

Literature review on consumer knowledge, attitudes and behaviours relating to sugars and food labelling

Executive summary

Food Standards Australia New Zealand (FSANZ) has undertaken a literature review to examine consumer knowledge, attitudes and behaviours relating to sugars in foods and as presented on food labelling. The purpose of a literature review is to assess the evidence as it presently stands in the available literature. The literature sourced for this review is of varying quality and uses different methodological approaches. Given the limitations of the literature this review does not aim to draw definitive conclusions. However, the findings from the literature, when taken together, do point towards some consistent findings regarding sugars, labelling and consumers' understanding and behaviour.

Consumers are concerned about the sugar content of food. They believe that consumption of sugar is associated with negative health outcomes, such as weight gain. Consumers who are attempting to reduce their sugar intakes report limiting their consumption of food categories they consider being high in sugar (e.g. sugar-sweetened beverages (SSBs)) and reading food labels. However, there is some evidence that consumers underestimate the sugar content of beverages containing fruit and other food groups. This may be due to the perceived healthiness and contextual understanding of fruit and other food groups such as vegetables.

Consumers do not understand what 'added sugars' are. When asked, consumers tend to report negative attitudes towards added sugars. However, they are not able to classify particular sugars as 'added' or 'natural'. This appears to be related to consumer associations between types of sugars and the perceived degree of refinement. Sugars such as honey are considered less refined, and therefore more natural and not 'added'.

The literature review has found mixed evidence regarding whether Australian and New Zealand consumers can use current labelling to make informed choices with respect to sugar. Their ability to use labelling depends on the type of task they are completing. When given a comparison task, consumers are capable of identifying which of two products is lower in sugar. However, international research suggests consumers generally aren't able to use abstract information such as grams of sugar listed on a label to evaluate whether a food is high or low in sugar. As such, consumers may not completely comprehend the high quantity of sugar in foods such as SSBs or confectionary items. Even though the majority of consumers understand that a food carrying a 'no added sugar' claim may contain naturally occurring sugar, the claim can lead some consumers to incorrectly conclude that the food does not contain any sugar.

There is a limited volume of research examining the interaction between labelling and consumer choices in relation to sugar. However, the review identified some evidence that the inclusion of added sugars as a separate element on nutritional labelling may lead some consumers to overestimate the sugar content of a food item. This occurs where consumers believe 'added' sugars are in addition to the 'total' sugar content. Furthermore, the inclusion of 'added' sugar on nutrition labelling may lead some consumers to place too much emphasis on sugar, resulting in less accurate evaluations of a food's overall healthiness.

Although the above is true for *most* consumers, a possible exception is consumers who are highly motivated to read and use food labels. Consumers with higher nutritional knowledge and health interests appear more motivated to use nutrition labelling in regards to sugar content. Such consumers appear to compare products more frequently and find utility in nutrition labelling as well as interpretive labelling, such as the Health Star Rating and Traffic Light Labels.

Finally, despite the general lack of evidence of impact of sugar labelling on behaviour, in the case of SSBs, there is evidence that some labelling interventions may reduce purchase intentions for, and actual purchases, of SSBs.

The above findings taken together indicate that consumers' pre-existing interest in sugar influences both the awareness of the sugar content in food, as well as an understanding of the health effects of sugar consumption. Individual factors such as health consciousness and personal motivation are key drivers of consumer use of nutritional labelling and consumption behaviours. For those who are motivated to use labels to select items lower in sugar, the findings suggest they can use current labelling to do so. There is little evidence to suggest that nutritional labelling changes behaviour.

Given the limited evidence available, further research in relation to Australian and New Zealand's consumers response to various forms of sugar labelling could be beneficial.

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1 Introduction

The purpose of this literature review is to examine the evidence for consumers' knowledge, attitudes and behaviours relating to sugars in foods and associated food labelling, in the Australian and New Zealand context. This body of work is part of a broader program of work that was agreed to by the Australia and New Zealand Ministerial Forum on Food Regulation (the Forum) to support further investigation of labelling approaches for providing information on sugars.

This literature review has in part been informed by a previous FSANZ rapid evidence assessment (FSANZ 2016) produced in response to Recommendation 12 of *Labelling Logic: Review of Food Labelling Law and Policy* (2011). An objective of the Recommendation 12 rapid evidence assessment was to examine the impact of using the term 'added sugars' in the ingredient list followed by bracketed lists of sugars that are added as separate ingredients. The scope of the current review is broader by comparison and has sought to examine the relationship between sugars, consumers and label elements such as the nutrition information panel (NIP), ingredient list, front of pack labelling and health related claims.

International research has been included in this review due to the limited research conducted in the Australian and New Zealand context. As such, some findings may not be directly generalisable to the Australian and New Zealand context given differing labelling requirements for food internationally.

This literature review primarily addresses the objective of developing the evidence base to further investigate labelling approaches for providing information on sugars by:

- Assessing consumer understanding and behaviours in relation to sugar¹.
- Investigating consumer understanding of the sugar content of foods.
- Investigating consumer understanding and use of sugar information on food labels.
- Investigating the impact of food label use on consumer food choices in relation to sugar.

Secondary objectives of this review were to:

- Assess consumer understandings of dietary guidelines in relation to sugar intake.
- Investigate how consumers perceive and conceptualise sugar.
- Investigate the influence of labelling of sugar and beliefs about sugar on consumer behaviour.

Literature sourced for this review includes publications from 2003 up to May 2017 identified by searching six relevant online research databases for which FSANZ has a license. Additional literature was sourced using searches via Google and targeted web searching. All research documents identified through this process were reviewed for relevancy, resulting in the 43 studies used in this report. More detail on the search and review methods is provided in Appendix 2.

This report is structured such that each specified primary objective is addressed in turn. Secondary objectives are addressed throughout in the most relevant sections of the report. Each section contains key points that highlight key messages/themes from the research in that area. The final section of this review includes limitations of the research literature. Technical and methodological detail of each of the 43 studies is provided in two tables in

¹ Sugar as a term in this literature review is inclusive of 'total', 'added', 'free' and 'natural' sugar terms

Appendix 1. Table A1.1 provides an overview of the study design and outcome measures of relevance. Table A1.2 summarises the internal and external validity (i.e. generalisability to Australia and New Zealand) of each study. Possible scores for the internal and external validity ratings for the studies are low, medium, and high.

2 Consumer understanding and behaviours regarding sugar

Key points:

- Twenty relevant studies were identified examining consumer understanding and behaviours regarding sugar, six of which were conducted in Australia/New Zealand.
- Three studies identified that some consumers appear to understand that sugar is a source of energy in food. One Australian study found that around half of consumers understood this. However, consumers have conflicting views about whether high energy content irrespective of sugar content is a positive or a negative attribute for a food product.
- One study found that some consumers believe sugar from fruit is less fattening than other sugar.
- Two studies found some consumers believe sugar is higher in energy than other macronutrients, such as fat and carbohydrates.
- Four studies identified confusion amongst consumers around the difference between “total” and “added” sugars. Two studies in particular found some consumers do not understand that “added” sugars are a subcomponent of “total” sugars, instead believing they are in addition to “total” sugars.
- A generalisation from two studies is that consumers perceive sugar as an unhealthy nutrient and report that they mostly try to avoid sugar or limit their intake.
- Two studies found that consumers appear to limit or avoid sugar intake because they associate consumption of sugars with weight gain.
- However, one UK study indicates consumers don't have a good understanding of how much sugar they should be consuming. This limits their ability to understand whether their current consumption needs to be reduced.
- Three studies identified two main strategies are used by consumers to reduce or limit their sugar intake: limiting intake of foods understood to be high in sugar (e.g. cakes, biscuits, Sugar-sweetened Beverages (SSBs), and reading food labels.
- Two studies point towards individual factors, such as self-reported attention paid to the health aspects of food and personal beliefs that they can avoid high sugar foods, that affect consumer attempts to limit their sugar intake.

2.1 What is the general level of consumer understanding of sugar?

An Australian study (Watson et al., 2013) examined general understandings of the energy content of foods amongst Sydney shoppers². It was found that half of the shoppers interviewed associated sugar with ‘high energy’. In a quantitative survey component of the same study consisting of 405 respondents, 14% indicated they believed kilojoules were only a measure of the sugar content of a food³. When asked for reasons why they would purchase a ‘low energy’ variant of a breakfast cereal or muesli bar, between 40% and 55% of respondents indicated they would purchase such an item as they thought it meant it had less sugar. The findings of this study suggest that some consumers relate sugar content of food with energy density. However, while sugar was a nutrient consumers report being wary of, higher energy content was considered a positive attribute for a food product. How participants defined energy as an aspect of food was not investigated within this study.

² Participants consisted of forty individuals aged 18 years and over who reported they either shared responsibility or were the main grocery buyers for their household.

³ The majority of respondents (65%) correctly identified kilojoule content as a measure of energy.

A study of 681 Australian adults (Timperio et al. 2003) found high sugar content contributed to a food being considered fattening. Some participants indicated that they believed sugars consumed through fruit however were not fattening. This suggests consumer's evaluation of the health effects of sugar may in part be influenced by the food type containing the sugar. The study also provided some insight as to how consumers understood sugar is metabolised in comparison to other nutrients. Fifty six percent of participants agreed with the statement "your body can burn sugar quicker than it can burn fat".

Some Australian research has identified that the context surrounding food appears to influence consumer understanding of sugars. More specifically, the way a food item is viewed or perceived by an individual within broader contextual settings appear to moderate consumer beliefs about the nutrient content of a food. A qualitative study (Colless et al. 2014), using 30 interviews of 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.

A Polish study of consumers (Rejman and Kasperska 2011) reported that participants appeared to understand sugar better than any other nutrient on food labels. This was despite sugar being only the fifth most important nutrient listed in terms of overall concern to consumers. There was a significant gender difference in reporting with females declaring that sugar was a term that was clear and understood more so than males (91% compared to 80% of males). This study only examined self-reported (subjective) understanding and did not test objective understanding of sugar.

A European cross-country⁴ study by the European Consumer Organisation (BEUC 2005) found that 51% of respondents could correctly identify a carbohydrate. When shown a food product with a high carbohydrate/sugar content, 12% of respondents believed it was nutritionally 'very good' and 54% reported it was 'rather good' nutritionally⁵. One third of respondents indicated that the high sugar content presented to them was a nutritional disadvantage.

Using an online survey, the perceptions of sugar amongst 367 British consumers were examined (Patterson et al. 2012). Respondents were asked to rank eight dietary components from highest to lowest calorie content. The dietary components were fat, carbohydrates, sugar, aspartame, saturated fat, protein, alcohol, and salt. The respondents tended to rank either saturated fat (50%) or fat (36%) as the highest calorie dietary component. However, 24% of respondents believed that sugar was highest in calories. Respondents' perceptions of the calorie content of carbohydrates differed from sugar, with 7.5% of respondents believing carbohydrates were highest in calories. These findings suggest some consumers believe sugar is higher in calories than other macronutrients, including carbohydrates.

In the same survey (Patterson et al. 2012), participants were asked to identify from a list of nutrients⁶ which were the most important to watch out for to avoid weight gain. Sugar was the fourth item listed overall with only 7.4% of respondents selecting this item behind saturated fats (32%), calories (27%) and fat (22%). This result suggests that if consumers were seeking to prevent weight gain, a smaller portion of consumers would consider sugar to be the main nutrient they would look out for compared to other nutrients.

⁴ European countries surveyed consist of Germany, Hungary, Spain, Poland and Denmark. 600 participants were interviewed per country giving a total of 3000 participants.

⁵ Response choices were: "not good at all" (3%), "not very good" (15%), "rather good" (54%), "very good" (12%) and "don't know" (17%).

⁶ The nutrients listed were: saturated fat, calories, fat, sugar, carbohydrates, alcohol, protein and salt.

In a qualitative study of 12 consumer reference groups (92 participants in total) across the United Kingdom (FSA 2007), sugar was generally perceived by most to be a confusing nutrient. On one hand, consumers indicated that they understood sugar was a necessary component of a diet as a source of energy, yet at the same time believed excess sugar was stored as body fat and were unable to reconcile these two valid perceptions.

The findings in this section broadly indicate that consumers associate sugar with energy. However, while they believe sugar is an unhealthy nutrient, they also perceive energy as a positive aspect of food. In general, it would appear some consumers are confused about the nutritional value of sugar.

2.2 How well are the concepts of ‘total sugar’, ‘added sugar’ and ‘free sugar’ understood?

An online survey of 1086 Australians (Department of Health 2013a) examined what they considered to be the most (and least) important nutrients to include in a front-of-pack nutrition label⁷ using maximum difference scaling. After the star rating system itself, ‘total sugar’ was the second most important component, with a percentage “score” of 12%. In comparison to ‘total sugar’, ‘sugars’ was only the eighth most important component, with a percentage score of 6%. This indicates that ‘sugars’ were only considered half as important for inclusion on a front-of-pack label as ‘total sugar’. ‘Added sugar’ was less important, achieving a rank of 12th most important, with a percentage score of 4%. The authors suggest respondents found more meaning and value in ‘total sugar’ rather than ‘sugars’ or ‘added sugar’. Another possible interpretation is that respondents did not understand what the terms ‘sugars’ and ‘added sugars’ meant, whereas they felt more familiar with the concept of ‘total sugar’.

A survey from the United States (Rampersaud et al. 2014) of 3361 individuals found that total sugar content of beverages⁸ was a primary concern for 51% of respondents. ‘Added’ sugars were found to be a primary concern for 39% of respondents and natural sugars were of concern for 7%⁹. Whether the respondents understood ‘total’ and ‘added’ sugars was not investigated.

A United States study (Laquatra et al. 2015) used in-depth interviews to examine how consumers interpret the listing of ‘added sugars’ on the U.S Nutrition Facts Label (NFL). Interviewees were 27 adults from Los Angeles, California; Baltimore, Maryland; and Atlanta, Georgia. It was found during interviews that some consumers believed ‘added sugar’ indicated food manufacturers “had added more sugar into a product” (Laquatra et al. 2015, p.1758). In this respect it is not clear whether participants mean a product with added sugars listed has more sugar added by the manufacturer than a product without added sugars listed, or whether the participants understood the added sugar was the component of total sugar added by the manufacturer (and not coming from ingredients such as fruit that have some inherent sugar). The authors reported that some interviewees thought the added sugars were in addition to (rather than a subcomponent of) total sugars. Interviewees tended to have negative perceptions of added sugars.

⁷ Respondents were instructed “Please select the nutritional component that is most important for your needs to include on a front-of-pack label, and also select the component which you think is least important for your needs”. The list of components included: the star rating system, total sugar, total fat, saturated fat, kilojoules, 2 positive nutrients (e.g. calcium, fibre, vitamins), trans fat, sugars, sodium, energy, added sugar, protein, and carbohydrates.

⁸ Beverages listed in the study were; regular soft drink, fruit drinks, fruit cocktail, sports drink, diet soft drink, 100% fruit Juice, 100% Fruit and Veg Juice 100% Veg Juice & Milk.

⁹ Total sugar was not a concern for 49%, Added sugar was not a concern for 61% and natural sugar was not a concern for 93% of respondents.

A quantitative phase of the same study further examined consumer understanding through a survey of 1088 Americans. Respondents were asked to view NFL's with or without added sugars listed. Where present on the NFL, 'added sugars' was located underneath 'sugars' or 'total sugars' and was indented. Of those who viewed NFL's with 'sugars' followed by 'added sugars' listed, 52% of respondents indicated they believed that 'added sugars' were in addition to the existing 'sugars' listed. Of those who viewed a NFL with 'total sugars' and 'added sugars' listed after it, 33.4% indicated they believed the 'added sugars' were in addition to the 'total sugars' listed. The different perceptions of what 'added sugars' means by consumers when presented with either 'sugars' or 'total sugars' on the NFL was statistically significant¹⁰. While fewer respondents thought of 'added sugars' as separate to the overall sugar content when presented with a 'total sugar' amount, a third of respondents in this condition still perceived added sugars as additional to the total sugars listed.

A consumer research study conducted by the United States Food and Drug Administration (FDA 2015a) found similar results. From a sample of 5,430 participants, they found consumers were better able to identify the sugar content displayed on a NFL without added sugars compared to NFLs with added sugar listed directly underneath sugars and indented. Eighty one percent of respondents were able to correctly identify the gram content per serve on a NFL without added sugar listed, compared to 65% of respondents who viewed a NFL with added sugar included. The study by Laquatra et al. (2015), discussed above, found that consumers exposed to a similar NFL tended to believe the 'added sugars' were in addition to 'sugars', leading to an inflated perception of the quantity of sugar in the product. It is possible that this same misunderstanding occurred in the FDA's study, negatively affecting consumers' ability to correctly identify the gram content per serve of sugar on the NFL¹¹.

The same study (FDA 2015a) also examined the effect of the location of an 'added sugars' declaration. It was found 71% of respondents could correctly identify the amount of added sugar on the proposed NFL, with added sugar listed underneath sugar and indented. In contrast only 53% correctly identified added sugars on an alternative NFL with added sugars listed in a separate location on the label (away from total sugars) under the heading "Avoid too much"¹². These differences between label formats were statistically significant. This finding suggests that consumers expect information on different types of sugar (e.g. total and added sugar) to be located together on food labels.

An online survey (Tierney et al. 2017) of 445 Northern Ireland participants investigated consumers' understanding of sources of sugar and how they classify these. Respondents were asked to classify "Sugars present in milk (Lactose)" and "Sugars in fresh fruit and vegetables" as either added/free sugars¹³ or natural sugars or to declare they 'don't know'. Ninety seven percent reported that sugars in fruit and vegetables were natural, with 83% of participants reporting sugars found in milk (lactose) as natural. This finding indicates that consumers understand that milk, fruit and vegetables contain natural sugars rather than added sugars.

¹⁰ Perception that 'added sugars' are in addition to 'sugars' listed = 52% (confidence interval of 46.8 – 57.1) compared to 'total sugars' = 33.4% (confidence interval of 28.9 – 38.3)

¹¹ In response to the findings of this research, the FDA has altered the proposed NFL. It will now require the word 'total' to be listed before sugars as well as the phrase "includes x g Added Sugars" indented below to clarify added sugars are part of the total sugars listed.

¹² The other negative nutrients listed under the "Avoid too much" heading were saturated fat, trans fat, cholesterol, and sodium.

The same study sought to assess if respondents could correctly classify common terms used to identify sugars or artificial sweeteners in ingredient lists (Tierney et al. 2017). The sugars respondents were asked to categorise were: agave nectar, corn syrup, fructose, fruit juice, glucose, honey, invert sugar, isoglucose, maltose, molasses, and sucrose. The artificial sweeteners respondents categorised were aspartame and saccharin. Respondents were given the following instruction “If you saw the following items listed how would you classify them? Please categorise each one as natural sugar, added/free sugar or an artificial sweetener”. Respondents also had the option of selecting ‘don’t know’. The following note was included underneath the instruction “Added/Free sugars are those that are added to foods during manufacturing/cooking”. No definition was provided for natural sugars or for artificial sweeteners. The researchers noted that (under the WHO guidelines) all of the substances listed could be categorised as either an added sugar or as an artificial sweetener. Over half of the respondents declared ‘don’t know’ on whether they would classify ‘Isoglucose’ and ‘Invert sugar’ as added/free sugars or natural sugars if seen in an ingredient list. Close to a third of respondents declared ‘don’t know’ on how to classify maltose and agave nectar. The majority of participants incorrectly classified honey, fruit juice, fructose and molasses as natural sugars. These findings suggest that most consumers when given this definition of added sugar are not able to use it to correctly categorise sugars. The authors of this study noted that respondent understandings and classifications of terms used to identify sugar may be influenced by how ‘technical’ the term appears. This finding further suggests that consumer definitions of ‘natural sugars’ may extend to perceiving a sugar type as natural when it is derived from what may be regarded as natural sources/processes rather than manufactured sources. However, the study did not examine why consumers classified these as ‘natural sugars’ (e.g. whether they associated fructose with fruit).

A series of experiments conducted with German-speaking Swiss consumers examined perceptions of ‘fruit sugar’ compared to ‘sugar’ (Sütterlin and 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 finding is in line with broader literature regarding explicit and implicit associations (Conner and Norman 2005). It supports the notion that the perceptions and attitudes towards the health status of some foods (e.g. fruit as healthy) may influence perceptions of sugar associated with them (e.g. ‘fruit sugar’) (this is discussed in more detail in Section 3).

The above findings suggest that context and possible associations between concepts of health and food types influence consumers’ categorisation of sugars. There was no research identified through the search strategy for this literature review that investigated consumer understanding of ‘free’ sugars specifically.

2.3 Are consumers aware of messages to limit sugar intake?

What are the messages and where are they sourced from?

A recent survey by the International Food Information Council Foundation (IFIC 2017) investigated American consumers’ opinions with regard to added sugar. The survey found that consumer¹⁴ opinions have become more negative by up to 32% in comparison to the previous year’s survey results. Overall, 6 in 10 viewed added sugars negatively¹⁵. Respondents reported on the information sources that were most influential in altering their opinions (in a more negative or a more positive direction) on added sugar. The sources of

¹⁴ 1002 residents of the United States representing a wide array of demographics were surveyed

¹⁵ 1 in 10 had positive opinions, 3 in 10 were neutral

information that influenced negative opinions were: firstly, news articles or headlines; second, friends and family; and third, scientific research¹⁶. In contrast to negative views, 7% of those surveyed indicated that their opinion of added sugars in the last year had become positive, with the main driver of this change reportedly being conversations with a personal health care professional.

Qualitative research commissioned by the UK Food Standards Agency (FSA 2007) found that consumers did not have an understanding of how much sugar they should be consuming. Therefore, participants did not have an understanding of whether they were consuming more or less sugar than dietary guidelines recommend.

A previously mentioned study in section 2.2, (Tierney et al. 2017) surveyed people in Northern Ireland on their awareness of the 2015 World Health Organization (WHO) guidelines related to 'free sugars'¹⁷. They found that 65% of the respondents surveyed were not aware of the guideline. Of interest, however, is that both age and self-reported interest in nutrition were positively associated with individuals' awareness of the WHO guidelines.

Earlier sections of this literature review and the findings from IFIC (2017) reported in this section suggest that consumers view sugars negatively. More specifically, they also have negative attitudes towards added sugar. However, there is limited evidence available on what messages about sugar consumers are being exposed to, or where they are sourcing information about sugar. One UK study suggested that consumers did not understand how much sugar they should be consuming and, therefore, whether they needed to reduce their intakes.

2.4 Are consumers attempting to reduce their sugar intake? If so, why, and how?

An Australian study (Pollard et al., 2016) gathered data from the Western Australian Department of Health's Nutrition Monitor Survey Series, as well as the South Australian Monitoring and Surveillance System. Using data pooled from 2,832 Western Australian adults and 10,764 South Australian adults, the study aimed to examine factors related to self-reported consumption rates of Sugar-Sweetened Beverages (SSBs). It was found that the level of attention an individual had towards the healthiness of their food influenced their consumption of SSB's. Those who report they "don't really think about" the health aspects of the food they eat were four and a half times more likely to regularly drink soft drink than those who 'pay a lot of attention'¹⁸. Such a finding suggests that factors such as an individual's level of attention to healthiness influence their intake of SSBs. Consequently, one reason for some consumers *not* attempting to limit their sugar intake may be in part due to the lack of attention they pay to the health aspects of the foods they eat.

Some additional support for individual factors influencing consumption of sugar as discussed in Pollard et al. (2016) at the beginning of this section comes from research conducted in Ireland (Naughton et al. 2015). In a study of 477 Irish adults, participants responded to a questionnaire that was analysed to provide a calculation of daily intake of sugar in grams. Existing food consumption habits and an individual's belief in their own ability to avoid sugary

¹⁶ Analysis of scientific reporting and media coverage of sugars by Borra and Bouchoux (2009) suggests that news stories related to sugar are often driven by new scientific research findings.

¹⁷ Respondents were asked "Have you heard of the World Health Organisation (WHO) recommendation for the reduction of added sugar to 5% of daily intake for additional health benefits?". The available response options were 'Yes' and 'No'.

¹⁸ Odd's ratios with confidence intervals: 'Pay a lot of attention' =1, 'Take a bit of notice' = 1.73 (1.28-2.34), 'Don't really think of' = 4.55 (1.15-7.64)

foods were two significant predictors of sugar consumption levels. Individuals who planned to avoid sugary foods and believed it was possible to do so had significantly lower amounts of sugar per day than those who did not plan to avoid sugars or did not believe they could. Like the study by Pollard et al. (2016) (which focused specifically on SSBs), this study supports the importance of individuals' personal attributes and habits in influencing their food choices.

The United States IFIC 2017 Food and Health Survey found that 76% of respondents are currently trying to avoid/limit sugars in general. Results from the previous year (IFIC 2016) found that 52% were trying to avoid/limit sugars and 61% were trying to avoid/limit 'added' sugars specifically. These results are similar to those from an IFIC survey conducted 10 years previously (IFIC, 2007). In 2007, 71% percent of respondents indicated they were trying to consume less sugar and 67% reported they were trying to consume less added sugars. The findings from the IFIC Food and Health surveys indicate over half of United States consumers have been trying to limit or avoid sugars and that this has not changed substantially in the past 10 years¹⁹.

In the same study (IFIC 2017), respondents who reported they were limiting or avoiding sugars in their diet were asked about the actions they were taking to achieve this. The main approaches American consumers report taking to reduce sugar include: drinking water over caloric beverages; removing some foods from their diet; not adding table sugar to food and drinks; and using nutrition facts labelling to inform food choices²⁰.

Consumers report that a common message they receive is that sugar intake is related to weight gain. The IFIC (2017) survey found a third of respondents believe sugar is the source of calories that is most likely to cause weight gain²¹. This result was an increase from 2016 when 25% of respondents believed sugar was the source of calories most likely to cause weight gain (IFIC, 2016). This suggests consumers may attempt to limit their sugar intake to prevent weight gain.

In a qualitative component of a study mentioned in section 2.1 (Patterson et al. 2012), the researchers examined what consumers considered to be the benefits of reduced sugar products. The researchers conducted four focus groups, each with 9-10 participants. Focus group participants identified reduced risk of diabetes, better dental health and weight loss as possible health reasons for purchasing a reduced sugar product.

Irish adults were asked an open ended question in a survey on how they manage their sugar intake (Tierney et al. 2016). The responses were classified into three common themes/categories that were representative of three-quarters of the responses given in total. Twenty seven percent considered avoiding processed and pre-packaged foods as important in managing sugar intake; another 27% of responses fell into the theme of avoiding easily recognisable sugary foods such as cakes, biscuits, fizzy drinks and fruit juices. The third theme accounting for 21% of responses involved consumers using current labels²² to manage their intake of sugars.

¹⁹ The IFIC surveys are conducted in a manner using a stratified sample base considered to be representative of the U.S population.

²⁰ >60% reported drinking water instead of caloric beverages, close to 50% reported eliminating certain foods and drinks from their diet, close to 35% reported avoiding the addition of table sugars to food and drinks, and another 35% reported using nutrition labelling.

²¹ Participants were asked "what source of calories is the most likely to cause weight gain?" Other response options included "Carbohydrates", "Fats", "Protein", "All about the same" and "Not sure".

²² At the time of the study nutrition information panels were displayed on most pre-packaged food products in Northern Ireland. However, with some exceptions (e.g. where health or nutrition claims were made), they were not mandatory. Traffic light labels were also commonly displayed, but not mandatory.

The findings in this section indicate that consumers who associate what they eat with health outcomes report trying to limit or avoid sugar intake. In line with broader literature concerning health related behaviour (Conner and Norman 2005), it would appear that what underpins limiting/avoidance behaviours regarding sugar is self-efficacy; an individuals' beliefs about their ability to alter behaviour and the level of attention paid to the health aspects of the foods they eat.

3 Consumer understanding regarding the sugar content of foods

Key points:

- Seven relevant studies were identified examining consumer understanding regarding the sugar content of foods, of which three were conducted in Australia/New Zealand.
- Three studies found that the food group in which a food falls appears to influence consumer perceptions of the sugar content of a food item. For example, some consumers underestimate the sugar content of fruit juices.
- Three studies found that consumers are relatively accurate at ranking beverages by their total sugar content. However, they have less understanding of which beverages contain (or do not contain) added sugar.
- Consumers' understanding of the sugar content of beverages containing fruit may be poorer than for other beverages. One study found that consumers tend to underestimate the sugar content of beverages containing fruit (but do not underestimate the sugar content of carbonated beverages). Another study found that around a quarter of consumers do not believe that 100% fruit juice contains naturally occurring sugar.
- Consumers believe that beverages containing fruit are healthier than beverages with a similar sugar content that do not contain fruit.
- Consumers' perceptions of fruit beverages may be related to consumers' beliefs that fruit is healthy and/or the belief (reported in section 2) that the sugar in fruit is less fattening than sugar in other foods.

3.1 Do consumers understand which foods are high in sugar?

3.1.1 Australian and New Zealand studies

Qualitative research conducted by the Australian Department of Health (2013b) indicates that consumers perceive food on a continuum of healthiness. The research included 15 focus groups, five accompanied shopping trips and an online bulletin board. The researchers concluded that the continuum of healthiness on which consumers place a food is dictated by the presence or absence of factors that are considered to be 'good' or 'bad' (e.g. sugar, fat, degree of food processing, perceived naturalness). This suggests that the presence of perceived unhealthy attributes (e.g. how processed a food is believed to be) may influence consumer perceptions of the presence of other 'unhealthy' elements such as sugar. That is, a food that appears to be overtly packaged and labelled with a high fat content may then be seen as being high in sugar as well, whether it contains high levels of sugar or not.

Three studies have looked at consumer understanding of the sugar content of various beverages. The studies examined slightly different questions, so it is not possible to pool their findings. One study is of Australian and New Zealand consumers, and is reported below in this subsection. The other two studies (Rampersaud et al. 2014, Bucher & Siegrist 2015) are reported in the next subsection of international studies.

A 2006 study of 2,091 Australians and New Zealanders found that using their own prior knowledge of beverages²³, people were reasonably accurate at gauging the relative levels of sugar in formulated beverages²⁴ and other non-alcoholic drinks (FSANZ 2006a). The majority of consumers correctly reported that formulated beverages contained more sugar than water

²³ Participants in this study were not shown nutrition information for the beverages.

²⁴ Formulated beverages consist of flavoured, non-carbonated, ready to drink products that are water based, contain vitamins or minerals, as well as a limiting sugar content to no more than 75g per litre.

(bottled or tap). Around 60% correctly thought that formulated beverages contained more sugar than milk, and about the same proportion believed that sugar sweetened soft drinks contained more sugar than formulated beverages. However, the results showed the consumers were uncertain about the relative sugar content of formulated beverages and fruit juices. Approximately 40% correctly thought that diet/no sugar soft drinks contained less sugar than formulated beverages.

3.1.2 International studies

A U.S survey previously described in section 2.2 (Rampersaud et al. 2014) examined perceptions of whether beverages were 'sugary' or not. Respondents were asked to indicate how sugary particular types of beverages were with water serving as a baseline comparison. The results showed a mixture of understanding with respect to sugary drinks: 96% replied that sugar sweetened soft drinks were sugary and 45% also thought diet soft drinks were sugary. Thirty-nine percent felt that 100% fruit juice was sugary, and this decreased to 24% for a combined fruit/vegetable juice drink²⁵.

A Swiss study of 100 children and their parents (Bucher and Siegrist 2015) found that, in a sort task in which parents and children were asked individually to rank 20 non-alcoholic beverages from unhealthy to healthy, a high sugar content (g/L) was the strongest predictor of perceived unhealthiness. The second best predictor of unhealthiness was the presence of artificial sweeteners, followed by presence of caffeine. Fruit content as indicated by a percentage was the fourth significant predictor of unhealthiness, and was the only predictor that contributed to perceived healthiness. Bottled water products were ranked as healthiest, followed by fruit juices, then soft drinks and energy drinks. These findings suggest that some consumers may understand there is a positive association between fruit and sugar content (i.e. that beverages high in fruit content will also be high in total sugar), or another possible explanation not tested in this study is that fruit drinks in comparison to other beverages may be put into this ranking position by virtue of the comparisons being made.

A nationally representative study of 2005 U.K adults (Gill and Sattar 2014) assessed the ability of consumers to estimate the sugar content of various beverages. Participants were shown pictures of beverages that had roughly equal sugar amounts. The beverages displayed were an assortment of SSBs, fruit juices and fruit smoothies. Participants were then asked to estimate how many tea spoons of sugar are in each drink. On average, the sugar content of fruit juices and fruit smoothies were under estimated by 48%. The sugar content of carbonated beverages on the other hand were over estimated by 12%. Given the actual sugar content of the beverages displayed were similar, the authors note this finding suggests consumers on average do not appreciate the sugar content of fruit related beverages. It may also be (as this review offers an interpretation) that the identification of fruit as a component of a beverage may mediate evaluations of sugar content. In line with the finding by Sütterlin and Siegrist (2015) outlined in section 2.2, it may be that a halo effect exists in relation to fruit, whereby the presence of fruit in a food elicits perceptions of healthiness that may in turn minimise evaluations of sugar content.

Beyond beverages, an experimental study conducted in Switzerland examining consumer understandings of healthy food choices (Mötteli et al. 2016) found no overall difference in the overall sugar content of foods chosen by a control group and 'healthy' group ($n = 187$). All participants were asked to select foods they would eat for an entire day from items in a food buffet assembled by nutritionists. Those who were randomly assigned to the healthy group were asked to choose items they would eat as part of a healthy and balanced diet, and the

²⁵ No confidence intervals have been provided, so the study does not indicate which proportions are statistically of significant difference.

control group was asked to select items that would constitute their regular daily diet. Both groups made food selections that would exceed Swiss dietary guidelines regarding energy intake gained from sugars. The average of total daily energy intake provided by sugar for both the 'healthy' group and control group was 21%²⁶ each. This amount exceeds the Swiss dietary guideline of less than 10% of daily energy to be obtained from sugars.

While there was no difference in sugar totals between the two groups, there was a significant difference in food selections made between the two groups. Those asked to select a healthy diet selected significantly larger portions of fruit and vegetables, as well as significantly smaller quantities of sweets, sugar-sweetened beverages and flavoured yoghurt with added sugar. The results suggest that participants understand that sweets, sugar-sweetened beverages and flavoured yoghurt with added sugar were less healthy than fruits and vegetables for instance. Given the selections made, it's more likely that the differences between the groups in regards to added sugar content is a by-product of different food groups selected between the two groups. The authors note, that while participants are able to identify generally healthier food items when asked to do so, it appears that participants overall were not aware of healthy portion sizes which led to excessive sugar selections by participants.

3.2 Do consumers understand which foods are high in added, natural, free or total sugar?

A survey conducted by the Department of Health (2013a) (see section 2.2) also examined how important respondents considered different nutrition information components they would like to see for different food categories²⁷. This may provide some insight into which food categories consumers consider high in sugar. The importance respondents attached to 'total sugar' varied considerably depending on the food category. 'Total sugar' was the second most important nutrition information for the category 'Breakfast cereals, muesli bars and snacks' (after the star rating system) and the most important for the category 'Juices and drinks'. In contrast, 'total sugar' was less important for 'Pre-prepared/convenience meals', 'Meats, chicken and fish', and 'Dairy products'. 'Sugars' and 'added sugar' were generally significantly less important than 'total sugar' and other nutrition information. However, for the category 'Juice and drinks', 'added sugar' was the fourth most important nutrition information component after 'total sugar', 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 sugar or added sugar than other food categories. Australian consumers may generally be less concerned about the added sugar content of food (compared to other nutrients, including total sugar) with the exception of beverages.

The study by Rampersaud et al. (2014) (see section 2.2 of this review) appears to show that respondents did not have a good general understanding of the types of sugars present in commonly-consumed beverages. Respondents were asked to indicate, for each beverage type, which of four sweeteners was contained in the product.²⁸ Respondents were not shown

²⁶ Participants in the control group selected food items that contained a total of 122.8 grams of sugar and participants in the 'health' group selected items that contained a total of 120.5 grams of sugar

²⁷ Respondents were instructed "In the grid below, please select the most important nutritional information that you would like to see for each type of food shown. You can select a maximum of five nutrients for each food type". The nutrition information items listed were: the star rating system, total sugar, total fat, fibre, sodium, kilojoules, sugars, saturated fat, carbohydrates, trans fat, energy, added sugar, protein, iron, calcium, vitamin D, and vitamin C.

²⁸ Options for all beverages were: Does not contain sugar; Contains natural sugar; Contains added sugar (including HFCS); Contains artificial sweetener (such as Splenda or Aspartame). Respondents could select more than one response option for each beverage.

food labels for the beverages and so needed to rely on their own prior knowledge of these beverages to complete the task. While 97% of respondents knew that water did not contain sugar, for all three 100% fruit juices tested²⁹ around 11% incorrectly believed that they did not contain sugar. In terms of awareness of added sugar, 77% percent of respondents were aware that regular soft drinks contain added sugar, 58% were aware that sports drinks contain added sugar, 62% were aware that 5% fruit drinks contain added sugar, and 50% of respondents were aware that cranberry juice cocktail contains added sugar. With respect to natural sugar, 80% of respondents correctly believed that this was present in 100% orange juice. This dropped to 74% for 100% apple juice and 73% for 100% grape juice. These numbers reversed for perceptions of added sugar: 8% incorrectly believed 100% orange juice contained added sugar, increasing to 12% for 100% apple juice and 13% for 100% grape juice.

The findings from Rampersaud et al. (2014) also suggest some consumers may not understand the sugar content and properties of vegetables and milk. While just over half of respondents correctly believed that pure vegetable juice contains natural sugar, 19% incorrectly believed that it does not contain sugar, and 7% incorrectly thought that such a type of beverage contains added sugar. Respondent understanding of the sugar content of fruit-vegetable juice blends was worse: only 49% of respondents realised these beverages contained natural sugar, with 33% incorrectly thinking they contain added sugar and incorrectly 5% thinking they do not contain any sugar. Regarding milk, 35% incorrectly thought that reduced-fat (2%) milk did not contain sugar and 39% thought that fat-free milk did not contain sugar, and these proportions were larger than the respondents who correctly thought that the milks contained natural sugar (24% and 23%, respectively). Such findings suggest that some consumers may be confused about the added and natural sugar content of fruit, vegetable and milk beverages.

²⁹ 100% orange, 100% grape, and 100% apple juice.

4 Consumer understanding and use of sugar information on food labels

Key points:

- Twenty relevant studies were identified that examined consumer understanding and use of sugar information on food labelling, of which seven were conducted in Australia/New Zealand.
- Two studies suggest over half of Australian and New Zealand consumers report regularly looking at the sugar content of foods they are purchasing for the first time. Some Australian and New Zealand studies found that information on sugar content was looked for more frequently than any other nutrient. This suggests consumers pay a lot of attention to sugar in food.
- Two Australian/New Zealand studies found that around one quarter of consumers believe that products carrying the claim 'no added sugar' do not contain any sugar. Approximately three quarters of consumers do understand that a product carrying this claim may contain naturally occurring sugar.
- From three large studies, of those consumers who report using food labelling, the NIP or international equivalent, appear to be the most commonly used. However, one study from the U.S indicates there is some evidence that consumers over-estimate how much they use nutrition labelling, including sugar information.
- The FSANZ consumer label survey found that when instructed to do so, the majority of Australians and New Zealanders are able to use mandated nutrition information on food labels to determine which of two products is healthier with respect to sugar.
- Three studies taken together indicate some consumers appear to have trouble interpreting sugar information on labelling in a meaningful way. Without further information to provide context, consumers have trouble assessing whether the amount of sugar (e.g. in grams) in a food product is "a lot" or "a little".
- Three studies found consumers tended to show confusion when presented with labelling that mentioned both (total) sugar and added sugar. This likely reflects the lack of understanding (reported in section 2) of differences in 'added' and 'total' sugar. One study by the U.S FDA found consumers generally expect sugars to be grouped together on food labels.
- Two studies found that listing 'added sugars' in nutrition labels may lead some consumers to overestimate the total sugar content of products. One study suggests that this may occur because consumers believe 'added sugars' are in addition to total sugars.
- One study found that consumers may place too much emphasis on added sugar content on labels when evaluating the overall healthiness of products. This may lead them to underestimate the healthiness of some products and to overestimate the healthiness of other products.

A previous review of 16 Australian and New Zealand studies (Ni Mhurchu and Gorton 2007) concerning consumer usage of nutritional labels suggests that while consumers report using nutrition information on food labels often, it appears that their comprehension and understanding of the information is low overall. Some research discussed in Section 4.2 indicates consumers may over estimate their use of nutrition labelling.

4.1 Which foods do consumers currently check for sugar content information?

A New Zealand survey of 118 shoppers in Christchurch sought to examine what consumers looked for when purchasing snack food items (Forbes, Kahiya, & Balderstone, 2015). An important finding in this survey of shoppers within a supermarket setting was the emphasis

consumers placed on sugar followed by fat content³⁰. Fifty-five percent of those surveyed reported using food labels when buying snack food items. However, the study did not measure the extent to which participants understood the labels they reported using. None the less, with sugar being the most important nutrient consumers were concerned about, its presence on labelling was reported as being influential on snack food selections amongst consumers.

A qualitative New Zealand study of 15 parents (Maubach et al. 2009) found that few reported using any packaging information when making food choices in a supermarket. Of those that did look at the NIP, sugar and fat were reported as being the two key nutrients parents looked for on labels. However, it was found that some parents still would buy less healthy products even when they reported reading the nutrition information. In the example described in the study, one parent reported that they used the NIP to avoid purchasing high sugar products for their child, but would still purchase a high-sugar breakfast cereal. The study did not investigate this apparent contradiction or what other factors influenced their decision.

No other literature was identified that specifically examined which foods consumers check for sugar content information. As described earlier in this report, consumers understand that some food categories (e.g. SSBs) are high in sugar. It is possible that for these food categories, consumers do not feel they need to check labelling because they believe they already know the most important information (e.g. that it is high in sugar). This hypothesis is somewhat supported by the findings of one study (not specific to sugar) by Grunert et al. (2010b)³¹. This observational study found that of six food categories (breakfast cereals, carbonated soft drinks, confectionary, ready meals, salty snacks and yoghurt), consumers spent the most time looking at labels on ready meals and the least time on carbonated soft drinks.

4.2 Which label element(s) do consumers check for sugar content information, and why?

Results from a consumer label survey conducted by FSANZ (2015) reported that 72% of Australians ($n = 1,396$) and 67% of New Zealanders ($n = 1,015$) reported using the NIP when first purchasing a food. The use of the ingredient list was similar with 72% of Australians and 66% of New Zealanders reporting that they use this information when buying a food for the first time. When using the NIP for a first time purchase of a food, the amount of sugar was reported as the most looked at item by consumers³². Of those who used the ingredient list, sugar was also the item looked for most frequently³³.

The same survey also asked respondents to indicate which label element they would use when selecting between two cereal variants³⁴ presented to them. Specifically, respondents were asked to indicate which label elements they would use to make a healthier choice in regards to sugar. The most common label element selected by respondents overall was the NIP. From responses gathered, population estimates were that 94% of people selecting the low sugar variant used the NIP. Of those who selected the higher sugar variant as the healthier option, 72% reported using the NIP to help inform their decision. Of those who considered both cereal variants as equally healthy, 72% selected using the NIP to make their decision. There was a statistically significant difference between the number of respondents using the NIP to inform their decision between the higher and lower sugar cereal variants.

³⁰ Between 40% and 45% of those surveyed placed importance on sugar and fat nutritional content.

³² 62.02% (59.23% - 64.73%) of Australians and 57.13% (54.05% - 60.15%) of New Zealanders.

³³ 42.57% (39.88% - 45.30%) of Australians and 41.01% (38.00% - 44.09%) of New Zealanders.

³⁴ One cereal had higher level of sugars and the other was lower. However, the lower sugar variant was higher in saturated fats while the high sugar variant was low in saturated fats.

An earlier online survey by FSANZ (2008)³⁵, examined which elements of food labels food buyers reported looking at the first time they bought a product³⁶. Of the elements in the NIP, fat was the most looked at nutrient, checked by 62% of Australian respondents and by 56% of New Zealand respondents. Sugar was the second most looked at nutrient, with 57% of Australian respondents and 53% of New Zealand respondents checking this. This finding suggests that sugar content has attracted a high amount of attention from Australian and New Zealand consumers for some time. The findings from the more recent FSANZ study (FSANZ 2015) suggest interest in sugar on food labels has increased relative to other nutrients, such as fat, over time. However, the differences in sampling do not permit this to be tested statistically.

A study of adults in Northern Ireland previously mentioned in this review (Tierney et al. 2017) found that total sugar content was the second most important item of interest behind calories. In terms of nutrition panel items that were ever looked at on food products, around 67% respondents indicated that both caloric and total sugar content were equally looked for most frequently.

A study of six European countries³⁷ (Grunert et al. 2010) found that across the countries sugar was the third most searched for nutrient after calories and fat³⁸. When asked which label elements individuals look for nutritional information, the most common element looked at was the nutrition grid³⁹ (38.5%), followed by Guideline Daily Amount (GDA) labels (29.2%). While there was some variation between countries, the overall results are representative of general trends. Statistical models were used to assess which individual factors were influential on consumer use of nutritional labelling instore. A model that looked only at demographic information (i.e. age, gender, BMI, country, social status) was not significant, however, when the model included variables including interest in healthy eating and nutritional knowledge the model became significant and explained 9% of variation⁴⁰. From this it appears that an understanding of nutritional information and an interest in healthy eating influences use of nutrition labels.

The above studies mentioned in this section have relied upon participants self-reporting on their behaviours in regards to label use. A study (Graham & Jeffery, 2011) that contrasted self-reported label use with tracking eye movements when looking at nutritional information found a significant difference between the two⁴¹. This suggests that what people actually do is not always the same as what they say they do. At the University of Minnesota 203 participants were exposed to 64 food products and their associated nutritional information. For each product they were shown they were asked to indicate whether they would buy the product or not. What they looked for on the food products and nutrition labels was measured using an eye tracker. After completing this task participants then filled out a questionnaire and reported on which elements of a food package they typically pay attention to. Self-reported looking for sugar on the nutrition facts label was evenly spread amongst reports

³⁵ The sample was drawn from TNSSR's online panel. The total sample included was 2000 (AU, $n=1200$; NZ, $n=800$). Weighting was applied by gender and age for the sample in both countries.

³⁶ This question was only asked of respondents who had indicated they were responsible for at least some of the grocery buying in their household: AU ($n=1129$), NZ ($n=732$).

³⁷ Countries included: UK ($n=2019$), Sweden ($n=1858$), France ($n=2337$), Germany ($n=1963$), Poland ($n=1800$), Hungary ($n=1804$).

³⁸ 33.8% percent of participants identified sugar, 38% identified fat and 39.6% identified calories.

³⁹ Equivalent to the Australian New Zealand NIP and U.S NFL

⁴⁰ Overall model shifted from $p=.241$ to $p<.01$ when interest and knowledge were included. Both variables were significant $p<.01$.

⁴¹ All self-reported distributions in the study were significantly different from those measured via eye tracking (χ^2 ranged from 24.8 to 215.7; $p<0.001$)

ranging from 'never' (19.5%) to 'always' (23.8%)⁴². By comparison, eye tracking measurements of where participants actually looked revealed 59.7% never/rarely⁴³ looked at sugar on the nutrition facts label and 1.1% almost always looked⁴⁴.

4.3 How do consumers understand sugar information on food labels?

In an Australian ($n = 506$) and New Zealand ($n = 501$) online experiment (FSANZ 2006b), participants were asked to assess the sugar level of six products with a 'no added sugar' claim and with or without a 'contains natural sugar' disclaimer. 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 the nutrition information panel and the ingredient list. All six of the products (vegetable juice, yoghurt, fruit and nut bar, muesli, apple juice, and canned peaches in fruit juice) contained some natural sugar. In the absence of a 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. The remaining participants rated these foods as containing some (low, medium, or high) sugar. The presence of the disclaimer had a statistically significant effect on the likelihood of participants incorrectly reporting that the food products contained no sugar. That is if the disclaimer was present, participants were less likely to report that the six products contained no sugar. The authors concluded that participants had a high level of awareness that products with the 'no added sugar' claim could contain natural sugar.

A New Zealand study (Gorton et al. 2010) sought to quantitatively assess how different demographics interpreted nutrition claims on food packaging. New Zealand shoppers ($n = 1525$) were presented with a mock cereal product with nutrition claims on the package, one of which was 'no added sugar'. Seventy two percent of respondents 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. There were significant differences by ethnic group in understanding of the sugar related health claim on the cereal package presented. New Zealand European were more accurate in responses to the sugar claim than Asian, Maori and Pacific participants on average⁴⁵.

Some literature shows that consumers believe the listing of added sugars on nutrition labels will be helpful. A survey of 288 U.S adults (Kyle & Thomas, 2014) asked how helpful, and why it would be helpful to know how much added sugar was in a food product. The majority (63%) reported that knowing how much added sugar would be helpful and 18% of respondents indicated they thought it would be confusing. Of those who reported the labelling would be helpful, 17% indicated that the reason it would be helpful was 'to know'⁴⁶. Of those who reported added sugars would be confusing, 43% did not provide a response when asked why they thought it would be helpful or confusing. However, 15% of those who

⁴² Responses for 'sometimes' = 30.3% and 'often' = 26.5%

⁴³ Never/rarely viewing an item was defined as viewing it on less than 10% of the 64 food products, sometimes as 10-40% of products, often as 41-80% of products, and always/almost always as over 80% of products.

⁴⁴ Other eye tracking measurements revealed 30.1% sometimes looked and 9.1% often looked for sugars on the NFL.

⁴⁵ Asian participants had the lowest percentages of correct responses; however as an ethnic demographic, they had the highest level of tertiary education reported. Comprehension of the English language was not a measured variable and may have influenced findings.

⁴⁶ 13% indicated health reasons and 10% responded to distinguish natural from added sugars. 17% were unresponsive as to 'why'.

reported added sugar information would be confusing indicated they thought so as the information was irrelevant/meaningless⁴⁷.

In a set of structured discussions within a focus group setting (Patterson et al. 2012), participants indicated that they would feel tricked if a product claiming to have reduced sugars did not have reduced calories as well. Generally, participants in the focus groups expected that a 15% or 30% reduction in sugar content of a food would at least lead to the same amount of reduction in calories. When presented with four food products with either a 'no added sugars' or 'reduced sugars' claim that had 29% to 49% sugar reductions, participants were surprised when they were informed that the caloric content had only reduced by 1.4% to 5.7%⁴⁸. Two quotes expressed the general sentiment of the participants: "*there must be a high calorie value in whatever is replacing the salt and sugar to make it nearly the same*"; "*we would be suckers to buy the no added sugar version*". When asked what 'reduced sugar' meant, participants indicated that they thought it would be helpful if it was stated how much the sugar was reduced in comparison to the same product without reduction⁴⁹.

As already discussed in section 2.2 of this review, findings from two studies (Laquatra et al. 2015; FDA 2015a) found that the inclusion of added sugars indented below 'sugars' or 'total sugars' caused confusion amongst some consumers. It was found that the listing of added sugars in such a manner on an NFL caused some consumers to overestimate the sugar content listed on the NFL. Given the results reported above in this section, while the inclusion of 'added' sugars on an NFL does not appear to affect visual attention it does appear to effect comprehension of NFLs in regards to total sugar content.

Vanderlee et al. (2015) used two experiments to look at how alternative label formats would influence consumer perceptions of the level of sugar in food products. The experiments were completed by 2008 Canadians (aged 16-24 years) through an online survey. The first experiment examined the likelihood of consumers correctly classifying the level of sugar ("a little", "a moderate amount", or "a lot") in two products: one categorised by the researchers as low-sugar (4g per serving) and one categorised as high-sugar (24g per serving). Respondents were randomly assigned to view the low- and high-sugar products with one of six different label formats. The researchers found that, overall, respondents were more likely to correctly classify the high-sugar product as containing "a lot" of sugar (64% of respondents) than they were to correctly classify the low-sugar product as containing "a little" sugar (48% of respondents). This may suggest consumers have a tendency to consider even small amounts of sugar to be "a moderate amount" or "a lot".

Respondents' performance on the first experiment was influenced by the label format presented. Respondents tended to perform best at correctly classifying the level of sugar in a product when they saw a label format that included percentage daily values (%DVs). Alternative formats included the Canadian nutrition facts label, the number of teaspoons of sugar listed next to the grams of sugar, and an infographic which showed the number of teaspoons of sugar in the product (i.e. one teaspoon image for each teaspoon of sugar). This finding suggests that without further information to provide context, such as %DVs, consumers may have trouble assessing whether the quantity of sugar in a product is "a little"

⁴⁷ Another 15% of those who rated added sugar labelling as confusing reported they didn't know why, and 14% indicated that they did not care.

⁴⁸ The four food products were baked beans, muesli, an instant hot beverage and confectionary. One item with a sugar reduced claim had the calorie content increase in comparison to a non-reduced variant.

⁴⁹ The *Australia New Zealand Food Standards Code* requires that where a comparative claim is made the reference food must be identified. The claim must also state the difference between the amount of the property of the food (e.g. the sugar content) in the claimed food and the reference food. For a reduced sugar claim to be made, the claimed food must contain at least 25% less sugar than the reference food.

or “a lot”.

A second experiment examined the effects of three different label formats on the likelihood of respondents correctly reporting that a product contained added sugar and classifying the product as containing “a lot” of added sugar. The three label formats were: the current (at the time of the study) Canadian nutrition facts panel, a Canadian nutrition facts panel with an extra line added “Added sugar 16g”, and a Canadian nutrition facts panel with an extra line added “Added sugar 16g” and “64%” listed in the %DV column. All three label formats included the same ingredient list. Unlike the first experiment, the second experiment did not include a low-sugar product. The respondents exposed to the “Added sugar 16g” label or the “Added sugar 16g” + “64%” DV label were more likely to correctly report that the product contained added sugar compared to respondents who saw the current label. Respondents exposed to these labels were also more likely to correctly classify the product as containing “a lot” of sugar than respondents who saw the current label⁵⁰. A possible explanation for the finding in this study is that the daily value presented to participants equalled 64%, which is a substantial amount that would indicate a high level of sugar⁵¹. Furthermore, how clearly participants understood sugar content is limited as participants were simply asked to indicate if they thought the added sugar content was ‘a little’, ‘a moderate amount’ or ‘a lot’.

A study conducted by the FDA in the United States (FDA 2015b) found that the amount of added sugars listed on a NFL influenced perceptions of healthiness. Participants ($n = 6,480$) were asked to compare two NFL’s representing two variants of a food product⁵². It was found that when the more nutritious variant of the food item had less added sugar, participants overall were able to correctly identify the more nutritious option. In contrast, when the more nutritious food item in the pair had more added sugar listed there was a decrease in participants’ ability to correctly identify the healthier option⁵³. A possible inference from this finding is that listing added sugar may disrupt the ability of consumers to identify healthier food choices. This is more likely to be a problem in more challenging choice scenarios where the healthier of two alternatives is not healthier with respect to every nutrient listed. However, the nature of the study may have influenced participants to focus specifically on sugar, leading participants to give greater weight to this nutrient.

A study from the United States (Adams et al. 2014) found that individuals ($n = 48$) generally lack an ability to translate the quantity of sugar as presented on an SSB’s nutritional facts label in grams into a physical amount. The inference of this finding is that when presented with an abstract representation of the sugar content (i.e. listed total grams of sugar), individuals lack the ability to meaningfully interpret this label information into what is physically presented to them⁵⁴. It was found in a subsequent experiment reported in the same article, that when a physical amount of sugar (as represented by a stack of sugar cubes) was used to represent the sugar content of an SSB, the desirability of an SSB to research participants ($n = 47$) was significantly reduced. This may suggest consumers do not fully comprehend the quantity of sugar contained in SSBs when relying only on information on grams of sugar per serve.

⁵⁰ The Daily Value for added sugars in this study was taken from the WHO recommendations to limit added sugar intake to <10%. The added sugar content labelled in this study meant the daily value for added sugars was 64%.

⁵¹ There was no variance in the daily value percentages presented to participants.

⁵² The food pairs participants compared consisted of cereal, a frozen meal and yoghurt. In each of the 3 pairs there was a more nutritious choice

⁵³ In comparison to control labels without added sugars listed, when the more nutritious item had more added sugars participants were 40% more likely to indicate the healthier choice was unhealthy.

⁵⁴ In this case participants could not judge the physical amount of sugar physically present in the SSB’s they viewed whilst having the sugar content in grams clearly shown to them.

4.4 What are the effects of labelling on awareness of sugar content?

The FSANZ consumer label survey (2015) (see section 4.2) also examined which label elements consumers used to complete a task related to sugar. Respondents were asked to choose which of two breakfast cereals was healthier with respect to sugar. Normal label information, including a NIP and ingredient list, was available for each product. Respondents were also asked to click on the screen to indicate which part(s) of the label they had mainly used to make their decision. Seventy five percent of respondents were able to correctly select the breakfast cereal that was lower in sugar. This finding suggests that, when given a specific task related to sugar, the majority of consumers in Australia and New Zealand are able to select a product with lower sugar.

Further analysis looked at the label elements used by respondents in the study (FSANZ 2015). The most commonly used label element was the NIP, used by over 70% of respondents. The ingredient list was the second most commonly used label element, used by around one quarter of respondents. The main information used in the NIP was sugars. Eighty four percent of respondents who correctly selected the breakfast cereal that was lower in sugar used this information. This compared with only 49% of respondents who selected the higher sugar cereal and 42% of respondents who thought the two products were equally healthy. Respondents tended to use the information on sugar per 100 grams more frequently than the sugar per serve information in the NIP to make their decision. Forty one percent of those who correctly chose the lower sugar cereal used the sugar per 100g information only (i.e. did not use the sugar per serve information). This compared to 28% of those who selected the higher sugar cereal, and 11% of those who thought the cereals were equally healthy.

Performance on the breakfast cereal selection task was associated with which label element(s) respondents used. Those who did not use the: NIP, sugar in the NIP, or per 100 gram sugar in the NIP were less likely to correctly choose the lower sugar breakfast cereal⁵⁵. Respondents who incorrectly chose the higher sugar breakfast cereal were more likely to use the ingredient list in general and more specific information within the ingredient lists of the products. As respondents were free to choose which label elements they used in their decision-making, it cannot be concluded whether use of (or failure to use) certain label elements was *causal* to respondents correctly choosing the lower sugar breakfast cereal. However, selection of the lower sugar cereal was *associated* with a particular pattern of label use, as described above. This finding suggests that label formats/elements influence consumer perceptions and understanding of the nutritional properties of a food they are viewing. This in turn may influence consumer choices in regards to selecting a 'healthier' option. Demographic information (e.g. sex, age and household income) were collected in the study. However, it was not reported whether there were demographic differences between respondents who chose the lower sugar breakfast cereal and those who chose the higher sugar breakfast cereal.

A study from the United States (Graham and Roberto, 2016) aimed to evaluate the impact of listing 'added sugars' in the NFL on awareness of added sugars when compared to the standard NFL (without 'added sugars'). Participants were 155 undergraduate students from Colorado. A statistical analysis that controlled for the differences in comparing the two different types of nutrition labels found there was no significant difference in viewing time of sugar information if 'added sugar' was listed. Given that visual attention is not a measure of comprehension or a holistic measure of attention, no inference from this lack of difference between label formats may be made. It was however noted by the authors that those who did

⁵⁵ The differences in label use between the groups that chose the lower sugar cereal, and the higher sugar cereal were statistically significant.

view 'added sugars' on the NFL considered it to be a desirable addition to the NFL.

In another eye tracking study conducted by the United States FDA (2015c), overall it was found that there was little difference in visual attention towards sugars across different NFL formats⁵⁶. One finding from the study was that it took participants slightly longer to visually attend to added sugar on the label when Daily Value percentages were presented on the right hand side of the NFL. Given different variants of the NFL in this study had the Daily Value located on the left hand side of the NFL, it suggests that label design and formatting plays a role in how consumers visually interact with labelling.

As already discussed in section 2.2 of this review, findings from two studies (Laquatra et al. 2015; FDA 2015a) found that the inclusion of added sugars indented below 'sugars' or 'total sugars' caused confusion amongst some consumers. It was found that the listing of added sugars in such a manner on an NFL caused some consumers to overestimate the sugar content listed on the NFL. Given the results reported above in this section, while the inclusion of 'added' sugars on an NFL does not appear to affect visual attention it does appear to negatively affect comprehension of NFLs in regards to total sugar content.

In a study of consumers in the U.K (FSA 2007), it was reported that individuals expressed surprise when sugar content was identified with a front of pack red signpost indicating a high content in cereals they otherwise thought were healthy. Consumers reported that they appreciated labelling sugar with front of pack traffic light colour coded sign posting was complex. While there was support that such labelling should be kept as simple as possible, participants also believed that a single signpost label with both 'total' and 'added' sugars labelled would be preferable. Participants generally considered that labelling sugars in other ways such as by listing 'natural' and 'added' sugars would be confusing and possibly misleading if natural sugars were high and coloured red and added sugars were low and coloured green.

⁵⁶ One format was the current NFL, the second was the proposed NFL with added sugars listed and the third label Format was an Alternative with sections advising what consumers should avoid or 'get enough' of.

5 Impact of food label elements on food choices in relation to sugar

Key points:

- Five relevant studies were identified examining the impact of food labelling on food choices/purchases in relation to sugar, of which two were conducted in Australia/New Zealand.
- However, whether people use labels to do this in real life situations will depend on factors such as their health consciousness.
- One study from New Zealand suggests that individual motivation to view interpretive nutrition and compare packaged products may result in healthier food choices.
- Two studies indicate that while consumers are generally aware that SSBs are high in sugar, they may not fully comprehend the quantity of sugar they contain. Some labelling interventions for these products appear to influence either purchase intentions or actual purchases. One study from the U.S found that variations of the NFL did not influence consumer purchase intentions.
- One more general study (not specific to sugar) suggests that changes to the format of nutrition labelling are unlikely to motivate consumers to use nutrition labelling to make healthier choices. This can be the case even where the change of format improves consumers' ability to evaluate the healthiness of food products.
- Taken together, studies suggest a disconnect between consumer reporting of how they use labelling to make food choices and what they purchase and consume.

5.1 What are the effects of labelling on motivation to use sugar information?

This review did not find any research which addressed the possible influence labelling may have on motivation to use sugar information specifically.

One previous study has examined the effects of different front of pack label formats on consumer motivation to make more healthful choices (Aschemann-Witzel et al., 2013). Consumer motivation to make healthier choices was assessed by asking participants ($n = 1000$) how important they believed nutrition and health were after making a choice from a range of 80 snack foods with nine differing front of pack GDA labels⁵⁷. The study found that some label formats could increase the healthfulness of choices made by participants when they were asked to choose a healthful product. However, when participants were asked to choose their preferred product, there was no statistically significant difference between the healthfulness of choices made by participants exposed to the different label formats, nor was there a difference between participants exposed to the presence of a label when compared to no label being present as a control. The authors concluded that the presentation of nutrition labels regardless of their format did not influence consumer motivation to select healthier choices.

5.2 What are the effects of labelling on choices to purchase / consume food items?

An experimental study consisting of 1357 New Zealand participants (Ni Mhurchu et al. 2017) sought to assess the effect of interpretive nutrition labels on food choices. Participants used

⁵⁷ Participants were randomly assigned to variations of FOP GDA labels included colouring used to identify high nutrient content, no colour coding, listing of daily intake percentages. The nutrients listed in the GDA labels were: kilojoules, sugar, fat, saturated fat, and salt.

their mobile phones to scan the barcodes of food items while shopping over a five week period. Upon scanning the barcode, participants were shown on their phone nutrition information for the product. Participants were randomly assigned to see one of three label formats. The first label condition served as a control in the study whereby participants viewed the existing NIP, the second condition involved participants viewing a Health Star Rating (HSR) and the third condition involved participants viewing a Traffic Light Label (TLL). Using the receipts from participants' grocery purchases it was found there was no significant difference amongst conditions in regards to the sugar content of food items purchased, or any other nutrient overall. The extent to which nutritional information received via a smartphone versus on the food package influenced the healthiness of purchased foods was not explored.

As noted above, the study by Ni Mhurchu et al. (2017) found interpretive labelling via a smartphone had no overall effect on participant purchases. However, for a subset of participants in this study who were frequent label users (participants who scanned more products than average), it was found the HSR and TLL conditions did result in healthier choices when compared to the NIP control condition. This suggests that interpretive labels such as the HSR and TLL can help motivate consumers (those who use them frequently) to make healthier choices.

Another experimental study conducted in New Zealand (Bollard et al. 2016) sought to assess the effect of plain packaging and warning labels on consumer intentions to purchase SSBs. Participants were 604 New Zealanders aged 13-24 years who consumed soft drinks regularly. Plain packaging of SSBs (in a manner similar to the way tobacco products are now packaged in Australia) significantly reduced the likelihood of participants reporting they would buy an SSB. On a scale measuring the probability⁵⁸ of purchasing an SSB, those assigned to the plain packaged condition indicated there was a 2.6 in 10 chance they would buy an SSB compared to those who saw a regular package (4 in 10 chances). Those who were presented with a text based warning⁵⁹ reported a 3.3 in 10 probability of buying an SSB, whereas those presented with a graphic warning⁶⁰ alongside text reported a 2.7 in 10 chance of buying an SSB. There was a statistically significant difference between those who saw a warning label and those who did not, who on average reported a 3.9 in 10 chance of buying an SSB.

While not specifically addressing sugar labelling, a study conducted in Baltimore in the United States (Bliech et al. 2012) found that providing caloric information influenced consumer purchases of SSB's. Four stores in low-income areas presented three different caloric information interventions at different times. The intervention consisted of caloric signs conveying either total caloric content, the percentage of the recommended daily value or thirdly, how many minutes of jogging the calories would equal. Data were collected on 1600 beverage purchases made by Black adolescents. Providing total caloric content did not influence purchase decisions. Showing daily value caloric information reduced the odds of buying an SSB close to 40% and showing information concerning physical activity reduced the odds of purchasing a SSB by nearly half⁶¹. Taking into consideration factors such as gender, time of day and average beverage cost, it was found that there were significant reductions in sports drink and iced tea SSB purchases. There was also a statistically significant increase in the purchasing of bottled water. The effect of %DV caloric information

⁵⁸ The 11 point Juster scale was used to measure self-reported in the moment probabilities of purchasing a beverage by participants. The scale ranges from 0 (no chance) to 10 (certain)

⁵⁹ The text based warning was an orange octagon with the words "WARNING: high sugar content"

⁶⁰ The graphic warning consisted of a picture of dental caries with the message "WARNING: consuming beverages with added sugars contributes to tooth decay"

⁶¹ For total caloric information odds ratio ([OR]=0.56, 95% Confidence Interval [CI]=0.36,0.89). For physical activity (OR=0.51, 95% CI=0.31, 0.85)

(but not total caloric content on its own) on purchase decisions in this study echoes the finding from Vanderlee et al. (2015)⁶² that %DV information for sugar had an impact on choices when non-interpretive quantitative information (grams of sugar) did not.

A study previously mentioned in section 4.3 (Adams et al. 2014) found in one experiment ($n = 125$) that the visual representation of the quantity of sugar (e.g. grams of sugar visually represented by sugar cubes) influenced participant selections of SSBs when compared to participants who were only given abstract information (grams of sugar). Participants who were only exposed to abstract information regarding the sugar content of a beverage were three times more likely to select an SSB of their choice as a reward for participating in the experiment.

In another experiment by Adams et al. (2014) ($n = 109$), the visual representation of sugar content using sugar cubes was removed. Instead, participants in one condition were asked to complete a mathematical exercise designed to assist them in converting the measure of grams into a measure of sugar cubes. In the control condition, participants were asked to complete exercises related to converting currencies and distances. In both conditions participants were split again into two groups; those who were given a health message indicating that some of the potential rewards for participation in the experiment (a range of beverages) had a high-sugar content, and those who received no sugar health message. For participating in this experiment participants could select either a bottle of water or an SSB as remuneration. It was found that there was no main effect regarding the presence or absence of a sugar health message. There was however a statistically significant main effect found depending on whether participants were asked to convert sugar or non-sugar measures. It was found that 69% of participants ($n = 55$) in the non-sugar condition selected an SSB as remuneration for participation, whereas only 48% of those in the sugar condition ($n = 54$) selected an SSB. The findings of this experiment suggest that a working knowledge of how to convert abstract information such as grams of sugar listed on a nutrition label into other measures (e.g. sugar cubes) may influence consumer choices. A benefit of this study was that all participants were consumers of SSBs, which means the findings give a good indication of the effect of the intervention on people who consume the most SSBs. However, an important limitation is its relatively small sample size per condition and demographic consisting of undergraduate students.

Another study from the United States which surveyed 2509 adults aimed to assess how labelling of sugar may influence intentions to purchase a food product (Khandpur et al. 2017). Participants were assigned to one of eight⁶³ variations of the Nutrition Facts Label and asked to view 10 food and drink items before being asked how likely it is they would buy that item in the next month. It was found that none of the label conditions had any effect on participant purchase intentions for the food products.

The findings in this section suggest that under certain conditions labelling has an influence on consumer choices in relation to sugar. When directed to compare two products and select the one that is lowest in sugar, Australian and New Zealand consumer are capable of doing so using current labelling. However, when consumers are not directed to make comparisons it would appear they do not make healthier choices. This points towards labelling's influence on consumer choices and purchase intentions of healthier food items being partly reliant on consumers actively comparing food/label information on multiple products. What appears to influence consumers making comparisons is their motivation to do so. Where consumers

⁶² See section 4.3 for the summary of the Vanderlee et al. (2015) research.

⁶³ The 8 conditions participants were randomly assigned to were; (1) no label (control); (2) the current NFL (without Added Sugar [AS]); (3) the proposed NFL without AS; or the proposed NFL with AS in (4) grams, (5) grams and teaspoons, (6) grams and percent Daily Value, (7) grams with high/medium/low text, or (8) grams with high/medium/low text and %DV.

evaluate single products using abstract nutrition information (e.g. grams of sugar) they are not accurate at determining whether they contain 'a little' or 'a lot'. Interpretive and contextual labelling (e.g. Daily Value, HSR) appears to assist consumers in making more accurate evaluations of a products sugar content. It may further be that interpretive labelling assists consumers in better understanding abstract label information. However, motivation on behalf of consumers appears to influence whether they will pay attention to any labelling, as such, the provision of interpretive labelling alone may not lead to behavioural change without consumers being motivated to use them.

6 Conclusions

Food Standards Australia New Zealand (FSANZ) has undertaken a literature review to examine consumer knowledge, attitudes and behaviours relating to sugars in foods and as presented on food labelling. The purpose of a literature review is to assess the evidence as it presently stands in the available literature. The literature sourced for this review is of varying quality and uses different methodological approaches. Given the limitations of the literature this review does not aim to draw definitive conclusions. However, the findings from the literature, when taken together, do point towards some consistent findings regarding sugars, labelling and consumers' understanding and behaviour.

Consumers are concerned about the sugar content of food. They believe that consumption of sugar is associated with negative health outcomes, such as weight gain. Consumers who are attempting to reduce their sugar intakes report limiting their consumption of food categories they consider being high in sugar (e.g. sugar-sweetened beverages (SSBs)) and reading food labels. However, there is some evidence that consumers underestimate the sugar content of beverages containing fruit and other food groups. This may be due to the perceived healthiness and contextual understanding of fruit and other food groups such as vegetables.

Consumers do not understand what 'added sugars' are. When asked, consumers tend to report negative attitudes towards added sugars. However, they are not able to classify particular sugars as 'added' or 'natural'. This appears to be related to consumer associations between types of sugars and the perceived degree of refinement. Sugars such as honey are considered less refined, and therefore more natural and not 'added'.

The literature review has found mixed evidence regarding whether Australian and New Zealand consumers can use current labelling to make informed choices with respect to sugar. Their ability to use labelling depends on the type of task they are completing. When given a comparison task, consumers are capable of identifying which of two products is lower in sugar. However, international research suggests consumers generally aren't able to use abstract information such as grams of sugar listed on a label to evaluate whether a food is high or low in sugar. As such, consumers may not completely comprehend the high quantity of sugar in foods such as SSBs or confectionary items. Even though the majority of consumers understand that a food carrying a 'no added sugar' claim may contain naturally occurring sugar, the claim can lead some consumers to incorrectly believe that the food does not contain any sugar.

There is a limited volume of research examining the interaction between labelling and consumer choices in relation to sugar. However, the review identified some evidence that the inclusion of added sugars as a separate element on nutritional labelling may lead some consumers to overestimate the sugar content of a food item. This occurs where consumers believe 'added' sugars are in addition to the 'total' sugar content. Furthermore, the inclusion of 'added' sugar on nutrition labelling may lead some consumers to place too much emphasis on sugar, resulting in less accurate evaluations of a food's overall healthiness.

Although the above is true for *most* consumers, a possible exception is consumers who are highly motivated to read and use food labels. Consumers with higher nutritional knowledge and health interests appear more motivated to use nutrition labelling in regards to sugar content. Such consumers appear to compare products more frequently and find utility in nutrition labelling as well as interpretive labelling, such as the Health Star Rating and Traffic Light Labels.

Finally, despite the general lack of evidence around the impact of sugar labelling on behaviour, in the case of SSBs, there is evidence that some labelling interventions may reduce purchase intentions for, and actual purchases, of SSBs.

The above findings taken together indicate that consumers' pre-existing interest in sugar influences both the awareness of the sugar content in food, as well as an understanding of the health effects of sugar consumption. Individual factors such as health consciousness and personal motivation are key drivers of consumer use of nutritional labelling and consumption behaviours. For those who are motivated to use labels to select items lower in sugar, the findings suggest they can use current labelling to do so. There is little evidence to suggest that nutritional labelling changes behaviour.

Given the limited evidence available, further research in relation to Australian and New Zealand's consumers response to various forms of sugar labelling could be beneficial.

7 Limitations in the literature

The purpose of this literature review is to develop the evidence base regarding the relationship between consumers, sugar and food labelling. The primary relevant demographic for this evidence review is Australian and New Zealand consumers. In comparison to the volume of internationally published research, there is little research that examines the Australian and New Zealand context specifically. As such, this literature review has included international publications and research. Using international research is a limitation as findings may not easily translate to domestic settings given different cultural contexts, diets and labelling standards.

Much of the information sourced for this literature review has relied upon consumer self-reporting. Self-reported data may not be an accurate reflection of what consumers actually do. As a result, the extent to which the findings can be assumed to predict actual consumer behaviour is unknown.

In addition, statistical models used in a number of studies included in this review revealed a substantial amount of variance that is not accounted for by variables measured in the studies. This indicates that there are other factors or latent variables (not just labelling) that influence the interactions between consumers, sugar, food and labelling that may not have been identified in the literature presented.

The majority of studies incorporated in this review have differing methodologies and research aims, meaning accurate pooling of results in many instances is not possible. However, in a number of cases studies using different methodologies had consistent findings. This enhances the confidence that can be placed on their conclusions.

FSANZ has attempted to place greater weight on studies of higher quality. Appendix 1 includes an assessment of the quality of each study, based on a review of the full text. Readers will note that there is a greater emphasis on the findings of high quality studies in the body of the literature review and the key findings in each section. In addition, some limitations of studies are noted in the body of the literature review. However the author encourages interested readers to use the information and assessments in Appendix 1 to further inform their understanding of the body of evidence.

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Appendix 1 Summary of studies used

Table A1.1 Overview of key features of studies

Authors	Country	Study type	Products	Stimuli used	Relevant outcome measure(s)
Adams et al. (2014)	United States	Experiment	Assorted Sugar Sweetened Beverages (Sunkist, Mountain Dew, Coke, Pepsi, Sprite, Dr Pepper)	20 fl ounce (~600ml) SSB bottle, sugar cubes, labels indicating grams of sugar in each SSB.	Accuracy of participants to estimate sugar content of SSB's depending on which experimental condition they were assigned. One group were given instructions how to estimate sugar content using sugar cubes. The control condition was given no measurement assistance. Perceived attractiveness of SSB's depending on understanding of sugar content of SSB.
Aschemann-Witzel et al. (2013)	Germany and Poland	Experiment	Various snack foods (e.g. muesli bar, chocolate bar).	80 snack foods. 9 variations of GDA front of pack labels.	Influence of a product (sweet vs. savoury), country of origin and front of pack GDA label format on consumer intentions to make a healthier choice of product. No significant difference was found amongst the variables on consumer intentions to select any type of snack food.
BEUC (2005)	Denmark, Germany, Hungary, Poland, Spain	Survey, face-to-face	NA	Product examples, not further described	% reporting reading the ingredient list, terms in the ingredient list, % understanding carbohydrates, unsaturated fatty acids, saturated fatty acids, trans fatty acids
Bleich et al. (2012)	United States	Experiment	Assorted SSBs available for purchase at 4 convenience stores	3 separate caloric information signs presented at different times. One showing total caloric content, second showing DV%, and third showing time spent doing physical activity	% difference in purchases of SSBs depending on information presented to customers
Bollard et al. (2016)	New Zealand	Experiment	SSBs	Warning labels and Graphic images of tooth decay	Difference in self-reported consumer likelihood to purchase an SSB depending on assigned labelling condition
Bucher and Siegrist (2015)	Switzerland	Experiment	22 non-alcoholic beverages (e.g. tap water, apple juice, iced tea, diet cola)	Original beverage bottles, tap water presented in a neutral transparent 0.5-litre PET bottle	Distance of each beverage from the unhealthy point on a 3m line anchored at 'healthy' and 'unhealthy', and criteria mentioned as relevant for sorting (analysed separately for children and parents)
Colles et al. (2014)	Australia	Face-to-face semi-structured interviews	NA	NA	All participants were first asked to share a story about 'food', and then asked 'where did you learn this?'. As required, enquires continued for 'good food', 'store foods', 'meat', 'fruit', 'vegetables', 'fat' and 'sugar'. Within discussions, other prompts related to 'where store foods come from', health, overweight, how adults and children learn and what they may like to learn
Department of Health (2013a)	Australia	Online Survey	NA	Various Labels or components of labels. (HSR and signposts)	% of importance placed on sugar or added sugar in regards to labelling
Department of Health (2013b)	Australia	Focus Groups	NA	HSR design elements	Qualitative findings regarding contextual aspects that influence consumer perceptions of healthiness
FDA (2015a)	United States	Online experiment	NFLs were presented as belonging to items such as "frozen meal" or "trail mix" for example	29 Nutrition Facts Label variants. There were three main Label categories (the old label format, the new label and an alternative)	% able to correctly identify sugar content depending on NFL type % able to correctly identify added sugar content within the new NFL and alternative NFL.
FDA (2015b)	United States	Online experiment	NFLs were presented as belonging to either 'frozen meal', 'cereal' or 'yoghurt'	Participants split into 3 conditions. NFL without added sugar listed, added sugar listed after 'sugars', and added sugar listed after 'total sugars'	Ratio of participants able to correctly identify the healthier food option from a pair depending on the amount of added sugar listed.
FDA (2015c)	United States	Experiment	NA	Variations of the NFL	Visual attention paid to sugars on the NFL depending on NFL layout
Forbes et al. (2015)	New Zealand	Face-to-face structured interview	NA	NA	From a structured questionnaire it was found the importance of Sugar as a nutritional component on consumer snack food purchase decisions.
FSA (2007)	United Kingdom	In-depth group discussions	Cereal products	Traffic Light coloured sign posts with different sugar types (natural, added, total) listed	Consumer interpretation of FoP labelling for sugars, as well as consumer attitudes towards such labelling regarding ease of use.
FSANZ (2006a)	Australia, New Zealand	Survey	Beverage types: Tap water, Bottled still-water, Sugar sweetened soft drink, Fruit juice, Milk, Diet/no sugar soft drink	NA, although examples of some drink names were given in the questionnaire to assist respondent accuracy in answering	Percentages of amount of sugar in other beverages compared to formulated beverages
FSANZ (2006b)	Australia, New Zealand	Survey/Experiment	Vegetable Juice, Yoghurt, Fruit & Nut Bar, Muesli, Apple Juice, Canned Peaches in fruit juice	'no added sugar' claim, 'contains natural sugar' disclaimer	% consumer assessment of sugar level in each product depending on claim and disclaimer
FSANZ (2015)	Australia, New Zealand	Survey	Milk, Cereal	Nutrition information panel and Ingredient list	% consumers looking for sugar in a food when purchasing for the first time % looking at either NIP or ingredient list when looking at sugar to inform choice

Authors	Country	Study type	Products	Stimuli used	Relevant outcome measure(s)
FSANZ (2008)	Australia, New Zealand	Survey	NZ	Respondents were shown a list of nutrients that appear in the NIP and were asked to indicate which they usually look for when buying a product for the first time.	% who reported looking at sugar in the NIP
Gill and Sattar (2014)	United Kingdom	Online Survey	Various SSBs, fruit juices, and smoothies	Pictures of non-alcoholic beverages and tea spoon measure of sugar content estimation	Estimation of sugar content of various beverages compared to actual sugar content
Gotron et al. (2010)	New Zealand	Survey	Mock products	Nutrition claims on products (e.g. 'no added sugar', '97% fat free')	% able to correctly identify what 'no added sugar' claim implies. % who correctly indicate 'no added sugar' claim does not indicate a food is a healthy product
Graham and Jeffery (2011)	United States	Experiment	64 foods representing meal items (e.g. pizza), snack items (e.g. crackers) and deserts (e.g. ice cream)	Food price and description A photograph of the food The food items Nutritional Facts Label	% of self-reported use of food labelling does not match actual visual attention paid to nutrition labelling as measured using an eye tracker
Graham and Roberto (2016)	United States	Experiment	64 commonly found pre-packaged food items	Nutrition Facts Label (either with or without added sugars listed), Price and description, ingredients list, photograph of food item	The addition of 'added sugars' on the nutrition facts label did not appear to increase visual attention towards sugar amongst young adults
Grunert et al. (2010)	Hungary, Poland, Germany, France, Sweden, United Kingdom	Observation, in-store interview, questionnaire	(mentioned in questionnaire) Ready meals, Soft drinks, Yoghurts, Breakfast cereals, Confectionary, Salty snacks	NA	% who correctly identify purpose of GDA label % of respondents who look for sugar information in the shopping aisle Differences between consumers depending on European country
IFIC (2007)	United States	Web-based survey	NA	NA	% reducing sugar intake
IFIC (2016)	United States	Web-based survey	NA	NA	% avoiding/limiting sugar intake % associate sugar with unhealthy outcomes % behaviours use to avoid sugars
IFIC (2017)	United States	Web-based survey	NA	NA	% avoiding/limiting sugar intake % associate sugar with unhealthy outcomes % of sources of information regarding sugars % behaviours use to avoid sugars
Khandpur et al. (2017)	United States	Experiment	Kellogg's Raisin Bran, Coca Cola, Clif Chocolate Brownie Energy Bar, Home Run Inn Classic Cheese Pizza, Kellogg's Frosted Flakes, Frosted Cheerio's, Vitaminwater, Gatorade	Image of the product A variant of the Nutrition Facts Label	Formatting of the Nutrition Facts Label had no effect on consumer intentions to purchase one product type over another
Kyle and Thomas (2014)	United States	Survey	NA	NA	% of respondents who believe labelling 'added sugar' will be helpful
Laquatra et al. (2015)	United States	Experiment	NA	Manipulated Nutritional Facts Labels	% correctly identify 'added' and 'total' sugar content depending NFL presented
Maubach et al. (2009)	New Zealand	Face-to-face semi-structured interviews	NA	NA	Interview responses, no quantitative information
Mötteli et al. (2016)	Switzerland	Experiment	179 real and fake food items (e.g. Tuna fish, boiled egg, banana, orange juice, sugar, Italian salad dressing, cereal chocolate bar, honey)	Healthy Group: asked to choose healthy meals. Food labels from real products where used. Different sizes of tableware to accommodate portion sizes as well as cards to indicate if participants would choose more or less of a single food item	Average energy and nutrient amounts selected between experimental conditions (total energy, protein, fat, saturates, carbohydrates, sugar, sodium, fibre) Average food group selections between groups (unsweetened beverages, vegetables, fruits, starchy foods, protein, oils and fats, sweets and savoury snacks) Average portion sizes and % of food products selected in each condition
Naughton et al. (2015)	Ireland	Survey	NA	NA	Existing dietary habits and reported individual factors such as a belief in one's self-control influence estimates of sugar consumption per day
Ni Mhurchu & Gorton (2007)	Australia and New Zealand	Literature Review	NA	NA	Pooled findings regarding consumer use and understanding of nutrition labelling and nutrition label claims
Ni Mhurchu et al. (2017)	New Zealand	Experiment	NA (no specific products were mentioned. Participants purchased food items available to them at grocery stores)	A phone app provided participants with either a HSR, a Traffic Light Label or a NIP	Products scanned using the phone app utilized in the study as well as products purchased by participants to establish Nutrition Profiling Scores between conditions
Patterson et al. (2012)	United Kingdom	Structured focus group discussions Online Survey	NA	NA	General perceptions surrounding sugar and nutritional claims for food % report awareness of nutritional claims regarding sugar in food % report being concerned about sugar in relation to weight gain
Pollard et al. (2016)	Australia	Survey	NA	NA	% attention paid to the health aspects of food consumed % soft drink consumers and occurrence of consumption
Rampersaud et al. (2014)	United States	Survey	22 non-alcoholic beverages (e.g. water, sugar sweetened soft drink, diet soft drink, 100% juice)	NA	% consuming each general beverage category, % identifying a beverage type as "sugary", % accurately identifying sweeteners in beverages, % expressing concern about sugar (total, added, natural)

Authors	Country	Study type	Products	Stimuli used	Relevant outcome measure(s)
Rejman & Kasperska (2011)	Poland	Survey	NA	NA	% using list of ingredients, Rating given to ingredient list influence on purchase decisions (5-point scale), % understanding sugar, % understanding fat, % understanding cholesterol, % understanding trans fat
Sütterlin and Siegrist (2015)	Switzerland	Experiment	NA	A made up cereal box	Association of the term 'fruit' with healthiness and ability of 'fruit' as a term to moderate the perceptions of sugar content
Tierney et al. (2016)	Northern Ireland	Online Survey	NA	Asked to classify a list of 13 sugars and artificial sweeteners	% perceived usefulness of traffic light labelling system (5-point scale from don't know to very helpful) % reported interest in food & nutrition % use of nutrition panel and items looked at (calories, total sugar, fat, salt, etc.). % awareness of WHO recommendation for sugar reduction % ability to correctly identify dietary sugars and sweeteners
Timperio et al. (2003)	Australia	Focus groups Survey	NA NA	NA NA	Comments on the kinds of factors that are considered when deciding whether a food or food group is 'fattening' % agree/disagree fresh foods are not fattening % agree foods with a high fat content are fattening % agree as long as I watch my fat intake I can eat what I like % agree saturated fat more fattening than unsaturated fat % agree your body can burn sugar quicker than it can burn fat
Vanderlee et al. (2015)	Canada	Experiment	NA	Manipulations of the Canadian Nutrition Facts Panel	% identify added sugar content as 'a lot' when presented with a Daily Value of added sugar content on an NFL
Watson et al. (2013)	Australia	Interview and Survey	NA	NA	% of respondents who associate sugar with high energy content of foods % of respondents who associate kilojoules with sugar

Table A1.2 Overview of study quality

Authors	Country	Study type	Achieved sample size	Sampling technique	Internal validity	External validity and generalisability to Australia/New Zealand
Adams et al. (2014)	United States	Experiment	Experiment 1= 48 Experiment 2= 115 Experiment 3= 125 Experiment 4= 136	Participants were either recruited via convenience sampling at the University of Alabama campus or via snowball recruitment via social media networks.	Medium (Participants were randomly assigned to conditions and statistical analyses were proved to be significant. The measure for perceived SSB attractiveness however may be influenced by factors such as emotional disgust rather than concrete understanding)	Low (overseas study that primarily uses university student population whose literacy and numeracy skills may not be transferable to the Australian and New Zealand context easily).
Aschemann-Witzel et al. (2013)	Germany and Poland	Experiment	1000 respondents	Participants were recruited in shopping centres who classified themselves as either whole or partly responsible for household grocery shopping.	Medium (Participants were randomly assigned to a GDA label variant. Both Germany and Poland at the time had GDA labelling on food products and the 80 snack food items participants were exposed to were tailored to each country)	Low (International study that uses front of pack labelling that is not used in Australia or New Zealand. Snack food items used in this study may not be common to the Oceanic region).
BEUC (2005)	Denmark, Germany, Hungary, Poland, Spain	Survey, face-to-face	3000, 600 in each country	No detail provided. 98% of respondents aged 20 years and older	Medium (respondents were asked about their food packaging information use, and use of the ingredient list was indirectly measured)	Low (while national statistical agencies were involved in the sampling design and the country strata were large, the European equivalent to the NIP was not required at the time unless a nutrition content claim was made on the product)
Bliech et al. (2012)	United States	Experiment	1600	Adolescents who purchased SSBs within the convenience store during the time of the study	Medium (Study was a reflection of caloric signage in a real world setting and found some significant differences depending on information conveyed to teenage customers within low income areas described in the study)	Low (Study location and participant characteristics do not translate to the Australian and New Zealand context)
Bollard et al. (2016)	New Zealand	Experiment	604	Recruitment was either via market research company 'Research Now' or via parents who were panel members	High (Sufficient participants per condition to meet statistical power requirements, experiment was between subjects with random allocation, appropriate measuring of co-variates)	Medium (Participants were a New Zealand sample and label conditions were reflective of current labels used for tobacco products in Australia, however such labelling practices and SSB taxes are not enforced)
Bucher and Siegrist (2015)	Switzerland	Experiment	100 children matched to 100 parents	Mail invitation to parents of children aged 7 to 10 years, using an address database maintained by the Schober Information Group	Medium (subjects were given the beverages to sort, beverages were sorted from 'unhealthy' to 'healthy', sort criteria was subject-driven and sugar content (not added sugar) was the most salient sort criterion)	Medium (overseas study so different food labelling, included products not on Australian or New Zealand markets.)

Authors	Country	Study type	Achieved sample size	Sampling technique	Internal validity	External validity and generalisability to Australia/New Zealand
Colles et al. (2014)	Australia	Face-to-face semi-structured interviews	30	Purposive sampling method using senior community members in Aboriginal communities in the Northern Territory.	Low (added sugar addressed indirectly, restricted and purposive sample, small sample size)	Medium (local study but on a specific aboriginal community)
Department of Health (2013a)	Australia	Online Survey	1086	Random invitation to participate from an online access panel	High (large sample response rate, sought to specifically address consumer preferences and understanding of factors that would make up the HSR)	High (Stratified sample of Australians with recent findings concerning consumer relative importance placed on total and added sugars)
Department of Health (2013b)	Australia	Focus Groups and accompanied shopping	15 group discussions 5 accompanied shopping trips	Not identified	Medium (Interviews were specifically targeted towards food and health outcomes keeping subject matter contained, assessment of shopping is a real world reflection)	Medium (Participants were representative of Australian individuals and discussed food and health in an Australian context)
FDA (2015a)	United States	Online experiment	5430	Participants drawn from a research panel managed by Ipsos	Medium (Participants were asked to assess the NFLs nutritional profile before making an assessment of perceived healthiness, this may have influenced results. Mock products were only identified by name, participants only witnessed a NFL)	Medium (NFL labelling does not translate to the Australian and New Zealand context, however NFL and NIP layout are similar)
FDA (2015b)	United States	Online experiment	6480	Participants drawn from a research panel managed by Ipsos	Medium (Given the study had questions focused on sugar content, there may have been priming effects whereby the nature of the study influenced consumer attention to added sugars listed when making a healthiness judgment)	Medium (NFL labelling does not translate to the Australian and New Zealand context, however NFL and NIP layout are similar)
FDA (2015c)	United States	Experiment	160	Recruited via a contractor by telephone. (participants were recruited from Washington, Chicago, Boston and San Francisco)	Low (In some instances participants were asked to look for particular label elements thus influencing visual attention results)	Low (NFLs are dissimilar to nutrition labelling used in Australia and New Zealand.)
Forbes et al. (2015)	New Zealand	Face-to-face structured interview	118	Respondents were approached at various supermarkets in Christchurch.	Medium (Responses were predominantly from higher income female consumers or European descent).	Medium (Given the study was conducted in New Zealand, findings may accurately translate to the main demographic of New Zealanders sampled).
FSA (2007)	United Kingdom	In-depth group discussions	52	Participants were recruited via hired research contractors	Medium (Discussions were held in various regions of the UK with a sample that reportedly shopped)	Low (Traffic light and signpost labelling is not currently in place in Australia and New Zealand)
FSANZ (2006)	Australia, New Zealand	Survey	2,091	Online national survey panels created by a market research company, respondents limited to those aged 14 years and older	Medium (online panel with no sampling bias information, showed participants pictures of beverages on the market, findings are only relative to formulated beverages, only looked at total sugar)	Medium (while the study is local, the findings only relate to total sugar in beverages)
FSANZ (2006b)	Australia, New Zealand	Survey/experiment	1007	Recruited through TNS Social Research's online panel	High (Establishing baselines for participant health consciousness were established, alongside relevant demographic information and basic dietary habits)	Medium (While demographics reportedly are representative of AUS and NZ populations the research was conducted some time ago)
FSANZ (2008)	Australia, New Zealand	Survey	2000	Recruited from TNSSR Online Panel. Random sampling from panel. Respondents were aged 14 years and over. Weighting was applied by age and gender for each country.	Medium (respondent's self-reported use of NIP information).	Medium (Specific to AU and NZ context, however the research was conducted some time ago).
FSANZ (2015)	Australia, New Zealand	Survey	2,411	Stratified sample survey conducted by Roy Morgan Single Source online sample.	Medium (Participants were asked which nutrients they looked for on nutrition labels when purchasing a product for the first time, type of product was not accounted for)	Medium (The sample is stratified across Australian and New Zealand demographics and provides information on what these populations self-report looking for)
Gill and Sattar (2014)	United Kingdom	Online Survey	2005	Participants recruited through Grayling online research panel.	High (The study is a within subjects design, pictured beverages all had similar sugar content, teaspoon estimate as a measure of a beverage sugar content was consistent throughout)	Medium (While the sample is reportedly representative of a wide demographic in the U.K which may translate to Aus and NZ populations, products respondents viewed may have different concentrations regarding sugar content between countries)
Gorton et al. (2010)	New Zealand	Survey	1525	Participants were recruited from 25 supermarkets and selected based on ethnicity to ensure equal sample distributions amongst demographics.	Medium (While there were even numbers representing ethnic groups within the New Zealand context, variables such as literacy were not gathered which may have influenced findings)	Medium (Study is broadly representative of New Zealand consumers, however products with health claims presented on the package were made up for the study so may not transfer to real consumer interacts with existing products)
Graham and Jeffery (2011)	United States	Experiment	203	Participants recruited through local media. Required to be 18 and older and able to read English	High (Study was a controlled within subjects experiment. The eye tracking equipment used is an accurate measure of where participants look. The questionnaire used valid items to assess consumer behaviours)	Medium (While participants viewed American nutrition labelling, the difference between self-reported use of labels and actual visual attention paid to labels may occur internationally)
Graham and Roberto (2016)	United States	Experiment	155	Convenience sample of university students studying in Colorado USA	Medium (Eye tracking is an accurate measure of visual attention paid, however as to whether more or less visual attention is an indicator of comprehending a labelling is a conceptual issue)	Low (Sample used is not representative of Australian or New Zealand populations and the Nutrition Facts Label is not used in these countries)

Authors	Country	Study type	Achieved sample size	Sampling technique	Internal validity	External validity and generalisability to Australia/New Zealand
Grunert et al. (2010)	Hungary, Poland, Germany, France, Sweden, United Kingdom	Observation, in-store interview, questionnaire	Hungary (1804 interview, 703 questionnaire), Poland (1800 int, 1494 quest), Germany (1963 int, 815 quest), France (2337 int, 833 quest), Sweden (1858 int, 1201 quest), UK (2019 int, 921 quest)	Consumers were approached whilst shopping in a variety of supermarkets. Participants were then given a take home questionnaire to fill out and return.	High (A large number of consumers participated in the study across 6 European countries. Countries were selected given their existing uptake and use of Front of Pack labelling. Matching of observational, interview and questionnaire data means an accurate representation of consumer behaviour and interaction with labelling may be made)	Low (the European context does not equate to the Australian or New Zealand context. Neither Australia or New Zealand use GDA labelling as do the countries studied)
IFIC (2007)	United States	Web-based survey	1,000	Representative sample of U.S. adult population (18+) on age, socioeconomic profile, race/ethnicity, region, and gender, no further details given.	Low (limited examination of sugars)	Low (Limited focus on sugars, USA population study)
IFIC (2016)	United States	Web-based survey	1,003	Sample from Research Now's consumer panel	Medium (some results relate to high fructose corn syrup, which is only a very small subset of sugars in food, most questions relate to added sugars and consumer behaviour)	Medium (While the study is from the USA, interest in limiting/avoiding added sugar appears to transfer between countries as does the association between sugar and weight gain)
IFIC (2017)	United States	Web-based survey	1,002	Sample from Research Now's consumer panel	Medium (Survey's main focus is on 'added' sugars so question items concerning why consumers may limit/avoid sugar overall may have been effected)	Medium (While the study is from the USA, interest in limiting/avoiding added sugar appears to transfer between countries as does the association between sugar and weight gain)
Khandpur et al. (2017)	United States	Experiment	2509	Online recruitment via Amazon's Mechanical Turk platform	Medium (Different label conditions significantly influenced consumer interpretations of sugar content but not their purchase intentions)	Medium (While the study is an international study, the finding that consumers may purchase a food item regardless of nutritional labelling may translate internationally).
Kyle and Thomas (2014)	United States	Survey	288	Online Survey	Low (No reporting of demographic information. Large number of respondents were unresponsive as to why they may think added sugar labelling would be helpful or confusing)	Low (Cannot translate the findings from this study to an Australian or New Zealand context).
Laquatra et al. (2015)	United States	Experiment	1088	Drawn from a national respondent database	Medium (Objective measures for consumer understanding of sugar labelling were employed)	Low (Nutrition Facts Label is not a label format used in Australia or New Zealand)
Maubach et al. (2009)	New Zealand	Face-to-face semi-structured interviews	15	Snowball sampling of Palmerston North parents with at least one child aged between 5 and 12 years old in their care	Medium (small sample size restricted to parents, ingredient list not asked about specifically, examined NIP)	Medium (New Zealand study, small sample size)
Mötteli et al. (2016)	Switzerland	Random allocation experimental group comparison study	187 total, 92 control subjects, 95 experimental participants in 'healthy' group	Recruitment of 18 to 65 year olds via public advertisements in supermarkets near the Swiss Federal Institute of Technology in Zurich	High (controlled experiment, required sample size for statistical effect met)	Medium (Swiss study utilizing Swiss population and dietary guidelines. Majority of food items assembled by nutritionists encountered globally)
Naughton et al. (2015)	Ireland	Survey	477	Random sampling of Irish population reported. Method not recorded	Medium (The sugar consumption dependent variable of grams per day is an approximation)	Medium (It is considered that the independent variables of habit and self-beliefs in this study translate to consumers globally in regards to diet choices)
Ni Mhurchu and Gotron (2007)	Australian and New Zealand	Literature Review	Pooled findings from 16 papers	Online search strategy identified suitable papers to review	High (A systematic review was undertaken contrasting findings from multiple studies)	High (All studies reviewed were either Australian or New Zealand and provides a broad picture of consumer use and understanding of food labelling)
Ni Mhurchu et al. (2017)	New Zealand	Experiment	1357	Participants were self-referred to partake in the study via responding to public adverts	High (Study ran as a randomised control trial with a large sample size, design was between group assessing differences of purchases amongst three label conditions with accurate measures of consumer scanning and purchasing)	High (The study was undertaken in New Zealand with a large sample size, however, given participants self-recruited, individuals with an existing interest in nutrition and food may have applied more than others)
Patterson et al. (2012)	United Kingdom	Structured focus group discussions Online Survey	~40 participants 367	All participants were gathered via a consumer database managed by Leatherhead Food Research, Surrey, UK	High (Questions in the focus group directly addressed consumer understanding of sugar claims and consumer awareness. In the survey consumers were directly asked about nutrition claims and nutrients that are of concern to them)	Medium (Nutrition claims used in this study are used in Australia and New Zealand)
Pollard et al. (2016)	Australia	Survey	2832 responses from Western Australia 10764 responses from South Australia	Data was gathered from the South Australian Monitoring and Surveillance Survey and the Nutrition Monitoring Survey Series (NMSS) conducted by the Western Australian Department of Health	High (large scale data collection of reported consumption of Sugar Sweetened beverages amongst Australian Consumers)	High (Data and results are a reflection of the Australian population)
Rampersaud et al. (2014)	United States	Survey	3,361 (61% completion rate)	Online national survey panel created by a market research company, respondents limited to those aged 18 years and older	High (objective measures of sugar knowledge relating to beverages)	Medium (online panel in the US with no sampling bias information, findings may not entirely translate to Australia/New Zealand)
Rejman & Kasperska (2011)	Poland	Survey	200	Snowball sampling of Warsaw consumers, with sample selected to be 50% male	Low (general look only, self-reported checks for nutrients not linked to the particular elements used to check)	Low (snowball sampling, Polish sample)

Authors	Country	Study type	Achieved sample size	Sampling technique	Internal validity	External validity and generalisability to Australia/New Zealand
Sütterlin and Siegrist (2015)	Switzerland	Experiment	Experiment 1 = 164 Experiment 2 = 202 Experiment 3 = 251 Experiment 4 = 162	Convenience sample of German speaking Swiss	Medium (Found consistent results indicating that the term 'fruit' was associated with healthiness and reduced the negative impact of sugar when listed in isolation)	Low (Sample population cannot be extrapolated to Australian and New Zealand contexts. 'Fruit sugar' is currently not a term used to denote sugar on food labels)
Tierney et al. (2016)	Northern Ireland	Online Survey	445	Recruitment via Ulster University staff and student mailing list with further snowball sampling via request to pass on survey to family and friends	High (tested knowledge of sugars specifically and in an order to avoid response bias, knowledge of WHO guidelines was specifically tested alongside demographic information)	Medium (small and geographically restricted sample size. Sugars and sweeteners used to assess knowledge are common on ingredient lists of packaged foods)
Timperio et al. (2003)	Australia	Focus groups Survey	62 681	Convenience sample recruited from workplaces, community groups, sporting facilities, and community organisations. Study was publicised through posters, emails, newspaper ads, emails, newsletters Random sample of electoral role for Victoria, Australia	Medium (tested knowledge around fat, ambiguity in some statement wording)	Medium (Australian & New Zealand study conducted inside past 15 years)
Vanderlee et al. (2015)	Canada	Experiment	2008	Participants aged 16 to 24 years old were recruited via an online commercial recruitment panel	Low (measurement used to assess consumer awareness of added sugar content was limited using a subjective 3 point scale consisting of 'a little', 'a moderate amount' and 'a lot')	Low (Canadian nutrition labelling does not align with Australian or New Zealand labelling)
Watson et al. (2013)	Australia	Interview Survey	40 405	Existing contacts of a recruited market research company Respondents were recruited at 2 shopping centres in Sydney	Medium (examined knowledge surrounding energy and perceptions of sugar, however, does not succinctly define what energy in food is)	Medium (Australian study of mostly main household grocery shoppers)

Appendix 2 Literature review method

Inclusion criteria for research

Relevant research previously identified in the FSANZ rapid evidence assessment examining the utility of grouping added sugars in the ingredient list was included. The search strategy for this assessment may be found in the published report located [here](#).

This literature review was limited to primary research on sugars, labelling of sugars and consumer interactions with sugar and sugar labelling. Initially there was no limitation set concerning date of publication. However, the peer reviewer noted that some of the studies initially included were very old and likely out of date. In response, 2003 was chosen as the cut off date for literature. This is based on mandatory labelling being fully implemented in Australia and New Zealand in December 2002. Studies prior to this would have been undertaken with consumers who (at least in New Zealand and Australia) were less familiar with nutrition labelling. The review included studies that examined:

- Consumer understanding of sugars in the context of food
- Consumer understanding of food labelling for sugars
- Which food label elements consumers use to identify sugars
- Consumer beliefs towards the consumption of sugar
- How and where consumers gain information about sugar
- Preferences of consumers towards the labelling of sugar
- The influence sugar labelling has on consumer food choices

No criteria were set with respect to study design (e.g. experiment, survey, or type of subject). Unless otherwise explicitly stated, searches were unconstrained with respect to publication date and country. All searches were limited to publications published in English.

Search strategy

Six separate online database searches were undertaken using simpler Boolean search term combinations. Grey literature was also searched

Online database searches

Databases searched were: PubMed, Science Direct, Food Science Source, FSTA - Food Science and Technology Abstracts, MEDLINE with Full Text and SocINDEX with Full Text. Initial searches were conducted from the earliest date of publication up to May 2017. The searches were:

- consumer AND (understand* OR aware*) AND AB sugar*. Search was limited to peer reviewed articles published in English. Two variants of this search were used, one had the geography restricted to Australia, and the other had the geography limited to New Zealand.
- AB sugar* AND consumer AND (intake OR consumption OR diet*) AND (understand* OR aware*) AND (education OR campaign OR message* OR info* OR guideline*)
- consumer AND (understand* OR know* OR comprehen*) AND label* AND AB sugar*
- AB sugar* AND (consumer OR child* OR adult* OR adolescent*) AND (intake OR consum*) AND (behave* OR respond)
- (consumer OR child* OR adult* OR adolescent*) AND (understand* OR knowledge) AND AB (food OR produc* OR beverage* OR drink OR soda* OR snack* OR discretionary OR juice*) AND TI sugar*
- AB (consumer OR child* OR adult* OR adolescent*) AND (intent* OR behave*) AND (attitude* OR belie* OR concern* OR use) AND AB sugar* AND (purchas* OR deci* OR choice) AND AB

(label* OR list OR panel OR info* OR claim OR pack*)⁶⁴

Other sources

To ensure the literature review incorporated a suitably broad range of references, the following additional searches were performed:

- FSANZ consumer research reports
- The FSANZ Behaviour and Regulatory Analysis section Reference Manager database
- the International Food Information Council Foundation website
- research cited by others, e.g. in summary articles or professional magazines

Research review process

The review process is outlined in Figure A2.1 on the following page. The search process initially identified 11392 potentially relevant research documents. Duplicates and out-of-scope papers (based on abstract and/or title) were excluded. Finally, documents identified as out of scope on the basis of full-text review were excluded. This resulted in 47 research documents being included, and which are described in Table A1.1 in Appendix 1.

Each included research study has been assessed for quality, and was scored using the three categories of low, medium, and high (Table A1.2, Appendix 1). Quality assessments related to internal validity and external validity. Internal validity addressed the study design and methods, and the external validity assessments considered sampling procedures, and whether the results could reasonably be expected to apply to Australia and New Zealand.

Literature review update drafting process

The literature review structure is based on the primary objectives stated within the Introduction. The review was reviewed by the section manager of the Behaviour and Regulatory Analysis Section and by the FSANZ project manager for the program of work investigating labelling approaches for providing information of sugars.

⁶⁴ 'AB' = term is required in the abstract of articles searched.' TI' = term to appear in the title of articles searched.

Figure A2.1. Number of documents retrieved at various stages of the review process.

