.6) and plain milk (8.1 ± 2.2). This was followed by 100% juice/water blends (6.2 ± 2.4), flavoured waters (5.8 ± 2.7) and fruit drinks (4.3 ± 2.6). Regular soda and diet soda both had the same mean healthfulness rating of 2.2 ± 2.1 . All comparisons were statistically significant ($P < 0.05$). The reason behind parents' perception of 100% juice/water blends as being less healthy than 100% fruit juice is unclear, but may be due to the term 'blend' implying that other things besides 100% juice and water could have been added.

Combining these two findings, Jensen et al. (2021) analysed whether perceptions about added sugars content or percentage juice influenced healthfulness perceptions of fruit drinks and flavoured waters. In both drink categories, those who believed the drink did not contain added sugars rated it as healthier compared with those who knew they contained added sugars (5.9 out of 10 ± 2.8 compared with 4.7 ± 2.3 for fruit drinks [$p < 0.001$], and 6.9 ± 2.5 compared with 6.4 ± 2.3 for flavoured waters [$p = 0.002$]). Caregivers who overestimated the percentage of juice in fruit drinks (81.3%) also rated them as healthier than those who were accurate about juice content (5.3 ± 2.5 compared with 3.5 ± 1.9 , $p < 0.001$). The same result was not seen in flavoured waters, possibly due to the much lower (or lack of) juice content. The healthfulness ratings of fruit drinks and flavoured waters were not significantly associated with believing the beverage contained 'diet sweeteners'.

An online randomised experimental survey of 1,603 parents of one to five year old children from the US aimed to assess parents' ability to identify certain ingredients in children's juices, fruit drinks and flavoured waters (Harris & Pomeranz 2021). The majority of respondents were female (79.4%). Parents were first asked how confident they were in their ability to identify ingredients from five options ranging from 'not at all confident' to 'extremely confident'. Parents expressed the greatest confidence in their ability to identify whether a drink was '100% fruit juice' (44% extremely or very confident, 30% confident), followed by the ability to identify the 'percentage of juice' in a product (36% extremely or very confident, 28% confident). Confidence in identifying 'added sugars' and 'natural ingredients' were both mixed, with an approximately even split across those who were either extremely or very confident, confident, or a little or not at all confident. Parents were least confident in their ability to identify 'diet sweeteners', with only 25% very or extremely confident and a majority (48%) a little or not at all confident. These terms were not defined for participants.

Next, Harris and Pomeranz (2021) randomly assigned parents to a condition where they viewed either the front of pack alone, or the front of pack with a nutrition panel and ingredients list. They were then asked to identify ingredients across eight children's drink products. The study did not consider fruit juice to be an added sugar. When only viewing front of pack information, the majority of participants accurately identified that sugar sweetened drinks contained added sugar, with 81% being accurate over half the time. Across individual products, between 55.2% and 89.9% of participants accurately identified the presence of added sugars in sugar sweetened drinks. However, participants were less accurate in identifying that unsweetened drinks did not have added sugar, with only 40% being accurate more than half the time. Across individual products, just 50.6% to 64.7% of participants accurately identified that no sugar had been added to unsweetened drinks, despite products having 'no added sugar', or 'sweetened only with fruit juice' claims on the front of pack. In the condition viewing front of pack with the nutrition panel and ingredients list, the proportion correctly identifying whether added sugars was present or not more than

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half the time increased to 84% for sugar sweetened drinks, and 47% for unsweetened drinks. However, the difference between front of pack and front of pack plus nutrition panel and ingredient list was only statistically significant for unsweetened drinks ($p < 0.001$). In individual products, the difference between conditions was only statistically significant for one drink type out of eight, and in two cases, accuracy declined in the condition viewing front of pack with the nutrition panel and ingredients list.

Despite approximately three-quarters of the sample reporting that they were confident in their ability to identify drinks with 100% juice, parents struggled to identify the percentage of juice in products (Harris & Pomeranz 2021). Only 51.2% to 62.6% correctly indicated that a 100% juice product contained 100% juice, even though it was stated on the front and back of pack. For the remaining products (not 100% juice), fewer than 8% of participants identified the correct range of percentage juice. This increased to between 33.9% and 62.6% in the front of pack + nutrition information and ingredients condition, which included % juice content on all but one product. Overall, juice content tended to be overestimated. For example, for products that contained 0% to 10% juice, the mean estimate for percentage of juice was 40%. Juice estimates were higher than actuals for all products except 100% juice.

A limitation of Harris & Pomeranz (2021) was that the nutrition panels presented to participants varied between the older style US NFL that included only 'sugars' in grams, and the newer style which has 'total sugars' and 'includes added sugars' in grams, and the percent of the daily value of added sugars to which the product contributes. Thus, in some cases participants had to rely on ingredient lists to identify added sugars, while for others they could rely on the NFL. The impact of these different NFLs was not analysed by the authors. However, it does not appear to have been a key driver of accuracy in identifying the presence of added sugar. For example, in some products with new NFLs, accuracy in identifying added sugars declined in the front of pack plus nutrition panel and ingredient list condition, while in other products, the additional information increased accuracy. These mixed results also occurred for products displaying the old NFL. Overall, Harris and Pomeranz's (2021) results highlight the difficulty consumers have in identifying the presence of added sugars and percentage of juice in children's fruit drinks, juices and flavoured waters, particularly identifying products that do not contain added sugar. These difficulties persist despite clear no added sugars claims, percentage of juice on label, or added sugars information in NFLs.

A nationally representative study of 2,005 U.K adults (Gill & Sattar 2014) assessed the ability of consumers to estimate the sugar content of different beverages with roughly equal amounts of sugar. Participants were shown pictures of an assortment of sugar sweetened beverages, fruit juices and fruit smoothies, and were asked to estimate how many teaspoons of sugar were in each drink. It is unclear from the study whether the images shown were front of pack only, or also included back of pack information such as an ingredients list and nutrition panel. On average, the sugar content of fruit juices and fruit smoothies were underestimated by 48%, while the sugar content of carbonated beverages was overestimated by 12%.

Finally, as outlined in section 1.5.1, in the EFSA (2022) online survey of 7,469 adults across the European Union, Norway and Iceland, approximately one third (33.9%) of consumers thought that 100% fruit juice contained added sugars (see Figure 1). This was lower than the 53.3% of participants that thought 100% fruit juice contained free sugars (see Table 3). Added sugars and free sugars were not defined for participants. This may reflect a general

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level of confusion around sugar sources in 100% fruit juice, or some level of understanding of the WHO definition of free sugar⁴, which includes fruit juices.

Table 4 - Consumer perception of added sugars* in 100% juice

Study	Location	Sample	Question framing	Proportion that think 100% juice contains added sugar
EFSA (2022)	EU Norway Iceland	7,469 Adults, nationally representative 51.3% female	Do you expect to find added sugars in 100% juice? (Yes/No/Don't Know) No product/label shown.	33.9%
Rampersaud et al. (2014)	US	3,361 Adults, not representative 57.2% female	Does 100% juice contain no sugar, added sugars, natural sugars, or non-nutritive sweeteners (Choose all that apply). No product/label shown.	Vegetable 7% Orange 8% Apple 12% Grape 13%
Jensen et al. (2021)	US	1,614 Parents of children aged 1-5 years. 78.8% female	Does the branded 100% juice product (six tested) served most often to children in the last month include added sugars? (Yes/No) Only asked of parents serving 100% juice (n=1,435). No product/label shown.	Average 47.3% Range across six 100% juice products 25.4% - 59.0%
Harris & Pomeranz (2021)	US	1,603 Parents of children aged 1-5 years. 79.4% female	Does one specific branded 100% juice product contain added sugars (Yes/No). Viewing either FOP only, or FOP + nutrition panel and ingredient list. Product contained a no added sugars claim FOP.	FOP only 35.3% FOP + 37.9%

*No study defined added sugars for participants.

Conclusion – Section 1.5.2

While results varied widely, taken together these studies suggest that consumers often have difficulty identifying added sugars content in non-alcoholic beverages (minimum 7% - maximum 59% inaccurate). No studies in this section defined added sugar for participants, which may have contributed to this uncertainty. However, in respect of accuracy, the studies

⁴ The WHO define 'free sugar' as all monosaccharides and disaccharides added to foods by the manufacturer, cook or consumer, plus the sugars that are naturally present in honey, syrups and fruit juices.

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did not consider fruit juice to be added sugars. Product types appeared to influence perceptions of added sugar, with products like soft drinks well known to include added sugar, while others, such as unsweetened drinks, had more uncertainty. For example, the proportion of consumers who thought 100% juice contained added sugars varied from as low as 7% up to 59% (see Table 4). This perception persisted even when product names included '100% juice' and when 'no added sugar' claims were made on the label. Fewer people perceived 100% juice to contain added sugars in a study that simultaneously asked whether a product contained natural sugar. This may suggest that some people were not distinguishing between total and added sugars when asked about only added sugars content.

Jensen et al. (2021) and Harris & Pomeranz (2021) also demonstrate that parents are poor at estimating the percentage of juice in children's drink products, with only between 35.8% and 53.6% able to identify the juice percentage in 100% juices. This was despite labelling on the front and back of pack, or '100% juice' being included in product names. However, for other drinks, consumers tended to over-estimate juice content.

Recognising the presence of added sugars negatively influenced consumer perceptions of how healthy a beverage was. Conversely, overestimating the percentage of juice positively influenced how healthy consumers perceived a product to be, relative to those who were accurate. Consumers also substantially underestimated the sugar content in fruit beverages and smoothies. This suggests that consumers may not fully appreciate the sugar content of fruit related beverages, potentially due to a halo effect elicited by the broader health benefits of fruit consumption.

1.6 Socio-demographics and understanding of sugar terminology

Three studies examined how socio-demographic factors relate to consumer understanding of sugar terminologies. This included research from Europe, Portugal and China.

In an online survey of 7,469 adults across the European Union, Norway and Iceland, participants' level of education impacted their self-rated understanding of sugar terminologies (EFSA 2022). FSANZ's analysis of the survey data found that participants with a secondary school education or lower had a significantly lower level of perceived understanding of 'total dietary sugars' ($p < 0.001$) and 'added sugars' ($p < 0.001$) than those with a university degree or higher education. Level of education was also related to participant's ability to identify the presence of added sugars in some products. For example, there were significant differences in identification of added sugars in lower and higher educated participants, with lower educated participants less likely to identify added sugars in ready to eat meals, fruit yogurt, breakfast cereals, sauces and condiments, soft drinks, energy drinks, sports drinks and alcoholic beverages (all $p < 0.001$). There was no significant difference in perceived understanding of 'free sugar' by level of education ($p = 0.019$).

In a 2020 online survey of 1,010 Portuguese adults, Prada et al. (2020) investigated whether sociodemographic factors such as gender, the number of children in the household, and level of education were associated with participants' understanding of sugars. They found that women had higher accuracy than men when categorising sugar ingredients by both composition (added vs intrinsic) ($p < 0.001$), and origin (natural vs artificial) ($p = 0.004$). Women also reported finding it easier to comprehend the WHO definition⁵ of free sugars than

⁵ The WHO definition presented was an official Portuguese definition, based on the WHO definition. Exact wording not provided in the study.

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men ($p = 0.013$). However, there was no significant difference between men and women in self-reported ability to determine free sugars in products. Prada et al. (2020) also found that participants with children were more accurate at identifying the composition (added vs intrinsic) of ingredients ($p = 0.023$). However, there was no significant difference in ability to identify whether the ingredient was natural vs artificial. Finally, participants with a higher level of education were more accurate than those with lower levels of education when categorising sugar ingredients by composition and origin ($p < 0.001$). Participants with higher education also reported finding it easier to comprehend the WHO definition of free sugars ($p = 0.013$), but no significant differences were found for the self-reported ease of identification of free sugars in products. It is noted that the sample in Prada et al. (2020) was predominantly female (76.6%), and had a higher level of education than the general Portuguese population.

Prada et al. (2020) also conducted a hierarchical regression to determine how much of the variance in ability to accurately classify sugar ingredients (by both composition and origin) was explained by various factors. The final model incorporated age, gender, children in the household, education, frequency of sugar consumption, frequency of using sugar nutritional information, perceived importance of sugar nutritional information for maintaining health, self-reported food literacy, self-reported knowledge of WHO free sugar guidelines, self-reported comprehension of the WHO free sugar definition and self-reported ability to identify free sugars in food products. Of these factors, the presence of children in the household ($p = 0.005$), higher levels of education ($p < 0.001$), greater frequency of using sugar nutritional information ($p < 0.001$), greater ease of WHO free sugar definition comprehension and ability to identify free sugars in products ($p = 0.002$), greater perceived importance of sugar nutritional information for maintaining health ($p = 0.044$) and higher self-reported food literacy ($p = 0.042$) were significantly associated with sugar categorisation accuracy. Gender differences that were significant in earlier models became non-significant ($p = 0.320$) in the final model where elements relating to sugar knowledge were incorporated. This suggests that differences between men and women may be driven by difference in their sugar knowledge. Overall, the model accounted for 17% of the variance in sugar categorisation accuracy, suggesting that factors not incorporated into the model may have more of an impact on consumers' ability to categorise sugar.

In a Chinese survey of 1,136 caregivers of adolescents from Changsha, Hunan Province, self-reported understanding of 'free sugar' differed depending on the parents' gender, parents' level of education and their child's gender (all $p < 0.05$) (Tang et al. 2020). Women (compared to men), higher educated parents (compared to lower educated parents), and parents of female children (compared to male children) reported higher levels of free sugar understanding. Non-significant associations were not reported. The authors suggested that women may have a better understanding due to their greater role in the family's food choices. Similarly, they suggested that parents of female children, especially mothers of female children, may be more likely to pay attention to sugar intake, due to a current sociocultural focus on female appearance in China.

Conclusion – Section 1.6

Overall, level of education appears to be consistently related to both perceived and objective measures of consumer understanding of sugar terminologies, particularly in certain product types. Differences in understanding between women and men may reflect broader differences in nutritional literacy and sugar knowledge. The presence of children in the household and the gender of those children may also impact understanding of sugar terminologies, as parents may pay closer attention to sugar information to manage their children's intake.

Research Question 2: Does the presence of ‘added sugars’ information in addition to ‘sugars’ or ‘total sugar’ information in the NIP or international equivalents confuse consumers?

Research Question 2 sought to understand whether the addition of ‘added sugars’ information to the NIP has the potential to confuse consumers or create unintended consequences.

Twenty-one studies contributed evidence towards this question. This included research from Australia (three), the US (15), Brazil (one), Canada (one) and Portugal (one).

This section first explores consumer perceptions of whether the addition of ‘added sugars’ information to nutrition panels would be helpful or confusing. Following this, several potential areas of confusion highlighted in the literature are explored, alongside possible labelling presentations that may reduce confusion.

2.1 Summary – Research Question 2

- Consumers generally report that added sugars information in nutrition panels is helpful, and not more difficult to understand than sugars information alone. However, Brazilian university students reported finding the distinction between total and added sugars to be confusing when viewing NIP presentations. These findings reflect consumers’ perceptions, which may not necessarily correspond to their actual ability to use the information.
- Providing added sugars information in NIP international equivalents improves consumers’ ability to identify added sugars content, and select products on that basis.
- However, several studies found that consumers may overestimate sugar content when added sugars is included in NIP international equivalents, due to perceiving added sugars as additional to, rather than a component of sugars.
- One study identified that indentation was useful for distinguishing added sugars as a component of sugars. However, this does not appear to be sufficient to reduce misperceptions that added sugars are additional to, rather than a component of sugars.
- Labelling formats that listed ‘total sugars’ rather than ‘sugars’ consistently reduced these misperceptions. The NFL format implemented in the US, which states ‘total sugars’ with ‘including added sugars’ indented below, substantially reduced the misperception, although there is some evidence that added sugars may still interfere with the ability to use total sugars information in complex tasks.
- Another study highlighted that consumers expect total and added sugars to be located together.
- Qualitative evidence suggests that consumers may have difficulty identifying whether a food is high or low in added sugar using only the gram amount listed in nutrition panels. The inclusion of a % daily value (DV) for added sugars may help consumers to identify if the gram amount represents a little, or a lot of added sugars. High/medium/low interpretive added sugar labelling may also aid consumer

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understanding of the level of added sugars in products without requiring product comparison. However, it did not improve consumers' ability to compare products and identify those with the highest sugar levels, relative to listing the gram amount of added sugars in a nutrition panel.

- Knowing or perceiving that a product contains added sugars may reduce how healthy that product is perceived to be. However, all other things being equal, the declaration of added sugars on nutrition panels does not appear to significantly interfere with consumers' ability to determine overall product health, to the detriment of other nutrients.
- Consumers generally find total sugars information to be more useful and influential than added sugars information. This may influence what information they would attend to if both items were included in the NIP.
- Consumers also appear to find more utility in 'total sugar' terminology, relative to 'sugars'.
- The importance of sugar terminology appears to depend on product type, with both total and added sugars information being more valued on products that consumers perceive to be high in sugar. Consumers were most interested in added sugars information for 'juices and drinks'.
- While there is a stated preference for total sugars over added sugars information, this may shift as consumers become more familiar with the concept of added sugars. For example, in the US, where added sugars labelling is mandatory, consumers in one survey ranked total and added sugars as similarly important. 50% of Americans aiming to reduce their sugar intake focused only on added sugar, relative to 31% who were trying to reduce natural and added sugar.

2.2 Self Rated Confusion

Three studies from the US and one from Brazil investigated whether consumers perceived added sugars information to be useful or confusing.

In a survey of a representative sample of 288 adults from the US (Kyle & Thomas, 2014), participants were shown an NFL with added sugars included and were asked how helpful or confusing the added sugars information would be and why. The majority (63%) reported that knowing how much added sugar was in a product would be helpful and 18% of respondents indicated they thought it would be confusing. Qualitative analysis of free text responses indicated that, of those who reported the labelling would be helpful, 17% indicated that it would be helpful 'to know'. 13% thought it would be helpful for 'health reasons', and 10% thought it would be helpful to 'distinguish natural from added' sugar. Of those who reported that added sugars would be confusing, 43% did not provide a response when asked why they thought it would be confusing. However, 15% indicated that they thought the information would be confusing as it was 'irrelevant/meaningless', 15% said they 'don't know' and 14% said they 'don't care'. This suggests that many of those reporting that added sugars information would be confusing may not have found the information useful or relevant to their personal circumstances, rather than being confused by it.

A study by the FDA (2015b) asked 6,480 adults from the US to evaluate one of three NFLs. One NFL listed 'sugars' with 'added sugars' indented below (S+AS), while the other had 'total

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sugars' with 'added sugars' indented below (TS+AS). The control condition only listed 'sugars' and did not include added sugars information. Participants were asked to rate the macronutrients section of the label by how 'easy to understand', 'useful to you personally' and 'believable' it was. They were also asked to rate how helpful it was for 'general dietary tasks' (such as comparing products and planning a healthy diet), and for 'determining the amount of added sugars in a food'. Ratings were on a scale of 1 - 5 where 1 = 'not at all' and 5 = 'very'. NFL formats with added sugars declared were rated as easier to understand relative to the control NFL with only sugar (mean 4.24 for S+AS and 4.28 for TS+AS vs 4.08 control, $p < 0.05$). NFLs listing added sugars were also rated as more helpful for determining added sugar content (mean 4.42 for S+AS and 4.47 for TS+AS vs 3.28 for control, $p < 0.05$). The two NFLs that listed added sugars did not significantly differ from one another across any of the preference dimensions. These results suggest that when added sugar is presented, consumers feel that NFLs are somewhat easier to understand, and can help to identify added sugar content. However, levels of understanding were relatively high across all NFL formats, and the authors reported that the addition of added sugars did not make the label more useful, believable or helpful for general dietary tasks. Unclear reporting of results reduces confidence in these findings⁶.

In a study of 783 adults from a university community in the US, Stastny & Keith (2018) asked participants in a restaurant ($n=236$) and in an electronic survey ($n=547$) about their ability to use added sugars information. Added sugars was defined for the participants (wording not disclosed). Responses were scored on a scale of 1 - 5 where 1 = 'strongly disagree' and 5 = 'strongly agree'. Participants reported being fairly confident in their ability to use added sugars information if it was available (restaurant mean 3.87, electronic mean 4.22). The reason behind the difference between groups may be due to variation in participant characteristics that resulted from the different sampling methods. For example, restaurant participants were more likely to be female (89.2% vs 67.9%) and less likely to be university students (14.7% vs 51.3%). The survey setting may have also impacted results. While the study did not specifically consider potential confusion, the findings suggest that participants generally felt confident that they could use added sugars information.

In a series of five focus groups, 32 Brazilian university students who use food labels were asked for their views on three NIP label presentations (Scapin et al. 2022). One presentation did not show any sugar information, one showed 'total sugars' with 'added sugars' indented below, and another showed total and added sugars as in the second condition, but with an octagonal 'high in sugar' warning label. As reported in section 1.4, most participants reported having never heard of the term added sugars, and were confused by the difference between total sugars and added sugars. Many also demonstrated confusion about the difference between total sugars and carbohydrates. This may be because, until October 2022, Brazilian nutrition labels were only required to declare carbohydrates and not total or added sugars.

Conclusion – Section 2.2

Overall, the studies in Section 2.2 suggest that consumers generally feel that it would be helpful, and not more difficult to understand than sugar information alone. However, Brazilian university students reported finding the distinction between total and added sugars to be confusing when viewing NIP presentations. These findings reflect consumers' perceptions, which may not necessarily correspond to their actual ability to use the information.

⁶ In some instances, the authors' reporting of the findings are inconsistent with findings shown in the table that they refer to. It is unclear whether this is an error in the table.

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2.3 Impact on estimating total and added sugars content

Eight studies suggest that including added sugar information in nutrition panels improves consumer ability to identify added sugar content, but may lead them to overestimate the total amount of sugar in a product when presented in certain ways. These studies were primarily undertaken in the US to evaluate changes to their NFL. One study was undertaken in Brazil. Table 5 summarises the four studies that compared consumer ability to identify total and added sugars content in grams using comparable experimental methods.

Table 5 - Consumer ability to identify total and added sugars content in grams.

Study	Label presentations	Added sugars not declared		Added sugars declared	
		% correctly identifying total sugar	% correctly identifying added sugar	% correctly identifying total sugar	% correctly identifying added sugar
Laquatra et al. 2015 US (n = 1,088)	Sugars vs. Sugars + Added sugars vs. Total sugars + Added sugars	92.0	N/A	54.8 - 66.3	N/A
FDA 2015a US (n = 5,430)	Sugars vs. Sugars + Added sugars	81	N/A	65	71
FDA 2015b US (n = 6,480)	Sugars vs. Sugars + Added sugars vs. Total sugars + Added sugars	90	6	65 - 76	86 - 88
Khandpur et al. (2020) US (n = 1,156)	Sugars vs. Total Sugars incl. Added Sugars	70.4	14.7	78.4	76.9

A US study (Laquatra et al. 2015) used in-depth interviews and a quantitative survey to examine how consumers interpreted 'added sugars' on the then proposed US NFL. This presentation included a line indented under 'carbohydrates' for 'sugars', with another further indented line under 'sugars' for 'added sugars'. As reported in Section 1.4, some interviewees thought that added sugars were in addition to, rather than a subcomponent of, total sugars.

In the quantitative phase, Laquatra et al. (2015) conducted a randomised controlled experimental survey with a nationally representative sample of 1,088 American adults. Participants were initially randomised to view one of three NFL formats. One format, 'Version S' included only 'sugars'. 'Version S+A' listed 'sugars' with 'added sugars' indented below.

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Version 'TS + A' listed 'total sugars' with 'added sugars' indented below. When asked to identify the total amount of sugars in the product, those viewing 'Version S' with no added sugars information were correct 92.0% of the time. This was significantly higher than the 54.8% who saw 'Version S+A' and the 66.3% who saw 'Version TS+A' ($p < 0.05$). This pattern was also seen in those who self-reported that they read NFLs, who may be expected to be more familiar with their interpretation.

Participants who viewed NFLs with added sugars were also asked "Is the number of grams of 'Added Sugars' in this product included in the grams of sugars shown in the [Sugars/Total Sugars] line, or is it in addition to the amount of sugars shown in the [Sugars/Total Sugars] line" (Laquatra et al. 2015, p. 1760). 52.0% of those viewing 'Version S+A' responded that added sugars were in addition to total sugars, which was significantly higher than the 33.4% of those viewing TS+A ($p < 0.05$). Self-reported NFL readers were significantly more likely to understand that added sugars were a component of total sugars in 'Version TS+A' (54.4% vs 41.7%, $p < 0.05$), but not in 'Version S+A' (39.3% vs 28.1%). These findings suggest that when added sugars information is included in the NFL, participants may overestimate total sugar content, as they perceive added sugars to be additional to total sugars. This problem was more pronounced when the term 'sugars' was used, rather than 'total sugars', particularly for NFL readers.

To further test these perceptions, participants in Laquatra et al. (2015) were shown three nutritionally identical products which differed only by the NFL format (Version S, S+A and TS+A). When asked which of the three products contained the least amount of sugar, 40.2% of the sample said they saw no difference or they did not know, while the majority (59.8%) believed there was a difference in sugar content based on the different NFL presentations. When asked to rank which products they would purchase when looking for a low sugar product, 76.2% ranked products labelled 'Version S' the highest, followed by 14.1% ranking 'Version TS+A' and 9.7% ranking 'Version S+A' the highest. These preferences also suggest that consumers overestimated sugar content in NFLs that listed added sugar.

A US randomised controlled online experiment (FDA 2015a) obtained similar results to Laquatra et al. (2015). From a sample of 5,430 participants, they found consumers were better able to identify the total sugar content displayed on an NFL without added sugars, compared to an NFL with 'added sugar' indented directly underneath 'sugars'. Eighty one percent of respondents were able to correctly identify the gram content per serve of total sugars on a NFL without added sugars listed, compared to 65% of respondents who viewed the NFL with added sugars included. The majority (71%) of participants could identify the gram content per serve of added sugars when it was listed. The study did not report whether participants were systematically over or underestimating total sugar, so it was not clear whether the reduced ability to identify total sugar content was due to believing added sugars were in addition to sugars/total sugars. The study sample was not nationally representative and there was no analysis on the extent to which respondents differed from the broader US population.

A similar randomised controlled online experiment undertaken by the FDA with 6,480 adults from the US (FDA 2015b) also found that consumers were better able to identify total sugar when added sugars was not disclosed. Participants were randomised to view one of three NFL formats, which either listed only 'sugars', 'sugars' and 'added sugars', or 'total sugars' and 'added sugars'. For each NFL, participants were randomised to see a product identity of either a yoghurt, cereal, or frozen meal, but were not shown any product images. 90% of participants viewing the NFL without added sugars correctly identified total sugar in grams, compared to 65% who saw the NFL with sugars and added sugars, and 76% who saw an NFL with total sugars and added sugars. This study reported that the most common incorrect

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response in NFLs listing added sugars was the sum of total and added sugars (65-80%), suggesting that consumers often perceived added sugars to be additional to sugars/total sugars. However, when participants were asked to identify the amount of added sugars, as expected those viewing the NFL without added sugars listed performed very poorly, with only 6% answering correctly based on their general knowledge. This contrasted with the majority of participants (86-88%) who answered correctly when added sugars were listed. Participants' accuracy in identifying total carbohydrates was not impacted by the presence of added sugars in the NFL. The study sample was not nationally representative and there was no analysis on the extent to which respondents differed from the broader US population.

A 2015 study with 160 participants over the age of 35 from Washington, Chicago, Boston and San Francisco used eye tracking technology to evaluate different NFL presentations (FDA 2015c). One format was an NFL without added sugars information, the second was the then proposed NFL with 'added sugars' indented under 'sugars', and the third was an alternative NFL with sections advising what consumers should 'avoid too much' or 'get enough' of. In this NFL presentation, 'added sugars' was listed under 'avoid too much' while 'total sugars' was listed separately in a 'quick facts' section. Overall, the study found little difference in visual attention across the NFL formats. However, significant differences were observed in participants' ability and speed in locating added sugars information. 83% of respondents noticed the amount of added sugars on the NFL with added sugars indented underneath sugars. In contrast only 53% noticed added sugars on the alternative NFL where total and added sugars were listed in separate sections ($p < 0.0001$). Participants were also significantly slower to find the added sugars information in the alternative format compared to the proposed NFL with 'added sugars' indented under 'sugars' ($p = 0.0007$). These findings suggest that consumers expect information on different types of sugar (e.g. total and added sugars) to be located together on food labels. However, this result may have also been influenced by participants' unfamiliarity with the format advising consumers what to avoid.

A 2017 randomised controlled online experiment with 2,509 adults from the US sought to understand how eight different NFL formats influenced consumer understanding of added sugars (Khandpur et al. 2017). NFL conditions included: no label, the then existing NFL (which did not list added sugar), and the then proposed NFL without added sugar, but with other new features. The remaining conditions included the then proposed NFL with variations of added sugars information, including: added sugars in grams, added sugars in grams plus teaspoons, added sugars in grams plus % DV, added sugars in grams plus high/medium/low text, and added sugars in grams plus high/medium/low text plus % DV.

The impact of NFL format on added sugars understanding was measured by collating correct answers to the following four questions to create a % correct score. Questions included:

- If you were to consume this entire product in one sitting, would you have exceeded the daily recommended amount of added sugar?⁷
- Do you think this product has a low, medium or high amount of added sugars?
- [For three product pairs] Which product has more added sugars per serving?
- [For three product pairs] Which product is healthier, based on added sugars per serving, for the average person?

Average added sugars understanding scores ranged from 43.4% for the no label control, to 84.7% for the NFL with added sugars in grams plus high/medium/low plus % DV (see Table

⁷ For this question, participants were given a list of nutrients (including added sugar) and were required to select which ones they thought they would have consumed in excess of the recommended daily intake.

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6). NFLs displaying added sugars content significantly improved understanding of added sugar. Labels that showed high/medium/low text also significantly outperformed other conditions, but did not significantly differ from one another. Including the % DV significantly improved added sugars understanding relative to the teaspoon condition or grams alone. This study did not ask questions about sugars content, so the potential for confusion about whether added sugars are a component of or additional to total sugars cannot be evaluated. However, it does demonstrate that added sugars information in the NFL can improve consumers' ability to identify and compare the amount of added sugars in products, particularly when combined with additional interpretive labelling.

Table 6 - US consumer added sugars understanding score by NFL presentation (Khandpur et al. 2017)

No Added sugars Conditions	Mean /100	Added sugars Conditions	Mean /100
Control - No label, product image only (n=319)	43.37	Proposed NFL – Added sugars (g) (n=301)	73.56 ^b
Existing NFL – No added sugars (n= 329)	68.69 ^a	Proposed NFL – Added sugars (g) + teaspoons (n=310)	74.42 ^b
Proposed NFL – No added sugars (n=320)	70.18 ^a	Proposed NFL – Added sugars (g) + % DV (n=308)	78.39
		Proposed NFL – Added sugars (g) + high, medium, low text (n=307)	83.48 ^c
		Proposed NFL – Added sugars (g) + high, medium, low text + % DV (n=315)	84.74 ^c

Note: Conditions with the same subscript letter after the mean do not differ significantly from each other at $p < 0.05$. All other comparisons are significant at $p < 0.05$.

In a randomised controlled online experiment conducted with a non-representative sample of 1,156 adults from the US, Khandpur et al. (2020) sought to understand whether the revised NFL implemented in the US (lists 'total sugars', with 'incl. added sugars' indented below) improved added sugars understanding relative to the previous NFL (that did not list added sugars). All participants viewed four different products (bread, 100% juice, yogurt and canned fruit) that had no NFL (control condition). Participants were then randomised to one of the labelling conditions, and viewed that label for each of the four different products. Understanding of added sugars was measured by collating correct answers to the following questions across the four products to create a % correct score for each condition.

- Added sugars content: Based on the NFL, please estimate how much added sugar, total sugar, or naturally occurring sugar is in one serving of this product.
- Added sugars level: Is one serving of this product a low, medium, or high source of added sugars?

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The authors compared change in understanding between the two NFL conditions (i.e., difference in understanding between control and old NFL vs. difference in understanding between control and new NFL).

Participants viewing the new NFL were significantly better at identifying added sugars content in grams, relative to those viewing the previous NFL (76.9% vs 14.7%, $p < 0.01$), and were also better at identifying grams of total sugars (78.4% vs 70.4%, $p < 0.01$), and naturally occurring sugar (defined as total sugars minus added sugars) (65.3% vs 15.1%, $p < 0.01$). Participants in the new NFL condition were also significantly better at identifying whether a product was a high, medium or low source of added sugars (47.1% vs 23.0%, $p < 0.01$). Results for individual products types were not reported. This suggests that the inclusion of added sugars information in the NFL may assist consumers to extract information about added sugar. In contrast to Laquatra et al. (2015), FDA (2015a) and FDA (2015b), the ability to identify total sugars content improved in the NFL with added sugars listed, with the majority (78.4%) of participants able to accurately identify total sugars in grams. This suggests that specifying 'total sugars' and 'incl. added sugars' could reduce misperceptions of added sugars being additional to total sugars. The improvement may also reflect a greater level of familiarity with the presence of added sugars in the NFL, which was announced in 2016 and was due to be implemented by most manufacturers by 2020, soon after this study was undertaken.

A further online experiment undertaken with 992 adults from the US sought to explore consumer comprehension of the newly implemented NFL compared with the old NFL (Kim et al. 2021). Participants were randomly assigned to view either the old NFL, the new NFL with a single column showing per serve information only, or the new NFL with dual columns showing per serve and per container information. Participants in the new NFL conditions were asked "what percentage of the total sugars come from added sugars in one serving of this food" (Kim et al. 2021, p. 652). Only approximately one third of participants were able to correctly answer this manipulation task (32.9% for single column NFL, 30.5% dual column NFL), with the majority of respondents incorrectly answering with the % DV. This performance was much worse than for other manipulation questions⁸, suggesting that consumers may have particular difficulty using total sugars and added sugars information, relative to other nutrients. However, it was also the only question that asked for a response in percentages, allowing it to be confused with the % DV, and required a more complex calculation than other questions.

In Kim et al. (2021), participants were also asked "if you ate 1/3 cup of this food, how many grams of sugar did you consume?" Those in the two new NFL conditions performed significantly worse on this question (63.4% correct in single column NFL, 63.1% dual column NFL) relative to those viewing the old NFL (73.3%) ($p < 0.01$). This again suggests that the presence of added sugars information may impact consumers' ability to utilise total sugar information. However, the results may also be influenced by other changes in the NFL relevant to the question (e.g. location of serving size), or participant's familiarity with the new and old label formats, which was not controlled for in the study. The question also asked about sugar, which is more consistent with the 'sugars' language used in the old NFL, relative to 'total sugars' in the new NFLs. Nonetheless, the majority of participants were still able to correctly answer the question.

⁸ Other manipulation questions asked: If you ate two servings of this food, how many grams of fat did you consume? If you ate two servings of this food, how many calories did you consume?

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A 2022 mixed methods study undertaken with Brazilian university students sought to compare the effectiveness of different NIP formats on consumer understanding of sugar levels (Scapin et al. 2022). In a qualitative stage, five focus groups of four to nine food label users (32 total) were asked for their views on three label conditions. The conditions included a control with no sugar listed in the NIP, as well as two NIPs listing 'total sugar' with 'added sugar' indented below, of which one also had a 'high in sugar' octagonal warning label. All participants agreed that the format without sugar was the least useful. While some participants at first expressed confusion about the difference between total and added sugar, they found the indentation of added sugars to be a helpful indication that added sugars was a component of total sugar. Most participants found it difficult to estimate what is a high level of added sugars from looking at total and added sugars in grams alone. Consistent with this, the NIP displaying the octagonal warning label was considered the most useful in drawing attention and facilitating fast interpretation of sugar content. Participants preferred this format as it provided them with a quick reference for sugar content, while also allowing them to compare quantitatively between products.

In the quantitative component of Scapin et al. (2022), an online experiment with 1,277 participants from a university community looked at the impact of five different NIP formats on consumers' ability to select products with the highest sugar content. NIP formats included the three used in the qualitative component, as well as a presentation with 'high in' embedded in the NIP next to added sugar, and a format with a separate 'high in added sugar' warning label with a magnifying glass and 'Ministry of Health' noted, next to the NIP. Participants in each NIP condition were asked to identify the highest sugar product from three options with varying added sugar levels. This was repeated for three different food products (wholegrain biscuits, cereal bars, yoghurt). When averaged across all products, all NIP formats significantly improved consumers' ability to identify high sugar products, relative to the current Brazilian NIP which does not include sugar information ($p < 0.01$). However, results were not significant for yogurt alone. While participants viewing NIPs with the high in sugar/added sugars warnings (octagonal and magnifying glass) had greater odds of identifying a high sugar product, this difference was not significant, and there were no significant differences between any of the other labelling formats. This indicates that while consumers may prefer to see warning labels, it does not necessarily improve their ability to identify high sugar products when they have the time and motivation to utilise the information available in the NIP.

A 2015 online survey of 2,008 Canadians aged 16-24 years (Vanderlee et al. 2015) examined the efficacy of three Canadian Nutrition Facts Tables (NFT) on consumers' ability to identify added sugars content. The first condition was the current Canadian NFT format, which included 'total sugars' in grams, with no % DV. The second condition included 'added sugars' in grams indented below 'total sugars' with no % DV for either, while the third condition included a % DV for 'added sugars', but not for 'total sugars'. All conditions included % DV values for all other nutrients, and showed an ingredient list below the NFT. Participants who were randomised to view the NFT with 'added sugars' in grams but not with the % DV were significantly more likely to identify that a product contained added sugars, relative to the table without added sugars listed (90% with added sugar, vs 76% without added sugar, $p < 0.001$). The relatively high proportion of participants who were able to identify added sugars when it was not listed in the NFT may reflect the presence of the ingredients list, which was not included other studies. The presence of the % DV for added sugars did not impact participants' ability to identify that a product contained added sugar. However, those viewing the NFT with % DV included for added sugars were significantly better at identifying when added sugars was 'a lot', compared to conditions without the % DV ($p < 0.001$). This aligns with the results of Khandpur et al. (2017) to suggest that including a % DV of added sugars may help consumers to understand whether a product is high or low

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in added sugar. However, neither of these studies investigated any potential misunderstandings or unintended consequences associated with % DVs.

Conclusion – Section 2.3

Overall, the studies in Section 2.3 suggest that the addition of added sugars information significantly improves participants' ability to identify added sugars content, and select products accordingly. However, the findings also suggest that consumers may view added sugars as additional to, rather than a component of, sugars/total sugars. Labelling formats that listed 'total sugars' rather than 'sugars' consistently reduced these misperceptions. While one study identified that indentation was useful for distinguishing added sugars as a component of sugars/total sugars, the collective results from other studies suggest that this is not sufficient. The NFL format implemented in the US which states 'total sugars' with 'includes added sugars' indented below improved consumers' ability to identify the amount of total sugar, suggesting that this format may substantially reduce the misperception of added sugars as additional. A further study also confirmed that consumers expect total and added sugars to be located together.

One study identified that the presence of added sugars information may interfere with consumers' ability to undertake more complex manipulation tasks about total sugar content. However, these results may have been impacted by other factors in the study design, as well as participants' familiarity with different formats for presenting nutrition information.

Qualitative evidence suggests that consumers may have difficulty identifying whether a food is high or low in added sugars using only the gram amount listed in nutrition panels. The inclusion of a % DV for added sugars may help consumers to identify if the gram amount represents a little, or a lot of added sugars. However, there were mixed results regarding high/medium/low interpretive added sugar labelling. In Scapin et al. (2022), there were no significant improvements in consumers' ability to compare and identify products with the highest sugar content when high/medium/low interpretive labelling was used. This may have been due to participants being motivated to use the grams of added sugar in the NIP in the context of the study. In contrast, high/medium/low interpretive added sugar labelling significantly improved consumers' ability to understand and use added sugar information, including their ability to identify whether a product had high medium or low levels of added sugars (Khandpur et al. 2017).

2.4 Impact on product healthfulness perceptions

Five studies provide insight into whether the presence of added sugars information impacts consumers' ability to evaluate overall product healthfulness. This includes research undertaken when added sugars is declared in nutrition panels, as well as research evaluating the impact of 'no added sugar' claims. Studies were undertaken in Australia (one), the US (three), and Portugal (one).

An online survey conducted by the FDA with 6,480 adults from the US (FDA 2015b) found that the amount of added sugars listed on a NFL may influence perceptions of healthfulness. Participants were asked to compare two NFLs representing a more and less nutritious variant of a food product. When the more nutritious⁹ variant of the food item had less added sugar, 91-92% of participants were able to correctly identify the healthier option. In contrast, when the more nutritious food item in the pair had more added sugars listed there was a

⁹ More nutritious variant was lower in calories and fat, and higher in fibre and vitamins.

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decrease in participants' ability to correctly identify the healthier option (83-85% of participants identifying the healthier option). While the majority of participants were still able to determine the healthier product, these findings indicate that listing added sugars may disrupt consumers' ability identify healthier food choices, where added sugars levels are inconsistent with the overall product healthfulness. However, it is also possible that the studies' focus on added sugars may have led participants to give greater weight to this nutrient.

The FDA (2015b) study also asked participants to rate how healthy a product was (either a more or less nutritious variant of a cereal, ready meal or yogurt), where 1 = 'not at all healthy' and 5 = 'very healthy'. They then investigated whether perceptions of healthfulness differed if added sugars was presented in the NFL. In contrast to the above findings, the results of this task suggested that added sugars declarations did not impact perceived healthfulness. The only significant difference found was for less nutritious cereals, where NFLs without added sugars were rated as healthier ($p < 0.05$). Non-significant results were also reflected when consumers were asked how likely they would be to buy a product if they were trying to maintain a healthy weight, and if they were trying to reduce tooth decay or dental cavities. In contrast, when participants were asked how likely they were to buy a product if they were trying to avoid added sugars, the NFLs with and without added sugars had significantly different ratings for more and less nutritious cereals, and more nutritious yoghurts ($p < 0.05$). The study also found that participants' perceptions of the levels of nutrients including saturated fat, sodium, calcium, dietary fibre and iron were not impacted by the presence of added sugars in the NFL. This suggests that declaring added sugars would not necessarily impact healthfulness perceptions to the detriment of other nutrients. However, in line with the findings highlighted in Section 2.3, it may help consumers to identify and avoid added sugar.

As reported in Section 1.5.2, in a study of 1,614 parents of children aged 1-5 years from the US, Jensen et al. (2021) investigated whether perceptions about added sugars content influenced healthfulness perceptions for fruit drinks and flavoured waters. In both drink categories, those who believed the drink did not contain added sugars rated it as healthier compared with those who knew they contained added sugars (5.9 out of 10 \pm 2.8 compared with 4.7 \pm 2.3 for fruit drinks [$p < 0.001$], and 6.9 \pm 2.5 compared with 6.4 \pm 2.3 for flavoured waters [$p = 0.002$]). This suggests that consumers believe that certain fruit beverages are healthier if they do not contain added sugar.

A 2022 survey of a nationally representative sample of 2,322 Australians asked participants how likely a series of front-of-pack claims were to indicate to them that a particular food product is better for them (Morley & Ilchenko 2022). 16.8% of participants felt that 'no added sugar' claims were 'extremely likely' to indicate that a product is better for them, with 37.4% choosing 'very likely', 37.5% 'somewhat likely', and 8.3% not at all. The 'no added sugar' claim was more closely associated with products being better for you than 'low sugar' claims (90.6% at least 'somewhat likely'), 'organic' claims (84.9% at least 'somewhat likely'), 'low fat' claims (87.0% at least 'somewhat likely'), and was roughly equivalent to 'no artificial preservatives, colours, or flavours' claims (91.6% at least 'somewhat likely'). This suggests that 'no added sugar' claims at least somewhat influenced healthfulness perceptions for the vast majority of respondents and were highly influential for over half of consumers surveyed.

A 2010 study with 320 participants from the US used conjoint analysis to investigate the relative importance of different nutrient content claims in determining healthfulness perceptions of food products (Drewnowski et al. 2010). The study asked participants to rate how healthy they would perceive a product to be if it contained the nutrient content claim, and translated this into a utility score for each statement's importance in determining healthfulness perceptions. Utility scores of 8 were considered important, while scores of less

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than -5 were considered unimportant. Overall, the study reported that claims relating to sugar and added sugars had lower utility scores and contributed less to overall health perceptions than claims declaring the presence of protein, fibre, calcium and vitamin C, or declaring the absence of saturated fat, cholesterol and sodium. Of the four sugar-related claims in the study, 'this product is free of added sugar' had the highest utility rating (10), and was ranked 10th out of 32 health claims. 'This product is sugar free' was ranked 15th with a utility rating of 9, and 'this product is low in total sugar' was ranked 17th with a utility rating of 9. The utility score for 'this product is low in added sugar' was not reported as it did not rank in the top 22 claims. This suggests that, relative to other nutrients, sugar and added sugar related claims may not have as strong of an influence on healthfulness perceptions. However, in line with Australian results from Morley and Ilchenko (2022), their high utility scores indicate they are still important for healthfulness perceptions. It is possible that perceptions around the health impact of sugar may have changed since this study was undertaken in 2010, with increased research and media coverage of its impacts and the introduction of added sugars labelling in the US. There was no clear preference for added sugars or total sugars information in determining healthfulness in this study. The relative importance of nutrition information may also depend on the product, which was not tested in this study.

A Portuguese study by Prada et al. (2021b) further suggests that sugar information can impact healthfulness perceptions. In an experiment with 200 participants (80% female), Prada and colleagues investigated whether consumer perceptions of product healthfulness, caloric value and taste were influenced by the presence of sugar related claims (including "0% sugar", "sugar-free", "no added sugars", "low sugar"). They found that products (cereals, yogurts, ice cream and cookies) with sugar-related claims were rated as significantly healthier, less caloric and less tasty than their regular versions ($p < 0.001$). There were no significant differences in healthfulness perceptions between the different sugar claims. In a second experiment with 206 participants, Prada et al (2021b) investigated whether claims highlighting the use of natural sweeteners (including "sucrose", "cane sugar", "honey" and "stevia") influenced perceived healthfulness, caloric value and taste. They found that participants evaluated products with claims relating to stevia and honey as healthier, while products with cane sugar and sucrose were rated as less healthy ($p < 0.001$). Products with claims relating to stevia were seen as less tasty than regular products, while honey, cane sugar and sucrose were perceived as tastier ($p < 0.001$). Finally, products with stevia related claims were also rated as less caloric, while products with honey, cane sugar and sucrose were seen as more caloric. While this study considered claims, and not sugar information in the NIP, the results suggest that health perceptions of food products may be influenced by the presence of sugar information. They also suggest that the source of sugar can influence health perceptions, with products like honey being seen as healthier, but not necessarily less caloric, than other sweeteners.

Conclusion – Section 2.4

Overall, the findings in Section 2.4 suggest that perceiving or knowing a product to contain added sugars may reduce how healthy that product is perceived to be relative to products without added sugar. Sugar related claims (e.g. 'no added sugar', or claims about the use of natural sweeteners) appear to increase perceived healthfulness, relative to products without claims. Parents also rated fruit drinks and flavoured waters as healthier when they believed they did not contain added sugar. However, the addition of added sugars information on nutrition panels is unlikely to substantially impact overall healthfulness perceptions, to the detriment of other nutrients. While consumers in one study were somewhat worse at choosing a healthier product based on all nutrients when added sugars information was higher for the healthier product, this only affected approximately 10% of study participants.

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Presenting added sugars in a nutrition panel did not tend to impact how healthy consumers rated products to be, nor did it affect their perception of the level of other nutrients.

2.5 Relative importance of sugar terminologies

Five studies examined the relative importance that consumers placed on different types of sugar information. This may inform which piece of information consumers would attend more to, should added sugars information be included on the NIP. However, two of the five studies were not undertaken in the context of the NIP, so there are some limitations in using the evidence for this purpose. FSANZ's 2017 Sugar Literature Review identified that sugar was a commonly sought piece of information, relative to other nutrition information (FSANZ 2017). Therefore, this section focuses only on comparison between different types of sugar information. Studies were undertaken in Australia (one) and the US (four).

An online survey of 1,086 Australians (Department of Health 2013) examined what consumers considered to be the most and least important nutrients to include in a front-of-pack nutrition label using maximum difference scaling. The task involved showing all potential nutrients in groups of five, and for each group respondents had to indicate the most and least important nutrient in the group 'for your needs'. This was repeated ten times, with each iteration containing a different combination of nutrients. After the star rating system itself, 'total sugars' was the second most important component, with a relative importance score of 12%. In comparison, 'sugars' was only the eighth most important component, with a relative importance score of 6%. This indicates that 'sugars' were only considered half as important for inclusion on a front-of-pack label as 'total sugars'. 'Added sugars' was seen as less important, achieving a rank of 12th most important, with a score of 4%. These findings suggest that participants may have found more meaning and value in 'total sugars' rather than 'sugars' or 'added sugars'. These terms were not defined for participants and the study did not explore how they were understood. The sample was not representative, and was slightly skewed towards females (57%), due to a focus on sampling main grocery shoppers.

The Department of Health (2013) survey also explored whether the relative importance of different nutrients differed by food category. The importance respondents attached to 'total sugars' varied considerably depending on the food category. 'Total sugars' was the second most important piece of nutrition information for the category of 'breakfast cereals, muesli bars and snacks' (after the star rating system) and the most important for the category 'juices and drinks'. In contrast, 'total sugars' was less important for 'pre-prepared/convenience meals', 'meats, chicken and fish', and 'dairy products'. 'Sugars' and 'added sugars' were generally substantially less important than 'total sugars' and other nutrition information. However, for the category 'juice and drinks', 'added sugars' was the fourth most important nutrition information component after 'total sugars', 'vitamin C', and the star rating system. These findings suggest that Australian consumers may believe that breakfast cereals, muesli bars, snacks, juices and drinks are more likely to contain high levels of total or added sugars than other food categories tested. It also suggests that Australian consumers may be less concerned about the added sugar content of food (compared to other nutrients, including total sugar). However, this may also be due to reduced familiarity with the term 'added sugars'.

A survey from the US of 3,361 adults (Rampersaud et al. 2014) found that total sugar content was one of the top three concerns ('primary concerns') for 51% of respondents when consuming beverages. Added sugars content in beverages was a primary concern for 39% of respondents and natural sugars were of concern for 7%. Other response options included: calories, saturated fat, trans fat, cholesterol, sodium, dietary fibre, protein, vitamins and minerals, calcium, iron, caffeine, and potassium. Respondents were more commonly female

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(57.2%), white (86.5%) and at least college educated (36.0%) relative to the broader US population. These findings are similar to the Department of Health (2013) research in suggesting that total sugar is of more concern to consumers than added sugar. However, factors that may influence preferences such as understanding of or familiarity with these terms were not investigated by this study.

The 2021 and 2022 annual Food and Health Surveys conducted in the US by the International Food Information Council reported on how consumers are using sugar information. The results of these surveys were weighted to represent the US population in respect of age, education, gender, race/ethnicity and region.

The 2021 survey of 1,014 adults aged between 18 and 80 years found that, of the information found in the carbohydrates section of the NFL (including 'total carbohydrate', 'total sugars', 'added sugars', 'dietary fibre' and 'sugar alcohol'), 'total sugars' had the biggest influence on their purchasing decisions, followed by 'total carbohydrate' (IFIC 2021). 'Added sugars' was ranked third, with 13% saying it had the most influence on their purchasing decisions, relative to 25% for 'total sugars'. The 2021 survey also found that of the 72% of participants who were limiting or avoiding sugar in their diets, approximately 27% were using the NFL to choose products with less total sugar, compared to 23% who were using the NFL to choose products with less added sugar.

In the 2022 survey of 1,005 adults aged between 18 and 80 years, participants were asked to nominate the top three pieces of nutrition information they looked at while shopping (IFIC 2022). 'Total sugars' was the third most frequently viewed with 21% putting it in their top three, closely followed by 'added sugars' at 20%. 'Calories' was the most commonly viewed item at 29%, followed by 'sodium' at 23%. The survey also found that 73% of participants limiting or avoiding sugar. Of these, 50% were avoiding only added sugars (defined as sugars added to packaged food and beverages), while 31% were avoiding both added and naturally occurring sugars. 18% were only avoiding naturally occurring sugars. Less than 0.5% were avoiding a specific type of sugar, or added sugars and a specific type of sugar, respectively.

The two IFIC surveys suggest that that added sugars information may be increasing in importance following the introduction of added sugars labelling in the US, potentially reflecting increased familiarity. Total sugars and added sugars were ranked similarly in the 2022 IFIC survey, and more Americans are focusing on reducing added sugars than reducing total sugar. However, the differences between years may also reflect differences in the way questions were asked.

A US study by Graham and Roberto (2016) used eye tracking technology to evaluate the impact of listing added sugars in the NFL. Participants were 155 undergraduate students from Colorado. The number of participants viewing 'sugars' information at least once declined from 72.5% when 'added sugars' was not listed in the NFL, to 47.7% when 'added sugars' was declared. However, for those people who did look at it, there was no statistically significant difference in mean viewing time of 'sugars' information across the NFL formats. Participants were also more likely to view 'added sugars' at least once (58.1%) than 'sugars' (47.7%) when both were present on the label, however this difference was not tested statistically. While visual attention is not a measure of comprehension or a holistic measure of attention, these results suggest that the declaration of 'added sugars' may divert some attention away from 'sugars' information. However, this may be due to the novelty of seeing unfamiliar information, as 'added sugar' was not widely included in NFLs when this study was undertaken.

Food Standards Australia New Zealand**Conclusion – Section 2.5**

Overall, the studies in Section 2.5 suggest that consumers generally find total sugar information to be more useful and influential than added sugars information. While measured in different ways, total sugar was rated as more important than added sugars in all four studies that compared consumers' stated preferences for this information. Reflecting the findings in Section 2.3, the Department of Health (2013) study also suggests that consumers may find more utility in 'total sugars' terminology, relative to 'sugars'.

However, the relative importance of sugar information appears to depend on product type. In particular, total and added sugars information may be more valued on products that consumers perceive to be high in sugar, such as breakfast cereals, muesli bars, snacks, and juices and drinks. While added sugars was less important than total sugar for all products, it received its highest ranking (4th) for 'juices and drinks'.

While there is generally a stated preference for total sugars over added sugars information, this may be influenced by how familiar consumers are with the concepts. Evidence from the US, where added sugars information has been mandatory on most labels since 2020, suggests that added sugars information may be increasing in importance over time. Total sugar and added sugars were ranked similarly in the 2022 IFIC survey, and more Americans are focussing on reducing added sugars than reducing total sugar. This idea is also supported by eye tracking research, which found that the inclusion of added sugars may divert some attention away from sugar information. However, this may be due to a novelty effect.

Research Question 3: How do consumers understand added sugars information for single ingredient foods?

Research Question 3 sought to explore how consumers may understand, or prefer to see, added sugars information on single ingredient foods that may be captured in the definition of added sugars. For example, how do consumers understand added sugars information on a jar of honey or a bag of white sugar, when those foods are sold individually. Any research relating to added sugars and single ingredient foods was considered in scope. Products referred to in this section do not reflect FSANZ's position around what could be included in a regulatory definition of added sugars.

Whether consumers perceive single ingredient foods to be added sugars when added to another product was not in the scope of Research Question 3, and is analysed in Section 1.5. Whether consumers perceive single ingredient foods to contain added sugars is in scope of Research Question 3, as this may inform whether consumers would be confused by different options for presenting added sugars information on these foods.

No research directly studied consumer preferences or responses to different presentations of added sugars information on single ingredient foods. However, 11 studies contributed broader evidence towards this question, including from Australia (three), the US (three), Portugal (two), United Kingdom (one), Switzerland (one), and Europe (one).

3.1 – Summary - Research Question 3

- No research directly studied consumer preferences or responses to different presentations of added sugars information on single ingredient foods.

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- However, broader research may provide some insights into how consumers might react to different options for presenting added sugars in the NIP for single ingredient foods which may be captured by an added sugars definition.
- Declaring added sugars information on single ingredient foods may mislead consumers who perceive added sugars to only be sugar that has been added.
- An interpretation of the results from one US study could suggest that presenting added sugars information as 0 grams for single ingredient foods may create a health halo. However, it is not possible to draw definitive conclusions on this hypothesis from available evidence.
- Any health halos may exacerbate existing perceptions of honey and fruit sugars as being more healthy than other sugar sources.
- An interpretation of the results from one US study suggests that consumers may be more likely to purchase a product when added sugars are lower than expected, and less likely to purchase when they are higher than expected. If consumers perceive single ingredient foods to contain extrinsic sugars (as commonly occurs for 100% juice), presenting 0 grams of added sugars may make them more likely to purchase those products. However, it is not possible to draw definitive conclusions on this hypothesis from available evidence.
- Given the limited evidence, information in this section should be used with caution.

3.2 Consumer response to added sugars information on single ingredient foods

No research directly studied consumer preferences or responses to different presentations of added sugars information on single ingredient foods. One US study identified some implications for labelling added sugars as 0g, which is a possible option for labelling single ingredient foods captured by an added sugars definition.

A 2020 randomised controlled online experiment conducted with 1,156 adults from the US (Khandpur et al. 2020) measured whether purchase intentions for bread, yogurt, canned fruit and 100% juice changed if added sugars information was presented in the NFL. Participants were first exposed to a control condition, where they viewed front-of-pack images of all four products without a NFL, before being randomly assigned to view the same products with either an old NFL without added sugar, or the newly implemented NFL which lists 'total sugars', with 'incl. added sugars' indented below. The new NFL also contained nutrition information per serving and per container, while the old NFL only contained nutrition information per serving. While purchase intentions are out of the scope of this literature review, they are used here as a proxy for consumer preferences.

Khandpur et al. (2020) compared change in purchase intentions between the two NFL types (i.e., difference in purchase intention between control and old NFL vs. difference in purchase intention between control and new NFL). Results showed that the effect of the NFL format on change in purchase intention depended on the product type. While the NFL format did not significantly affect purchase intentions for yoghurt (7g added sugars per serve) and canned fruit (5g added sugars per serve), those viewing the NFL with added sugars were more likely to purchase the 100% juice (0g added sugars per serve) and less likely to purchase the

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bread (4g added sugars per serve) than those who were shown the NFL without added sugars (both $p < 0.01$).

The authors posit that these results may suggest that people are more likely to purchase a product when added sugars are lower than expected, and less likely to purchase when they are higher than expected. This may be particularly the case in the new NFL format, in which the 'per container' figures may differ substantially from the 'per serve'. For example, as the new NFL displayed added sugars per serve and per container, the considerable per container value for bread (not specified), which contains multiple serves per container, may have been unexpected and off-putting for consumers. However, the study did not measure consumers' expectations around added sugars content for the products in the study, and thus could not confirm whether consumers expected added sugars to be higher in the juice, or lower in the bread.

Reduced purchase intentions may also have been due to higher levels of other nutrients of concern shown in the per container column, or other changes between the old and new NFLs. The authors also suggest that the higher intent to purchase 100% juice when added sugars information is present may be driven by a health halo associated with seeing a 0g value for added sugar. However, the study did not measure healthfulness perceptions, so cannot confirm whether a health halo occurred for the 100% juice. Similarly, as this effect was only seen in a single product, it cannot be generalised to other products. Thus, based on current evidence it is not possible to confirm whether a health halo may occur when 0g of added sugars is presented in a nutrition panel.

Conclusion – Section 3.2

In line with the findings presented in Section 1.5.1, these results suggest that the effect of added sugars information on purchase intentions may differ by product type. While Khandpur et al.'s (2020) interpretation of their results could not be confirmed by their study design, they indicate a potential unintended consequence where labelling added sugars as 0g may create a health halo for 100% juice products. It is also possible that consumers may be more likely to purchase a product where added sugars are lower than expected, and less likely to purchase when added sugars are higher than expected. However, this may have been driven by high per container values of added sugars or other nutrients of concern, which are not mandatory to present in NIPs in Australia and New Zealand. It is therefore not possible to make a definitive conclusion regarding these hypotheses.

3.3 Consumer understanding of added sugars content in single ingredient foods

Eleven studies provided insight into consumer perceptions of added sugars content in single ingredient products. This may inform whether consumers would be confused or misled by different options for presenting added sugars information on these products. Consumer understanding of added sugars content in all food and beverage products is explored in Section 1.5.

Honey

As reported in Section 1.5, in an online survey of 7,469 adults across the 27 European Union members states, Norway and Iceland (EFSA 2022), the majority of participants (82.5%) thought that honey did not contain added sugar. As demonstrated in Sections 1.3 and 1.4, many participants associate the concept of added sugars with extrinsic sugar that has been added to a product. While not explicitly tested in any study, the combination of these findings

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suggests that consumers may be misled if the sugar content of honey is listed as added sugars in the NIP, as it may suggest that something extrinsic has been added.

On the other hand, as raised in Khandpur et al. (2020) in relation to 100% juice, there may be a risk that presenting 0g of added sugars for honey could give honey a health halo. This potential for a health halo may exacerbate the perception that honey is healthier than other sources of sugar (Colles et al. 2014; Prada et al. 2021a; Prada et al. 2021b). However, given that no study has directly examined these issues, it is not possible to draw a definitive conclusion.

100% Juice

As reported in Section 1.5, consumer understanding of added sugars content in 100% juice is highly variable, with between 7% and 59% of participants across five studies perceiving that it contains added sugars (see Table 6). Fewer people perceived 100% juice to contain added sugars in a study that simultaneously asked whether a product contained natural sugar. This may suggest that some people were not distinguishing between total and added sugars when asked about only added sugars content. Nonetheless, presenting 100% juice as containing added sugars when sold as a single ingredient food may lead to confusion for those who understand added sugars to be extrinsically added.

This confusion may be exacerbated by the finding that consumers are often unable to accurately estimate the percentage of juice, both in mixed juice products and in 100% juice. As reported in Section 1.5, this was the case even when the percentage of juice was clearly labelled on the front and/or back of the label (Harris & Pomeranz 2021; Jensen et al. 2021). In Department of Health (2013) research, Australian consumers perceived added sugars information as more important to include on front-of-pack labelling for drinks and juices relative to other products, suggesting they may value the ability to distinguish intrinsic and extrinsic sugar for these products.

On the other hand, as raised in Khandpur et al. (2020), there may be a risk that presenting 0g of added sugars could give 100% juice a health halo. This potential for a health halo may build upon health halos that already exist around sugar originating from fruit, which is often perceived as healthier than other sugar sources (Gill & Sattar 2014; Sütterlin & Siegrist 2015; Timperio et al. 2003). However, given that no study has directly examined these issues, it is not possible to draw a definitive conclusion.

Conclusion – Section 3.3

There is limited evidence on consumer understanding of added sugars content in single ingredient foods. One study found that the majority of European consumers do not think honey contains added sugar. Five studies showed significant variation in consumer understanding of added sugars content in 100% juice, with two studies also demonstrating that consumers have difficulty estimating the percentage of juice in pure and mixed juice products even when the percentage of juice is provided on the label. As consumers often perceive added sugars to be extrinsic sugar that has been added to a product, presenting added sugars in the NIP for these products may suggest that something extra has been added. However, as outlined in Section 2.3, a possible interpretation of the results of one US study suggests that presenting 0g of added sugars for single ingredient foods may create a health halo, which could exacerbate existing perceptions of honey and fruit sugars and being more healthy than other sources of sugar. Given the limited evidence, the information in this section should be used with caution.

Conclusion

This rapid systematic review examined literature from January 2003 – July 2022 on consumer understanding of ‘added sugar’ and similar terminologies, as well as consumer perceptions of ‘added sugars’ in Nutrition Information Panels (NIP) or their international equivalents. The review identified 36 relevant studies, including five from Australia, one from New Zealand, one undertaken across both Australia and New Zealand, and 29 international studies. Twenty-nine studies were quantitative, three were qualitative and four used mixed methods.

International evidence was included due to limited research in the Australian and New Zealand context and because of the specific relevance of studies undertaken to assess the impact of including ‘added sugars’ information in NIP equivalents overseas. However, international findings may not be directly generalisable to the Australian and New Zealand context given different food regulatory systems, cultures and exposure to different messaging around sugars. In addition, many studies identified in the review did not use nationally representative samples, and often had a very high proportion of female or highly educated respondents. Studies also used varying definitions of added sugars or did not define added sugars for participants. As such, results should be interpreted with respect of the definition used, or interpreted with care where a definition was not provided to participants or was not specified by study authors.

Acknowledging these limitations, the findings of the literature review suggest that declaring added sugars information in the NIP will improve consumers’ ability to identify added sugars content, and select products on that basis. Consumers typically report that ‘added sugars’ information is helpful, and not more difficult to understand than sugar information alone. However, ‘total sugars’ information is also generally reported to be more useful and influential than ‘added sugars’ information. These findings also reflect consumers’ perceptions, which may not necessarily correspond to their ability to use the information.

The findings also suggest that declaring added sugars in the NIP has the potential to cause consumer confusion or create unintended consequences.

Consumers commonly understand ‘added sugars’ to be sugar that is added during manufacturing or food preparation, rather than being inherent or naturally occurring in food. This literal interpretation of ‘added’ adds complexity to the labelling of single ingredient foods that may be captured by a definition, as identifying added sugars in the NIP may suggest that something has been added to those foods. However, no research directly studied consumer preferences or responses to different presentations of added sugars information on single ingredient foods. An interpretation of the results from one US study may suggest that presenting added sugars information as 0 grams for single ingredient products could create a health halo, which may exacerbate existing perceptions of honey and fruit sugars as being more healthy than other sugar sources. However, given that this study did not directly examine these issues, it is not possible to draw a definitive conclusion. Alternative terminologies, such as ‘free sugar’, were not well understood by consumers.

The results also suggest that consumers have more positive attitudes towards sugars perceived as ‘natural’, and may not always view these as ‘added’. Consumers did not always make the distinction between total sugar and added/free sugar, and some were confused by the difference. Rather, consumers tended to employ a different interpretive frame wherein sugars viewed as natural or less processed (e.g. sugar naturally present in fruit or brown sugar) were perceived as good, while those found in packaged foods or that were viewed as

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more processed were seen as bad. Several studies demonstrate that sugar sources that are perceived as natural or less processed, including fruit sugar, honey and brown sugar, are generally viewed as healthier. Some consumers defined added sugars as those that are 'synthetic', 'artificial', 'fake' or 'unnatural'. Consumers often thought that sugar ingredients that were perceived as natural (e.g. honey or fructose) were 'inherent' rather than 'added' to a packaged food. This perception may be reduced where consumers are more familiar with adding 'natural' sugar ingredients to other foods. For example, consumers demonstrated greater understanding that honey could be both natural and added, relative to sugar types like lactose, which are less frequently used as a sweetener in home cooking. These results may also reflect that there are varying interpretations of the terms 'natural' and 'artificial'.

Several studies demonstrate that consumers may perceive 'added sugars' to be additional to, rather than a component of 'sugars' or 'total sugars', leading them to overestimate sugar content. Labelling formats that listed 'total sugars' rather than 'sugars' consistently reduced these misperceptions. Consumers also appear to find more utility in 'total sugars' terminology, relative to 'sugars'. The format implemented on the US NFL, which lists 'total sugars' with 'including added sugar' indented below, reduced the misperception substantially.

Consumers may have difficulty identifying whether a food is high or low in added sugar using only the gram amount listed in nutrition panels. The inclusion of a % DV for added sugars may help consumers to identify if the gram amount represents a little, or a lot of added sugars. High/medium/low interpretive added sugar labelling may also aid consumer understanding of the level of added sugars in products without requiring product comparison. However, it did not improve consumers' ability to compare products and identify those with the highest sugar levels, relative to listing the gram amount of added sugars in a nutrition panel.

It is unclear whether consumers would attend less to sugars or total sugars information, if added sugars was declared in the NIP. Some evidence from eye tracking research suggests that consumers may attend less to 'sugars' information when 'added sugars' is listed. However this could be due to a novelty effect. While consumers generally report finding 'total sugars' information to be more useful and influential than 'added sugars' information, this preference could change as they become more familiar with added sugar. For example, in one US survey, where added sugars labelling is mandatory, consumers ranked total and added sugars as similarly important. 50% of Americans aiming to reduce their sugar intake focused only on added sugar, relative to 31% who were trying to reduce natural and added sugar.

The importance of sugar terminology appears to depend on product type, with both total and added sugars information being more valued on products that consumers perceive to be high in sugar. Consumers were most interested in added sugars information for 'juices and drinks'.

Listing added sugars in the NIP appears unlikely to interfere with consumers' ability to determine overall product health. While knowing or perceiving that a product contains added sugars may reduce how healthy that product is perceived to be, the declaration of added sugars on the NIP does not appear to significantly interfere with consumers' ability to determine overall product health, to the detriment of other nutrients. An exception to this may be the potential halo effect created by presenting 0g of added sugars on products high that are still high in total sugars, noting evidence for this effect was limited.

Finally, the review identified potential concerns around 'no added sugar' claims. While the majority of consumers understand that products with 'no added sugar' may still contain sugar, a sizable proportion (17% - 30%) did not understand this distinction or were unsure.

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Appendix 1 – Methods

Search Strategy

Six online databases were searched via EBSCO Discovery (available through the FSANZ library):

- Science Direct
- Food Science Source
- FSTA - Food Science and Technology Abstracts
- MEDLINE with Full Text
- SocINDEX with Full Text
- EconLit with Full Text

Online database searches were undertaken using simple Boolean search term combinations. Searches were undertaken in July 2022. Searches were limited to peer-reviewed papers available in English and published from 2003 to 2022. 2003 was adopted as the lower limit of the search to align with the 2017 Sugar Literature Review (FSANZ 2017).

Search string 1¹⁰:

TI (“sugar*” OR “total sugar*” OR “added sugar*” OR “free sugar*”) AND AB (“consumer*” or “customer*” or “user*”) AND AB (“understand*” OR “perceive” “perception*” OR “know*” OR “comprehend*” OR “confus*” OR “aware*”) AND AB (“label*”, OR “pack*” OR “nutrition information panel” OR “NIP” OR “nutrition facts” OR “defin*”)

Search string 2:

TI (“consumer*” or “customer*” or “user*”) AND AB (“understand*” OR “perceive” “perception*” OR “know*” OR “comprehend*” OR “confus*” OR “aware*”) AND TI (“sugar*” OR “total sugar*” OR “added sugar*” OR “free sugar*”)

As this was a rapid systematic review, the search strings were targeted to those studies of most direct relevance to consumer understanding and use of sugar information. A rapid review was justified given the existence of the 2017 Sugar Literature Review, which had much broader search parameters.

However, to ensure the literature review incorporated a suitable range of references, further literature was sought by hand-searching:

- the reference lists of all included studies.
- studies that have cited any of the included studies (using Google Scholar) and

¹⁰ ‘TI’ indicated that the terms must be in the title of the study. ‘AB’ indicates that the terms must be in the abstract of the study.

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- studies included in the FSANZ's 2017 Sugar Literature Review.

Two confidential reports were also received from stakeholders.

Inclusion and Exclusion Criteria

Decisions regarding inclusion/exclusion criteria were made prior to the literature search commencing.

Inclusion Criteria

The review included studies that examined:

- Consumer understanding of specific sugar terminologies, including 'sugars', 'total sugar', 'added sugar', and 'free sugar'
- Consumer attitudes towards different types of sugar
- Consumer perceptions of specific products as being added sugars when added to other products
- Consumer perceptions of specific processes that create sugar as contributing to added sugar
- Consumer perceptions of added sugars information for single ingredient foods
- Consumer confusion arising from added sugars labelling

No restrictions were placed with respect to study type or sample size.

Exclusion Criteria

The review excluded studies that examined:

- Consumer behaviour in relation to sugar
- Sources of information about sugar
- Sufficiency of current information about sugar
- Consumer understanding of sugars identified in ingredients lists, or in other non NIP label elements
- Consumer value of added sugar labelling
- Impact of added sugars labelling on consumer behaviour
- Impact of added sugars labelling on reformulation
- Effect of the NIP in changing consumer behaviour

Many of the excluded areas were explored by the FSANZ 2017 Sugar Literature Review.

Research Review Process

The database search initially identified 129 potentially relevant documents. References were exported to EPPI-Reviewer, a web-based software program for managing and analysing data for literature reviews. Duplicates were then removed using EPPI-Reviewer duplicate management tools. References allocated a similarity score of at least 0.95 by the software were automatically excluded. Each remaining potential duplicate identified by the software was manually screened and excluded by one officer.

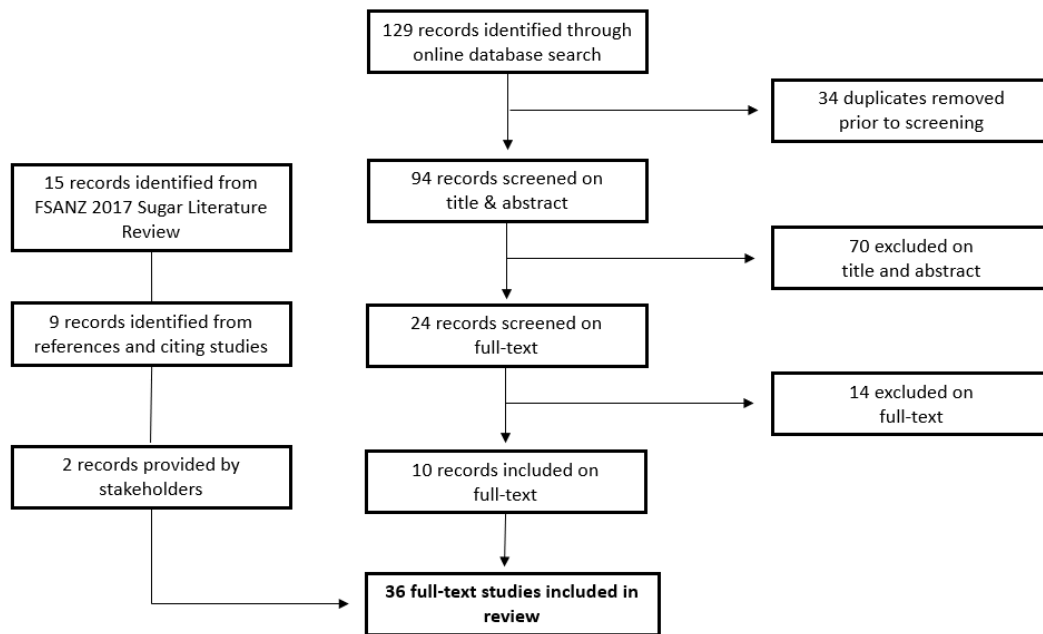
Following removal of duplicates, out of scope papers were removed based on title and/or abstract. Finally, documents identified as out of scope on the basis of full-text review were

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excluded. The screening process was conducted by one officer. Data extraction was carried out by one officer.

Figure A1 shows the number of documents retrieved at various stages of the review process. The information depicted in Figure A1 is based on the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA; Moher et al., 2010). Grey literature and the targeted nature of the search strings used can explain the lower number of records identified through the initial search.

Figure A1: Number of documents retrieved at various stages of the review process.



Appendix 2 – EFSA 2022 Data Analysis Methods

The EFSA (2022) study asked participants three questions that were relevant to the current literature review (Questions 7, 8 and 10). Detailed analysis of these questions was not reported in the EFSA (2022) report. FSANZ accessed the raw dataset that was available online in August 2022 (see <https://zenodo.org/record/6323326>) and analysed participant responses to these three questions. The dataset included 7,469 citizens (aged 18-76 years) across the 27 EU Member States, Iceland and Norway. The methods used to analyse the data for each question is outlined below, as well as detailed reporting of the results. All significance testing was conducted using SPSS statistical software.

Question 7

Question wording:

On a scale from 1 to 10, how well would you say you understand the following terms?

- Added sugars
- Free sugars
- Total dietary sugars

Analysis:

A two-way mixed ANOVA¹¹ was conducted to determine whether levels of perceived understanding significantly differed across the different sugar definitions (added. vs. total dietary. vs. free), and between participants with a lower level of education (secondary school or below, $n = 4,036$) vs. a higher level of education (university degree or higher, $n = 3,358$). Post-hoc tests were conducted using a Bonferroni-corrected alpha of 0.017.

Level of education was initially reported in the raw data set as Primary school or below ($n = 306$), secondary school or high school ($n = 3,730$), University degree or higher ($n = 3,358$) and Prefer not to say ($n = 75$). Given the relatively low number of participants with 'primary school or below' education, this group was combined with the 'secondary school or high school' group to create the 'lower level of education' group. The 75 participants who selected 'prefer not to say' when asked about their level of education are not included in this analysis.

Findings:

The two-way mixed ANOVA revealed that perceived understanding significantly differed across the different types of sugars ($F(2, 13851.57) = 4.18, p = 0.017, \eta_p^2 = 0.21$). Post-hoc tests showed that perceived understanding was significantly greatest for 'added sugars' ($mean = 7.30 \pm 2.39$), followed by 'total dietary sugars' ($mean = 6.77 \pm 2.57$), followed by 'free sugars' ($mean = 5.41 \pm 2.97$), all $p < 0.001$.

There was also a significant main effect of level of education ($F(1, 7392) = 21.23, p < 0.001, \eta_p^2 = 0.003$), as well as a significant interaction between type of sugar and level of education ($F(1.87, 13851.57) = 4.18, p = 0.017, \eta_p^2 = 0.001$). Post-hoc tests showed that participants with a lower level of education (secondary school or lower) had a significantly lower level of perceived understanding of 'added sugars' ($mean = 7.21 \pm 2.41$) than those with a higher

¹¹ Normality tests were not required given the high sample size (Field, 2018).

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level of education (university degree or higher; $mean = 7.41 \pm 2.36$; $t(7392) = 3.60$, $p < 0.001$). The same patterns of results was found regarding perceived understanding of 'total dietary sugars' ($mean = 6.62 \pm 2.62$ vs. $mean = 6.95 \pm 2.51$, $t(7249.63) = 5.59$, $p < 0.001$). However, there was no significant difference in perceived understanding of 'free sugars' between the two education groups ($mean = 5.33 \pm 2.97$ vs. $mean = 5.50 \pm 2.97$; $t(7392) = 2.35$, $p = 0.019$, note Bonferroni-corrected alpha of 0.017).

Question 8

Question wording:

For each of the following statements, please indicate whether you think it is true or false. Please indicate 'Don't know' if you really don't know.

- A product with "no added sugars" contains no sugar
- Added sugars are all artificial
- Sugars and added sugars are the same
- Fructose can be used as added sugar
- Honey can be used as an added sugar
- Added sugars can be from natural sources
- Added sugars are added during food preparation
- Added sugars are added during manufacturing
- Free sugars and added sugars are the same
- A product with "free sugars" contains no sugar
- Fruit contains sugars
- Added sugars can be found in savoury foods
- Added sugars are only added to sweet foods
- Honey is a source of free sugars
- Syrup is a source of free sugars
- 100% fruit juice contains free sugars

Analysis:

The percentage of participants that selected each response option (True/False/Don't know) were calculated for each statement.

Findings:

Table 1: The percentage of participants that selected each response option for each question. The most prevalent responses are bolded.

Statement	True	False	Don't know
A product with "no added sugars" contains no sugar	13.27%	69.80%	16.94%
Added sugars are all artificial	24.34%	49.56%	26.09%
Sugars and added sugars are the same	18.88%	54.69%	26.43%
Fructose can be used as added sugar	67.99%	8.56%	23.46%
Honey can be used as an added sugar	71.54%	9.47%	19.00%

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Added sugars can be from natural sources	64.21%	12.97%	22.81%
Added sugars are added during food preparation	62.66%	14.30%	23.04%
Added sugars are added during manufacturing	71.43%	6.94%	21.64%
Free sugars and added sugars are the same	12.55%	49.02%	38.44%
A product with "free sugars" contains no sugar	11.37%	54.37%	34.26%
Fruit contains sugars	90.05%	4.49%	5.46%
Added sugars can be found in savoury foods	66.41%	9.77%	23.82%
Added sugars are only added to sweet foods	15.72%	64.13%	20.15%
Honey is a source of free sugars	53.22%	10.47%	36.31%
Syrup is a source of free sugars	37.25%	21.25%	41.50%
100% fruit juice contains free sugars	53.34%	12.89%	33.77%

Question 10

Question wording:

In which of the following products do you expect to find added sugar?

- Fresh vegetables
- Ready-to-eat meals
- Fresh fruits
- Plain yogurt
- Fruit yogurt
- 100% Fruit juice
- Honey
- Ice cream
- Breakfast cereals (cornflakes, bran flakes)
- Milk
- Baked goods (cookies, cakes, pastries)
- Sweets and chocolate
- Sauces and condiments
- Soft drinks
- Energy drinks
- Sports drinks
- Alcoholic beverages
- None of the above

Analysis:

The percentage of participants (based on the total sample) that selected each product as containing added sugars was calculated. These percentages were also calculated based on education level. Education level was dichotomised as 'lower level of education' (secondary school or below, n = 4,036) and 'higher level of education' (university degree or higher, n = 3,358), as for Question 7. The 75 participants who selected 'prefer not to say' when asked

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about their level of education are not included in the percentage calculations that are reported for the different education-level groups. Differences in percentages between the two education-level groups were statistically compared using chi-square tests. Given the high number of comparisons, a sequential-Bonferroni correction was used to minimise type 2 error.

Findings:

Table 2: The percentage of participants selecting each product as containing added sugar. Significant p-values are bolded, based on a sequential-Bonferroni correction.

Product	Selected as containing added sugar			
	Total sample	Lower level of education	Higher level of education	P value
Fresh vegetables	4.79%	4.34%	5.33%	0.046
Ready-to-eat meals	70.02%	68.24%	72.33%	<0.001
Fresh fruits	9.06%	9.39%	8.76%	0.344
Plain yogurt	17.18%	16.58%	17.72%	0.194
Fruit yogurt	69.05%	67.05%	71.56%	<0.001
100% Fruit juice	33.90%	34.79%	32.76%	0.066
Honey	17.49%	18.33%	16.44%	0.032
Ice cream	82.46%	81.49%	83.77%	0.010
Breakfast cereals (cornflakes, bran flakes)	61.37%	58.62%	64.74%	<0.001
Milk	11.72%	11.45%	12.03%	0.437
Baked goods (cookies, cakes, pastries)	80.95%	80.45%	81.63%	0.200
Sweets and chocolate	86.20%	85.75%	86.93%	0.144
Sauces and condiments	65.83%	62.98%	69.48%	<0.001
Soft drinks	80.01%	78.34%	82.04%	<0.001

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Energy drinks	82.43%	81.00%	84.22%	<0.001
Sports drinks	70.18%	68.26%	72.75%	<0.001
Alcoholic beverages	59.34%	57.41%	61.70%	<0.001

1.74% of the total sample selected “none of the above.”

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Appendix 3 – Overview of Included Studies

Study	Country	Method	Participants	RQ1	RQ2	RQ3
Colles et al. 2014	Australia	Qualitative interviews	30 (70% female)	1.5		3.3
Department of Health 2013	Australia	Quantitative survey	1086 (57% female)		2.5	3.3
Drewnowski et al. 2010	United States	Quantitative survey	320 (78% female)		2.4	
EFSA 2022	European Union, Norway and Iceland	Quantitative survey	7,469 (51% female)	1.2, 1.3, 1.5, 1.6		3.3
FDA 2015a	United States	Quantitative survey	5,430 (57% female)		2.3	
FDA 2015b	United States	Quantitative survey	6,480 (58% female)	1.5	2.3, 2.4	
FDA 2015c	United States	Quantitative eye tracking	160 (54% female)		2.3	
FSANZ 2006	Australia and New Zealand	Quantitative survey	1,007 (50% female)	1.3		
Gill & Sattar 2014	United Kingdom	Quantitative survey	2,005 (51% female)	1.5		3.3
Gorton et al. 2010	New Zealand	Quantitative survey	1,525 (72% female)	1.3		
Graham & Roberto 2016	United States	Quantitative eye tracking	155 (71% female)		2.5	
Harris & Pomeranz 2021	United States	Quantitative survey	1,603 (80% female)	1.5		3.3
IFIC 2021	United States	Quantitative survey	1,014 (51% female)		2.5	

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Study	Country	Method	Participants	RQ1	RQ2	RQ3
IFIC 2022	United States	Quantitative survey	1,005 (51% female)		2.5	
Jensen et al. 2021	United States	Quantitative survey	1,614 (79% female)	1.5	2.4	3.3
Khandpur et al. 2017	United States	Quantitative survey	2,509 (59% female)		2.3	
Khandpur et al. 2020	United States	Quantitative survey	1,156 (53% female)	1.4	2.3	3.2, 3.3
Kim et al. 2021	United States	Quantitative survey	992 (49% female)		2.3	
Kyle & Thomas 2014	United States	Quantitative survey	288 (‘representative’ % female)		2.2	
Laquatra et al. 2015	United States	Mixed methods interviews and survey	27 interviews (% female not stated) 1,088 survey (‘representative’ % female)	1.4	2.3	
Morley & Ilichenko 2022	Australia	Quantitative survey	2,332 (‘representative’ % female)	1.5	2.4	
Mumena 2021	Saudi Arabia	Quantitative survey	424 (100% female)	1.5		
Nuss et. al. 2020	Australia	Quantitative survey	2,062 (51% female)	1.5		
Patterson et al. 2012	United Kingdom	Mixed methods focus groups and survey	4 focus groups, 9-10 participants (100% female) 367 survey (84% female)	1.4, 1.5		
Prada et al. 2020	Portugal	Quantitative survey	1,010 (76.6% female)	1.2, 1.5, 1.6		

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Study	Country	Method	Participants	RQ1	RQ2	RQ3
Prada et al. 2021a	Portugal	Qualitative focus groups	5 focus groups, 40 participants (77% female)	1.4		3.3
Prada et al. 2021b	Portugal	Quantitative survey	406 (80% female)		2.4	3.3
Rampersaud et al. 2014	United States	Quantitative survey	3,361 (57% female)	1.5	2.5	
Santana et al. 2022	Brazil	Qualitative focus groups	5 focus groups, 32 participants (50% female)	1.4	1.5	
Scapin et al. 2022	Brazil	Mixed methods focus groups and survey	5 focus groups, 32 participants (50% female) 1,277 survey (78% female)	1.4	2.3, 2.4	
Stastny & Keith 2018	United States	Quantitative survey	783 (76% female)		2.2	
Sütterlin & Siegrist 2015	Switzerland	Quantitative survey	780 (40% female)	1.5		3.3
Tang et al. 2020	China	Quantitative survey	1,136 (70.4% female)	1.2, 1.6		
Tierney et al. 2017	United Kingdom	Quantitative survey	445 (77% female)	1.5		
Timperio et al. 2003	Australia	Mixed method focus groups and survey	12 focus group, 62 participants (six groups female) 681 survey (51% female)	1.5		3.3
Vanderlee et al. 2015	Canada	Quantitative survey	2,008 (50% female)		2.3	