FOOD STANDARDS Australia New Zealand
Te Mana Kounga Kai – Ahitereiria me Aotearoa

Consumer Literature Review and Meta-analysis for W1135

Consumer value/motivation, understanding and behaviour in relation to energy content information on alcoholic beverages

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Executive summary

Food Standards Australia New Zealand (FSANZ) undertook a rapid systematic review and meta-analysis to examine the evidence base regarding consumer value/motivation, understanding and behaviour in relation to energy content information about alcoholic beverages. This report outlines the methodological approach to the review, and summarises the available evidence.

Searches of electronic databases and hand-searching were used to identify 38 studies for this review. The review includes peer-reviewed articles published in academic journals, as well as grey literature (i.e., unpublished theses and research produced by governmental and non-governmental agencies). Findings across studies were narratively synthesised and, where the outcome measures across studies could be combined, meta-analysis was used to estimate summary effects.

This review is not without limitations. The body of evidence is comprised mainly of studies conducted outside of Australia/New Zealand and therefore caution is applied in generalising the findings automatically to Australian/New Zealand populations. However, the fact that the available New Zealand- and Australian-based studies produced consistent results with the internationally-based studies reduces this concern. Additionally, as in Australia and New Zealand, mandatory energy labelling is currently not implemented in any country. Studies also varied in quality and differed in methodological approaches, however general conclusions may be drawn based on the consistency of the findings across studies.

Results from 18 studies showed that consumers generally value energy labelling on alcoholic beverages (pooled proportion of consumers supporting energy labelling = 69% [95% CI: 56-79%]). However, certain groups (such as heavy drinkers, people who are not health-/weight-conscious, males, people with lower-level education) are likely to value the information less than others. Additionally, although consumers generally value energy content information, other information may be valued on the label to a greater extent (e.g., alcohol content, ingredients, warnings about particular health risks that are associated with alcohol consumption) and this likely varies across different groups in the population.

Results from 22 studies showed that, based on their general knowledge, consumers generally have a poor understanding of the energy content of alcoholic beverages. Firstly, only a minority of consumers are able to correctly estimate the energy content (i.e. number of kilojoules or calories) in alcoholic beverages using their general knowledge (pooled proportion of correct estimates across studies = 18% [95% CI: 14-24%]). Secondly, consumers are generally unable to correctly rank the energy content of different alcoholic beverages using their general knowledge. Rather, consumers tend to underestimate the relative energy content of wine and spirits. That is, wine and spirits are mistakenly perceived as being lower in energy compared to other alcoholic beverages. Conversely, consumers tend to overestimate the relative energy content of beer. That is, beer is mistakenly perceived as being higher in energy compared to other alcoholic beverages. Thirdly, consumers are generally unaware that alcohol is the main source of energy in wine, beer, and spirits; rather, believing that sugar or carbohydrates are the main sources. Overall, these studies

indicate that consumers are unable to make informed choices based on their general knowledge of the energy content of alcoholic beverages.

Results from 16 studies showed that energy content information (in kilojoule/calorie numerical format) has no effect on consumers' likelihood of drinking an alcoholic beverage. However, this finding may be explained by the additional finding that consumers do not understand energy content information when presented in calorie/kilojoule numerical formats. There is limited evidence available regarding the effect of energy content information when presented in other (non-numerical) formats, or when presented for a range of different alcoholic beverages. There is also limited evidence available regarding the effect of energy content information on other relevant behaviours, such as consumer choice among different types of alcoholic beverages, or the number of drinks consumed over time.

Finally, there is limited evidence available to answer the question of whether providing energy labelling on alcoholic beverages is likely to encourage some 'at risk' groups of consumers to offset the energy from alcoholic beverages by reducing food intake.

Contents

Introduction

Under the Australia New Zealand Food Standards Code, manufacturers are required to label most packaged foods with a nutrition information panel (NIP), which contains average energy content[1] information expressed in kilojoules (or both in kilojoules and in kilocalories). Conversely, manufacturers are not required to provide nutritional information (including energy content information) on packaged alcoholic beverages. However, if a permitted nutrition content claim about energy or carbohydrate content is made on the label of an alcoholic beverage, an NIP is then required.

On 16 August 2019, the Australian and New Zealand Ministerial Forum on Food Regulation (the Forum) noted that:

Currently, consumers' ability to understand the energy contribution that alcohol makes to their diet is severely limited, as alcoholic beverages are exempt from providing nutrition information on the label.

The Forum agreed to refer work on energy labelling of alcoholic beverages to Food Standards Australia New Zealand (FSANZ)[2]. In response, FSANZ is undertaking some initial work to investigate the problem statement as noted by the Forum. To inform this work, FSANZ undertook a literature review to examine the evidence base regarding consumer value/motivation, understanding and behaviour in relation to energy content information on alcoholic beverages. The literature review investigated the following eight research questions (grouped into three overarching topics):

Consumer value of (and motivation to use) energy content information regarding alcoholic beverages:

- Do consumers want energy labelling on alcoholic beverages?
- How much do consumers value energy content information relative to other information on the label of alcoholic beverages?

Consumer understanding of the energy content of alcoholic beverages (based on their general knowledge):

- Are consumers able to correctly estimate the absolute energy content of alcoholic beverages?
- Are consumers able to correctly rank the energy content of different alcoholic beverages?

[1] **Average energy content** means the average energy content calculated in accordance with section S11—2.

[2] This was in response to an independent review of food labelling law and policy that was undertaken by an expert panel (Blewett et al., 2011). The panel rejected the view that alcohol products like all other foods should carry an NIP, given alcoholic beverages contain few nutrients of concern other than alcohol, but noted the provision of energy content deserves consideration.

- Do consumers understand that the main source of energy in most alcoholic beverages comes from the alcohol itself?

The effect of energy content information on consumer understanding and behaviour:

- What is the effect of energy content information on alcohol consumption/purchasing behaviour?
- What is the effect of energy content information on consumers' understanding of the energy content of alcoholic beverages?
- What is the effect of energy content information on the prevalence of "drunkorexia"[3] behaviour (food restriction to compensate for calories from alcohol)?

This document outlines the methodological approach to the literature review, and summarises the evidence that was available to answer each research question.

Methods

Literature search strategy

FSANZ undertook a systematic search for literature on consumer value, understanding and behaviour in relation to energy content information regarding alcoholic beverages. Literature was identified by:

- Searching six online databases for peer-reviewed studies published between January 2003 and July 2020
- Searching the FSANZ Behavioural and Regulatory Analysis section reference database
- Emailing the International Social Science Liaison group (ISSLG)[4] requesting any published or unpublished research relevant to the review
- Searching the websites of known relevant agencies
- Searching the reference lists and citing studies of obtained studies

A total of 32 full-text documents (consisting of 38 unique studies) were included in the literature review. The literature search and screening process was conducted by one officer. More details on the literature search strategy and research review process are available in Appendix 1.

[3] The non-medical term "drunkorexia" is commonly used in scholarly articles, and was first coined by popular media in 2008 (Burke et al., 2010; Preonas, 2020).

[4] The ISSLG consists of members from international food regulatory agencies involved in social sciences and economics in food regulation.

Study quality assessment

The quality of each included study was assessed using a revised version of the Quality Assessment Tool for Studies with Diverse Designs (QATSDD) (Sirriyeh et al., 2012). The QATSDD was chosen because eligible studies were expected to vary in design. The revised QATSDD consists of a total of 14 items (12 items for quantitative or qualitative studies, 14 items for mixed-design studies) that may be broadly categorised into the following themes/quality criteria:

- Theoretical/conceptual framework and research aims
- Sampling and recruitment methods
- Procedural details
- Data collection tools
- Data analyses
- Ethics
- Strengths and limitations

Each item is rated according to the degree to which each quality criteria is met: 0 = no mention at all; 1 = very slightly met; 2 = moderately met; 3 = completely met (except for the ethical approval criteria which is rated on a dichotomous scale of 0 or 3). The revised QATSDD is further described in Appendix 2, and a full copy of the revised QATSDD is provided in Table A2 in Appendix 2.

Based on the revised QATSDD criteria, studies were evaluated as being "low," "medium," or "high" in overall quality. Low quality studies were those that rated poorly on many criteria (i.e., had a total rating of less than 50%[5]), and/or had missing methodological details or inadequately reported results, which made it difficult to have confidence in the findings. Medium quality studies were those that rated poorly on some criteria, but there were no major concerns regarding the methodology or reporting of results, and therefore it was possible to have some confidence in the findings. These studies tended to have total ratings that were greater than 50%, but less than 70%. High quality studies rated highly on most criteria, and there were no concerns regarding the methodology or reporting of results, and therefore it was possible to have a high-level of confidence in the findings. These studies tended to have total ratings that were greater than 70%.

The quality evaluations of each study are reported in Appendix 3, along with an overview of general study characteristics. Study quality assessments were conducted by one officer.

Evidence synthesis

The evidence from each study was collated thematically under the research questions in order to present a narrative overview of the available evidence. The overall quality of the evidence that was available to answer each research question is described using a narrative approach. This is because there is currently no available

[5] Total ratings for each study were calculated by summing the ratings of each criteria and dividing this by the maximum possible total rating and multiplying by 100 (as described in Sirriyeh et al., 2012).

tool that may be used to quantitatively synthesise the quality of evidence from studies that used diverse designs. However, considerations were given to the general principles of the GRADE approach (Guyatt et al., 2011) when narratively synthesising the quality of the evidence. That is, consideration was given to the quality of the individual studies (as assessed by the revised QATSDD), the consistency of findings across studies, and the directness of the measures (e.g., self-reported hypothetical measures of behaviour lack directness).

Meta-analyses were also conducted where appropriate (i.e., for studies that used similar methodologies and measures). The studies that used consistent methodologies and measures reported results relevant to:

- consumer value of energy content information regarding alcoholic beverages (as measured by the percentage of participants supporting energy labelling on alcoholic beverages), and
- consumer understanding of energy content information regarding alcoholic beverages (as measured by the percentage of participants who were able to correctly estimate the energy content of alcoholic beverages).

Two meta-analyses were therefore conducted in order to provide a pooled estimate for each of these two outcome measures. Both meta-analyses were conducted using the Generic Inverse Variance method with a random-effects model (see Appendix 4 for further information). The findings of each meta-analysis are reported in conjunction with a narrative overview of the studies that could not be included in the meta-analysis (i.e., studies that did not report exact proportions or used different measures relevant to consumer value or understanding of energy content information regarding alcoholic beverages).

Due to a lack of consistency in the study designs and measures used, it was not possible to conduct meta-analyses on studies that reported results relevant to the effects of energy content information on consumer behaviour and understanding. These studies were therefore only narratively synthesised.

Write-up and synthesis was conducted by one officer.

The draft literature review report was internally peer reviewed by FSANZ staff members. The final draft was then externally peer reviewed by an independent academic with expertise in the behavioural sciences. Peer review comments were considered and incorporated into the final version of the report.

Findings

Overview of study characteristics

38 unique studies (from 32 documents) were eligible for inclusion. Twenty-two studies were peer-reviewed articles published in academic journals, and 16 were grey literature (i.e., unpublished theses and research produced by governmental or non-governmental agencies). Only six studies recruited participants from Australia (n = 3) or New Zealand (n = 3); the majority of studies (n = 32) recruited participants

from the United States of America (USA), the United Kingdom (UK) or from wider Europe. Most studies (24/38 = 63%) involved quantitative, cross-sectional surveys (with two of these studies also utilising a conjoint design); six studies used qualitative designs (i.e., focus-groups or semi-structured interviews); five studies used experimental designs, and three studies used a mixed design (i.e., had both quantitative and qualitative components).

Just over half of the studies (21/38 = 55%) were of low quality according to the QATSDD. Thirty-two percent (12/38) were of medium quality, and 13% (5/38) were of high quality. Common reasons for low quality ratings were missing methodological information and/or inadequate reporting of results.

Appendix 3 provides an overview of the characteristics and quality ratings for each study. Studies are grouped in tables by the three overarching topics of the literature review (consumer value/motivation [Table A3.1], consumer understanding [Table A3.2], effects of energy content information on consumer behaviour and understanding [Table A3.3]).

Consumer value/motivation

Eighteen studies assessed consumer value of (or motivation to use) energy content information regarding alcoholic beverages (see Table A3.1 in Appendix 3). This included studies that asked consumers whether they support energy labelling on alcoholic beverages, how important the information is to them, or how much they are willing to pay for the information. In most studies, consumers were asked about energy labelling in particular (only two studies asked participants about energy content information in general [i.e., not necessarily on the label]; Barber, 2016, Study 4; Tricas-Sauras et al., 2015). The majority of studies (11/18 = 61%) were of low quality (28% [5/18] and 11% [2/18] were of medium and high quality, respectively). Only three studies were based on Australian (n = 1) or New Zealand (n = 2) samples.

Meta-analysis: Proportion of participants who support energy labelling of alcoholic beverages

Seven of the 18 studies reported the proportion of participants in the sample who supported energy labelling or who reported wanting more energy content information in general regarding alcoholic beverages. The results from the seven studies, involving more than 13,000 participants, were combined using meta-analysis in order to calculate a pooled proportion of participants supporting energy labelling.

Studies included in the meta-analysis used a self-report questionnaire format (e.g., ‘Do you think that energy/calorie content should be on the label of all alcoholic beverages?’). The way in which participants could respond varied across studies. Two studies used a dichotomous response format, where participants could select ‘yes’ or ‘no’ (Tricas-Sauras et al., 2015), or ‘agree’ or ‘disagree’ (Maynard et al., 2018b, Study 1). Three studies used a Likert scale (Center for Science in Public Interest [CSPI] 2003; Moore et al., 2010; Walker et al., 2019b), where participants rated how important including energy content information on the label was, or how much they agreed with the statement that it should be included on the label (e.g., 1 = strongly disagree; 7 = strongly agree). Participants who selected that they agreed or strongly agreed with the statement (or rated it as important or very important) were

counted as supporting energy labelling. The remaining two studies did not report how participants could respond (Nikolaou et al., 2015; Royal Society for Public Health [RSPH], 2014).

Figure 1 shows a forest plot depicting the proportions and 95% confidence intervals (CI) for each study included in the meta-analysis[6]

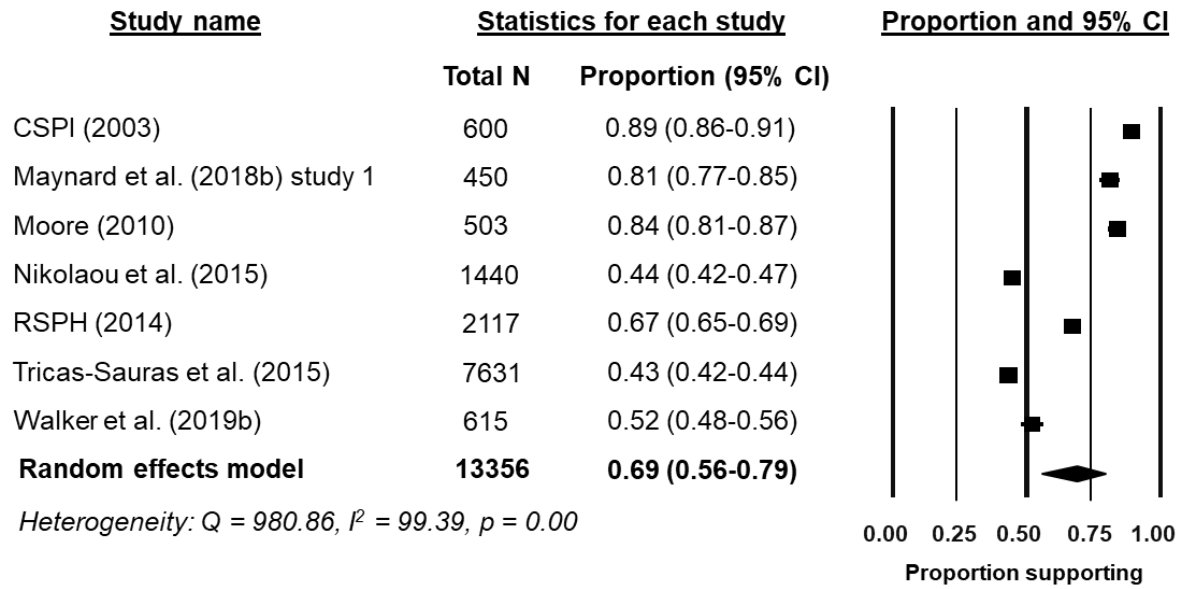

***Figure 1*: Forest plot showing proportions and 95% CIs for studies that reported the proportion of participants in the sample who supported energy labelling.**

As shown in Figure 1, the pooled proportion was 0.69 (95% CI: 0.56-0.79). Thus, based on a total combined sample of 13,356 participants from seven studies, the majority of participants (69%) reported that they support energy labelling on alcoholic beverages. However, studies did not use representative samples of the population, and only one study used participants from New Zealand (Walker et al., 2019b). The remaining studies used participants from the USA (CSPI, 2003; Moore, 2010), UK (Maynard et al., 2018b Study 1; Nikolaou et al., 2015; RSPH, 2014), or wider Europe (Tricas-Sauras et al., 2015); none used participants from Australia. Therefore caution should be taken when generalising these findings to Australian/New Zealand populations.

All but one study (Tricas-Sauras et al., 2015) assessed energy *labelling* in particular; Tricas-Sauras et al. (2015) instead asked participants "Would you like to be provided

[6] Each square in the forest plot represents the proportion from one study, and the horizontal line represents the CI of that proportion (note that most CIs are very small and therefore not visible on the graph). The diamond represents the weighted average (pooled) proportion across all studies. Statistics are also shown for each unique study, including the total number of participants in the sample (Total N), and the proportion of participants supporting energy labelling and the lower and upper limits of the 95% CI (Proportion (95% CI)).

with more information regarding calorie content?" However, leave-one-out analyses[7] showed that the pooled proportion was not largely affected by the inclusion of any one study (re-calculated pooled proportions ranged from 0.63 to 0.72).

As shown in Figure 1, there was some variation in the size of the proportions across studies. That is, while four studies reported proportions of approximately 0.7 and above (CSPI, 2003; Maynard et al., 2018b Study 1; Moore, 2010; RSPH, 2014), three studies reported lower proportions ranging from approximately 0.4 to 0.5 (Nikolaou et al., 2015; Tricas-Sauras et al., 2015; Walker et al., 2019b). Heterogeneity statistics confirmed that there was significant variability in proportions across studies. The I^2 value (99.39) indicates that 99.39% of the observed variability in proportions across studies is due to true differences among studies, and may potentially be explained by moderators (such as the different participant characteristics of the samples used across studies).

Heavy drinkers may value energy content information less than low or moderate drinkers (e.g., see Maynard et al., 2018a below, under the 'Qualitative studies' section). Indeed, heavy drinkers were overrepresented in the sample of participants used by Walker et al. (2019b), which may explain the relatively low proportion of participants supporting energy labelling in that study (0.52). Additionally, Nikolaou et al. (2015), who also reported a relatively low proportion of participants supporting energy labelling (0.44), used a sample of undergraduate college students. Although Nikolaou et al. (2015) did not report participant levels of alcohol consumption, drinking levels are typically high in college samples (El Ansari et al., 2013; Wiki et al., 2010). However, note that it was not possible to perform formal moderator analyses, due to the small number of studies included in the meta-analysis. Additionally, the remaining studies did not report participant levels of alcohol consumption, or used different measures of alcohol consumption that made it difficult to compare across studies[8]. Thus, the hypothesis that the variability in proportions across studies may be explained by differing participant levels of alcohol consumption is purely speculative. It therefore remains possible that the variability in proportions across studies may be explained by other differing participant or methodological characteristics.

Two studies reported separate proportions for female and male participants, and found that support for energy content information was more prevalent among female participants than male participants (Nikolaou et al., 2015: females = one half, males =

[7] Leave-one-out analyses involves performing the meta-analysis multiple times; each time one study is left out in order to determine whether excluding a single study greatly changes the pooled proportion.

[8] For example, Tricas-Sauras et al. (2015) measured alcohol consumption by asking participants how often they consume alcohol (daily, regularly [several times a week], occasionally [1-2 months], rarely [a few times a year], never). The majority of participants stated that they consume alcohol regularly, however the amount of drinks consumed per typical drinking occasion was not measured. In contrast, Walker et al. (2019b) measured alcohol use using a shortened version of the Alcohol Use Disorders Identification Test (AUDIT-C; Dawson et al., 2005), which considers both frequency of drinking and the number of drinks consumed on a typical drinking day.

one third; Tricas-Sauras et al., 2015: females = 64.5%, males = 35.5%)[9]. Tricas-Sauras et al. (2015) also reported separate proportions by level of education, and found that support for energy content information was more prevalent among participants who reported completing higher-level education (primary education = 3.2%; upper secondary education = 17.8%; university education = 79%).

Narrative synthesis of additional studies that assessed consumer value

The remaining 11 studies were not included in the meta-analysis because they did not report the proportion of participants who supported energy labelling (or energy content information in general) regarding alcoholic beverages. Rather, these studies reported whether the majority supported or valued the information (i.e., without providing exact proportions), or used different measures of value. Of these 11 studies, seven used qualitative designs (focus-groups or open-ended questions), three used quantitative (cross-sectional) designs and one used an experimental design. Consistent with the findings of the meta-analysis, the majority of these studies reported that participants generally supported/valued energy labelling, but there was some variability that may be explained by differing demographics. These studies are further described below (grouped by design).

Qualitative studies

Walker et al. (2019a; medium quality) conducted focus-group discussions with New Zealand-based drinkers to examine consumers' perspectives on energy labelling on alcoholic beverages. All participants were given four non-branded bottles with four different labels. The labels included: 1) an NIP, 2) energy content information alone [in kilojoules and calories, both with and without % daily intake information], and 3) a combination label with energy, standard drinks, and percent alcohol content presented in one panel. Participants generally desired having additional information on the label (including the energy content), however, some felt that the energy content was only relevant for a particular subgroup of people (those who were concerned about their weight). Whether findings differed by gender was not examined in this study.

Roderique-Davis et al. (2020, Study 2; low quality) also conducted focus group discussions with drinkers from Wales. Participants were provided with labels that are commonly used on alcoholic beverages in Wales (i.e., labels without calorie content information), and also with re-designed labels that contained additional information (including calorie content information). Consistent with Walker et al. (2019a), Roderique-Davis et al. (2020, Study 2) reported that participants valued the inclusion of calorie content information because they felt that it raised awareness of the calorie content of the drink. One participant remarked: "People are more conscious of weight and obesity and I don't think they necessarily draw the link between the drink and their calorie intake." Consistent with this finding, a prior study conducted by the same

[9] Nikolaou et al. (2015) only reported separate proportions for males and females, therefore these proportions were combined for the overall meta-analysis (see Appendix 4 for more information). Tricas-Sauras et al. (2015) reported the overall proportion as well as separate proportions for different (but overlapping) subgroups, therefore the overall proportion was used for the overall meta-analysis.

authors (Roderique-David et al., 2020, Study 1; low quality) also found that drinkers from Wales generally recommended that calorie content information be on the label of alcohol beverages[10].

Additional qualitative studies that used focus-group methodologies indicated that the value of energy content information may vary across different groups in the population, consistent with Walker et al. (2019a). Both Pabst et al. (2019; medium quality) and the Victoria Health Promotion Foundation (2009; low quality) found that energy labelling was mainly perceived as valuable by those who were concerned about their weight or health. Pabst et al. and the Victoria Health Promotion Foundation recruited German wine consumers and Australian alcohol consumers, respectively. Additionally, both Barber (2016, Study 4; medium quality) and the Victoria Health Promotion Foundation found that energy content information regarding alcoholic beverages was of more value amongst female participants than male participants. Barber recruited participants from the UK. This gender difference is also consistent with previously described studies (Nikolaou et al., 2015; Tricas-Sauras et al., 2015; see Meta-analysis section above). Furthermore, in response to an open-ended question ('do you have any comments about calorie labelling'), participants in Maynard et al.'s (2018a; high quality) UK-based study indicated that they do not value energy content information because their motivations for drinking are to get drunk or to socialise. The majority of the participants in this study were undergraduate college students who engaged in heavy drinking[11].

Quantitative studies

Three studies that used quantitative designs found that participants generally valued energy content information regarding alcoholic beverages.

Maynard et al. (2018b, Study 2; medium quality) conducted an online survey based on participants living in the UK. Participants were asked to what extent they agree with the statement 'alcoholic beverages should include more nutritional information (i.e., calorie information),' using a rating scale from 1 (strongly disagree) to 100 (strongly agree). The group mean rating was 66.01 (*SD* = 28.05), indicating that participants generally agreed with the statement. However, this study did not examine whether ratings differed across different participant demographics.

Annunziata et al. (2016b; low quality) conducted an online survey using a conjoint design, where participants were presented with various picture cards of different wine labels that varied in the information presented (including type of nutritional information [NIP vs. calorie content information alone vs. no nutritional information] and numerous other attributes such as price). Participants were from Italy, Spain,

[10] Participants in this study were asked a series of open-ended questions regarding energy content and health warning information on alcoholic beverages, however the wording of the questions was not reported in the paper.

[11] AUDIT mean scores ranged from 10.2 to 11.5 (SDs = 4.7-5.0), indicating hazardous or harmful drinking (or at risk of developing any alcohol use disorder; see Saunders et al., 1993). Note that the AUDIT is a longer version of the AUDIT-C (see Footnote 8 and Dawson et al., 2005).

France and the United States of America (USA). Participants from three of the four countries preferred labels that included calorie content information. That is, both Italian and Spanish participants preferred the calorie (kcal) label (as opposed to the NIP or no nutritional information), and participants from the USA preferred the NIP label[12]. However, French participants preferred no nutritional information. The finding that Italian participants preferred wine products with a kcal label (as opposed to an NIP or no nutritional information) was replicated by an additional study conducted by Annunziata et al. (2016a) using a similar methodology.

Experimental study

Vecchio et al. (2018; low quality) investigated the amount of money Italian wine consumers were willing to pay for different wine nutrition labels. All participants viewed four bottles of red wine that differed in the nutritional information provided on the back label (kcal content per glass vs. NIP for 100mL vs. a link to an external website to obtain the nutritional information vs. energy, carbohydrate and sugar content with guideline daily amounts[13]), and were asked to write a sealed bid for each product. Bids were significantly higher for all nutritional labelling conditions compared to the no nutritional labelling condition (i.e., the label that only contained the website link). Additionally, bids significantly increased as the amount of nutritional information increased (i.e., bids were highest for the NIP, followed by the daily guideline amounts, followed by the kcal per glass, followed by the website link). The authors concluded that participants attributed more value to the labels with nutritional information (including kcal per glass) than the label that only contained a website link to the information.

Summary

In summary, consistent with the findings of the meta-analysis, the majority of these studies reported that participants generally supported/valued energy labelling, but there was some variability that may be explained by differing demographics or factors (such as gender/whether consumers are weight- or health-conscious/whether their motivations for drinking are to get drunk). Despite the variable quality of the studies, there was a high degree of consistency across the body of evidence, whether generated using qualitative or quantitative methods.

How much do consumers value energy content information relative to other information regarding alcoholic beverages?

Nine of the 16 studies described thus far not only reported whether participants value energy content information in absolute terms, but also reported how much

[12] However, it should be noted that it is unclear whether participants from the USA preferred the NIP label because they value energy content information in addition to other nutritional information, or because they value particular nutritional information that does not include energy content information (e.g., only information relating to sugar and/or carbohydrates, etc.). This study was still included in the current literature review, however, given that the study reported sufficient information specifically in relation to the value of energy content information for participants from the other three countries.

[13] Guideline Daily Amounts (GDA) were expressed as a percentage of the recommended daily intake of 2000 kcal, e.g., “Energy 86kcal, 4.3% GDA”.

consumers value energy content information relative to other information regarding alcoholic beverages. Taken together, these studies indicate that, although participants valued energy content information, there was some information that participants valued to a greater extent. In all but one study (Tricas-Sauras et al., 2015), participants were asked about including the information on the *label* in particular; Tricas-Sauras et al. (2015) instead more generally asked participants if they would like to be provided with more information. The findings of these studies are further described below, grouped by the two types of measures used (i.e., the proportion of participants supporting labelling of the information vs. other measures of value [such as group mean ratings of support for labelling]), as in the previous section of this report.

Comparison of the percentage of participants supporting different types of labelling information

Four studies that reported the percentage of participants supporting energy labelling also reported the percentage of participants supporting the labelling of other information (see Table 1).

Table 1. Percentage of participants supporting the inclusion of each type of information on the label of alcoholic beverages

Study	Alcohol content/units	Ingredients	Calories	Serving size	Health warnings (no examples)	Health warnings (with examples)	Nutritional information	Dietary/drinking guidelines*
CSPI (2003)	94%	91%	89%	84%	N/A	N/A	N/A	N/A
Maynard (2018b, Study 1)	91%	N/A	81%	N/A	77%	86% (examples included liver disease, cancer, harm to unborn baby)	N/A	N/A
Moore et al. (2010)	92%	N/A	84%	N/A	N/A	N/A	Carbohydrates = 75%; fat = 71%; protein = 6%	77%
Tricas-Sauras et al. (2015)	N/A	50.4%	43.2%	N/A	N/A	54.8% (examples included drink driving, drinking during pregnancy, development of cancer, liver cirrhosis	37.9%	54.8%

* In Moore et al. (2010), it is unclear whether participants were provided with any additional explanation of what is meant by 'dietary guidelines'.
In Tricas-Sauras et al. (2015), the term 'drinking guidelines' was not defined in the question that was provided to participants. However, participants in Tricas-Sauras et al. (2015) were asked a prior question that may have implied that the question was about guidelines regarding how much one should drink and when one should not drink at all. This prior question was: 'What is your understanding of 'low risk' drinking.' Participants could respond by selecting one of the following: 'Limiting drinking to a certain average level of alcohol per day or per week'; 'Not drinking to drunkenness'; 'Mainly drinking with meals'; 'Not drinking in conjunction with driving'; 'Other'.

Although the percentage of participants supporting energy labelling was mostly high in these studies (range = 81-89%; except Tricas-Sauras et al.'s 2015 percentage of 43.2%), an even higher percentage of participants supported labelling of alcohol content/units (Maynard et al., 2018b Study 1; Moore et al., 2010; CSPI, 2003) and ingredients (CSPI, 2003; Tricas-Sauras et al., 2015). In contrast, relative to the percentage of participants supporting energy labelling, a lower percentage of participants supported labelling of other nutritional information (Moore et al., 2010; Tricas-Sauras et al., 2015) and serving size information (CSPI, 2003).

Moore et al. (2010; low quality) also found that a lower percentage of participants supported labelling on what the Dietary Guidelines recommend (compared to the percentage of participants supporting energy labelling), although it is unclear whether participants were provided with any additional explanation of what is meant by Dietary Guidelines. In contrast, Tricas-Sauras et al. (2015; medium quality) found that a higher percentage of participants wanted more information on drinking guidelines. Although the term 'drinking guidelines' wasn't defined in the question provided to participants in this study, participants were asked a prior question[14] that may have implied that the question was about guidelines regarding how much one should drink and when one should not drink at all.

Two studies assessed the percentage of participants supporting health warning labelling[15]. Maynard et al. (2018b; low quality) found that a lower proportion of participants supported health warning labelling compared to energy labelling. However, after participants were provided with specific examples of health risks (e.g., liver disease, cancer, harm to unborn child), support for health warnings increased, surpassing the percentage of support for energy labelling (see Table 1). Tricas-Sauras et al. (2015; medium quality) also provided participants with examples of the health risks associated with alcohol consumption (drink driving, drinking during pregnancy, development of cancer, liver cirrhosis), and found that a higher proportion of participants supported health warning labelling compared to energy labelling.

Comparison of the value of energy labelling vs. other information based on other measures of value

Five of the studies that assessed consumer value of energy content information regarding alcoholic beverages (not measured as the proportion of participants supporting labelling), also reported information regarding consumer value of other information.

Two of these five studies assessed consumer value of alcohol content information. Maynard et al. (2018b, Study 2; medium quality) found that participants valued alcohol content information and energy content information on a label to a similar degree (on a scale of 1 [strongly disagree there should be more information on the

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[14] This question was 'What is your understanding of 'low risk' drinking.' Participants could respond by selecting one of the following: 'Limiting drinking to a certain average level of alcohol per day or per week'; 'Not drinking to drunkenness'; 'Mainly drinking with meals'; 'Not drinking in conjunction with driving'; 'Other'.

[15] Health warning labels describe the health risks associated with alcohol consumption.

label] to 100 [strongly agree there should be more information on the label]), which is inconsistent with the studies that found that a higher proportion of participants support alcohol content labelling than energy content labelling (Maynard et al., 2018b Study 1; Moore et al., 2010; CSPI, 2003). However, Walker et al. (2019a; medium quality) found that New Zealand participants most consistently selected alcohol content as their first choice when asked which of the following they would like to see on all bottles of alcohol: alcohol content; energy (kilojoule/calorie) content; carbohydrate content; sugar content; and number of standard drinks per bottle.

All five studies assessed consumer value of health warning information. Most studies found that participants valued health warning labels *more* than energy content information. However, there was some variation across different demographics.

In a study by Roderique-Davis et al. (2020, Study 1; low quality), participants were asked a series of open-ended questions regarding calorie and health warning information for alcoholic beverages[16]. Although including calorie information on the label was recommended by participants, most participants in this study suggested focusing on long-term risks such as addiction, liver failure and mental health. Annunziata et al. (2016a; low quality) also found that, using a quantitative conjoint design, Italian wine drinkers valued health warning information ('don't drink and drive') more than energy content information.

Annunziata et al. (2016b; low quality) also used a quantitative conjoint design, although participants were recruited from different countries. The majority of participants (i.e., those from Spain, France and Italy) preferred health warning information (such as 'avoid drinking alcohol when you are taking medicine' and 'avoid drinking alcohol during pregnancy') over energy content information. However, there was a subset of participants (those from the USA; who reported a higher prevalence of obesity/overweight than participants from the other countries) that preferred nutritional information over health warning information. Similarly, Walker et al.'s (2019a; medium quality) New Zealand-based study, which used a qualitative focus-group design, indicated that participants valued health warning information more than energy content information, although this was specific to a particular subgroup: Māori participants. Health warning information was of special significance to Māori participants, which may reflect a growing emphasis in Māori communities on strategies to improve health. However, providing nutritional information (including energy content information) on the label was also generally supported by this group.

In contrast to the above studies, Maynard et al. (2018b Study 2; medium quality) found that participants valued health warning information *less* than energy content information[17]. However, participants in this study were simply asked to what extent they agree with the statement 'alcoholic beverages should have information about the health impact of drinking (i.e., health warning labels).' This general description of health warning labels differs from descriptions used by other studies where specific examples such as drink driving or liver failure were provided or discussed. The

[16] The wording of the open-ended questions was not reported in the paper.

[17] *M* = 66.01 vs. 61.31, on a scale of 1(strongly disagree there should be more information on the label) to 100 (strongly agree there should be more information on the label).

finding that the relative value of health warning labelling may depend on whether specific examples are given is consistent with Maynard et al. (2018b, Study 1). It is also possible that consumers may value different types of health warning labels to differing degrees, which could affect whether they are valued more or less than energy labelling. However, in the majority of studies, participants were provided with (or discussed) examples of multiple types of health warnings at once. Therefore it was not possible to determine whether the relative value of health warning labels depends on the type of health warnings, based on those studies[18].

Finally, two of the five studies also assessed consumer value of information regarding price and the number of glasses or units not to exceed (Annunziata et al., 2016a; Annunziata et al., 2016b). Annunziata et al. (2016a; low quality) found that, based on a sample of Italian wine consumers, participants preferred nutritional information (including energy content information) *more* than information regarding price and the number of glasses not to exceed. Consistent with Annunziata et al. (2016a), Annunziata et al. (2016b; low quality) found that participants from Italy, Spain and the USA preferred nutritional information *more* than information regarding price and the number of units not to exceed. However, the French participants in Annunziata et al. (2016b) preferred nutritional information *less* than information regarding price and the number of units not to exceed, which is not surprising, given that the French participants did not value energy content information in absolute terms (as previously described).

Summary

The available research that has been described in this section is not without limitations. The majority of these studies were rated as low in quality, mainly due to missing methodological information. Furthermore, few studies (3/16) recruited samples from Australian or New Zealand populations. However, the use of self-reported quantitative data (coupled with qualitative methods where participants freely expressed their views) provided a direct measure of consumer value across these studies. General conclusions may therefore be made based on the consistency of the findings across studies.

Taken together, findings from the meta-analysis and additional studies indicated that participants generally valued energy labelling regarding alcoholic beverages in absolute terms (pooled proportion = 69%). However, certain groups (such as heavy drinkers, people who are not health-/weight-conscious, males, people with lower-level education) are likely to value the information less than others. Additionally, although participants generally valued energy content information, other information may be valued on the label to a greater extent (e.g., alcohol content, ingredients, warnings about particular health risks that are associated with alcohol consumption). However, there is also information that may be valued on the label to a *lesser* extent than energy content information (e.g., other nutritional information, serving size

[18] Participants in Maynard et al. (2018b, Study 2) did see specific health warning messages later in the study (i.e., after participants were asked to rate their level of agreement with the statement referring to general ‘health warning’ labels). However, there were eight different types of health warning messages that were manipulated between subjects, and the study was underpowered to detect whether a change in support for health warning labelling depended on the particular type of health warning.

information, price). The relative value of energy content information is also likely to vary across different groups in the population.

Consumer understanding

This section summarises studies that examined consumer understanding of the energy content of alcoholic beverages. Participants in these studies were not provided with energy content information, as the aim of these studies was to examine participants' general knowledge regarding the energy content of alcoholic beverages.

The section is further broken up into three subsections:

The first subsection summarises studies that examined whether participants were able to correctly estimate the energy content of a particular alcoholic beverage (i.e., in kilojoules or calories). These studies therefore examined participants' knowledge of the *absolute* energy content of alcoholic beverages.

The second subsection summarises studies that examined whether participants were able to correctly rank the energy content of different alcoholic beverages. Participants in these studies were provided with a list of different alcoholic (and non-alcoholic) beverages, and instructed to correctly rank them from highest to lowest in energy content. These studies therefore examined participants' knowledge of the *relative* energy content of different alcoholic beverages, which is relevant to the question of whether participants would be able to make informed choices between different alcoholic beverages (based on their general knowledge regarding the energy content).

Finally, the third subsection summarises studies that assessed whether participants understand that the main source of energy in most alcoholic beverages comes from the alcohol itself.

Are consumers able to correctly estimate the absolute energy content of alcoholic beverages?

Fourteen studies assessed whether consumers are able to correctly estimate the absolute energy content of alcoholic beverages (see Table A3.2 in Appendix 3). The majority of these studies (10/14 = 71%) were of low quality (the remaining 28% were either of medium quality [n = 2] or high quality [n = 2]). Only one study was based on a New Zealand sample; no studies were based on an Australian sample. Eleven studies used quantitative designs (surveys), whereas two studies used qualitative designs (focus-group methodologies) and one study used a mixed design (had both quantitative and qualitative components).

Meta-analysis: Proportion of participants who were able to correctly estimate the energy content of alcoholic beverages

Eleven of the 14 studies reported the proportion of participants in the sample who were able to correctly estimate the number of kilojoules or calories in an alcoholic beverage. The results from these 11 studies, involving more than 11,000 participants, were combined using meta-analysis in order to calculate a pooled proportion of

participants who were able to correctly estimate the energy content of alcoholic beverages.

Studies included in the meta-analysis used a self-report questionnaire format (e.g., "How many calories [in kilojoules or kcal] do you think are in a 125ml glass of red wine?"). One study examined knowledge of the energy content of beer (Maynard et al., 2018a), three studies examined knowledge of the energy content of wine (Annunziata et al., 2015; Annunziata et al., 2016a; Annunziata et al., 2016b), and seven studies examined knowledge of the energy content of a range of alcoholic beverages (Alcohol concern, 2010; Bui et al., 2008 Pilot study; CSPI, 2003; Growth from Knowledge group [GfK], 2014; Pabst et al., 2019; RSPH, 2014; Walker et al., 2019b). In all studies, the volume of the beverage was specified[19].

The way in which participants could respond to the question varied across studies. Four studies provided participants with response categories to choose from, where only one category was deemed correct (e.g., '<50kcal', '51-100kcal', '101-150kcal', '151-200kcal', '201-250kcal', '251-300kcal', '>300kcal', or 'I don't know'; GfK, 2014). Three studies used a free-response format, where participants generated their own estimates (Maynard et al., 2018a; Pabst et al., 2019; Walker et al., 2019b). However, accuracy was defined differently across two of these studies; Maynard et al. (2018a) defined estimates that were within 10% of the true value as accurate, whereas Walker et al. (2019b) defined estimates that were within 15% of the true value as accurate. The way accuracy was defined in the third study (Pabst et al., 2019) was not reported. The remaining four studies did not report how participants could respond to the question (Alcohol concern, 2010; Annunziata et al., 2016b; CSPI, 2003; RSPH, 2014).

Figure 2 shows a forest plot depicting the proportions and 95% confidence intervals (CI) for each study included in the meta-analysis[20].

[19] For studies that examined a range of beverages, specified volumes mainly differed across different beverages, based on standard serving sizes (e.g., 12 oz for beer, 5 oz for wine, 1.5 oz for distilled liquor), except for in GfK (2014), where all beverages (wine, beer, whiskey) were the same volume (100mL).

[20] Each square in the forest plot represents the proportion from one study, and the horizontal line represents the CI of that proportion. The diamond represents the weighted average (pooled) proportion across all studies. Statistics are also shown for each unique study, including the total number of participants in the sample (Total N), and the proportion of participants who were able to correctly estimate the energy content and the lower and upper limits of the 95% CI (Proportion (95% CI)).

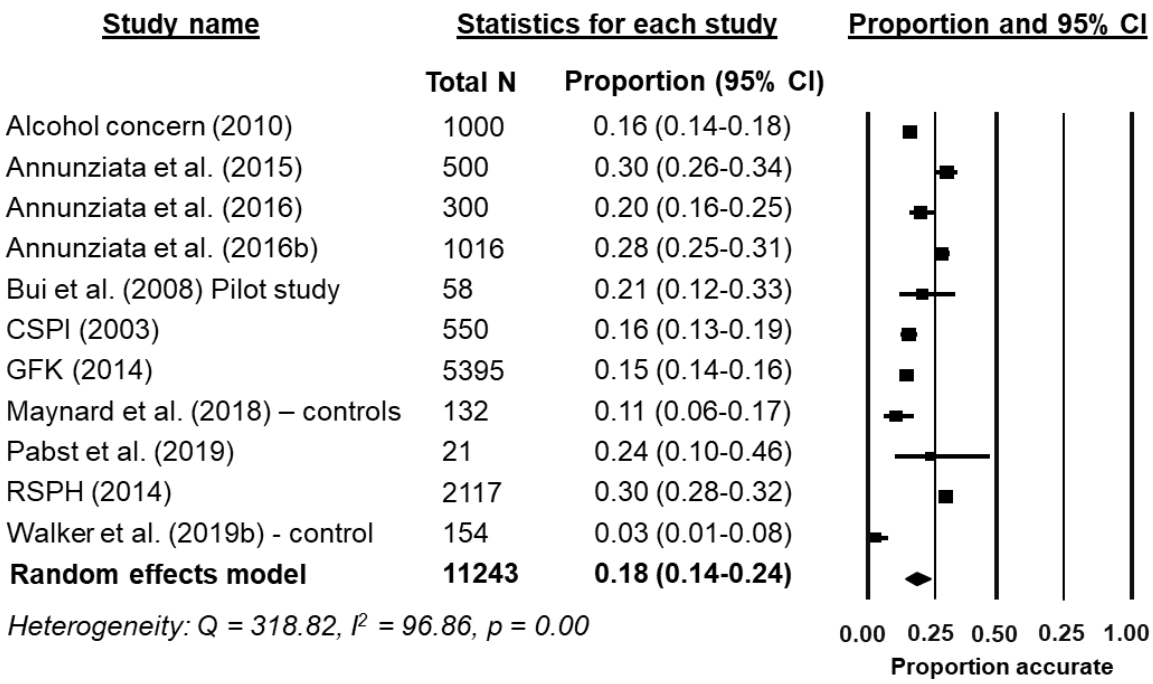

***Figure 2*: Forest plot showing proportions and 95% CIs for studies that reported the proportion of participants in the sample who were able to correctly estimate the energy content of alcoholic beverages.**

As shown in Figure 2, the pooled proportion was 0.18 (95% CI: 0.14-0.24). Thus, based on a total combined sample of 11,243 participants from 11 studies, only a minority (18%) were able to correctly estimate the energy content of alcoholic beverages. However, most studies did not use representative samples of the population, and only one study used participants from New Zealand (Walker et al., 2019b). The remaining studies used participants from the UK (Alcohol concern, 2010; Maynard et al., 2018a; RSPH, 2014), USA (Bui et al., 2008 Pilot study; CSPI, 2003), Germany (Pabst et al., 2019), Italy (Annunziata et al., 2016a), wider Europe (Annunziata et al., 2015; GfK, 2014), or both wider Europe and the USA (Annunziata et al., 2016b); none used participants from Australia. Therefore caution should be taken when generalising these findings to Australian/New Zealand populations.

Leave-one-out analyses showed that the pooled proportion was not largely affected by the inclusion of any one study (re-calculated pooled proportions ranged from 0.17 to 0.20).

As shown in Figure 2, there was some variation in the size of the proportions across studies. That is, proportions ranged from 0.03 to 0.30. Heterogeneity statistics confirmed that there was significant variability in proportions across studies; the I^2 value (96.86) indicates that virtually all of the difference in results between the studies was not due to chance, rather due to other unexplained factors. However, proportions were still consistently low (i.e., 0.30 or below), and therefore the imprecision and inconsistency do not undermine confidence in the overall conclusion that knowledge of the actual energy content of alcoholic beverages is low.

Three studies reported proportions for separate subgroups of participants. Annunziata et al. (2016b; low quality) found that the prevalence of correct energy

content estimates of wine was lowest among Italian participants (followed by the USA participants, followed by Spanish participants), and highest among French participants. However, the prevalence of correct estimates was still consistently low across all countries (range: 0.22-0.36). Annunziata et al. (2016a; low quality) also found a similar pattern among Italian, Spanish and French participants. Additionally, RSPH (2014; low quality) reported that, although women were less likely than men to state that they did not know the number of calories in a large glass of wine or in a pint of beer, there was little difference in the number of men and women who correctly identified the calorie content.

All but two studies (Alcohol Concern, 2010; RSPH, 2014) reported on the direction of inaccuracy (i.e., whether participants tended to underestimate or overestimate the absolute energy content of alcoholic beverages). The direction of inaccuracy is important to consider because this may influence how consumers behave in response to energy labelling. For example, if a consumer discovers that they were previously overestimating the energy content of an alcoholic beverage, then viewing the correct energy content information may cause them to increase their consumption of that alcoholic beverage (see the Findings section on 'Effects of energy content information on consumer behaviour and understanding' for further review and discussion).

The reported direction of inaccuracy varied across studies. However, it is difficult to determine the direction of inaccuracy as most studies did not use balanced response categories. For example, GfK (2014; low quality) asked participants to estimate the amount of calories in a 100mL glass of white wine by selecting one of the following categories: '<50kcal', '51-100kcal', '101-150kcal', '151-200kcal', '201-250kcal', '251-300kcal', '>300kcal', or 'I don't know.' The correct answer was '51-100kcal', and therefore the majority of the response categories consisted of values that were higher than the correct amount. The finding that most participants overestimated the calorie content of the glass of wine may therefore be explained by the fact that participants were more likely to select a response category that had a higher value than the correct amount due to chance.

Only four studies reported on the direction of inaccuracy that was not biased by the response categories (Bui et al., 2008 Pilot Study; Maynard et al., 2018a; Pabst et al., 2019; Walker et al., 2019b). Both Bui et al. (2008 Pilot study; low quality) and Maynard et al. (2018a; high quality) reported that the majority of participants overestimated the energy content of beer. Additionally, Pabst et al. (2019; medium quality) reported that most participants overestimated the energy content of white wine, red wine, beer, and gin and tonic. In contrast, Bui et al. found that the majority

of participants *underestimated* the energy content of light beer[21]. Walker et al. (2019b; high quality) also found that participants tended to underestimate the energy content of alcoholic beverages. Participants in Walker et al. (2019b) were asked to estimate the energy content of one type of alcoholic beverage, however the type of beverage varied among participants (depending on what they had previously selected as their preferred type of drink out of wine, beer or spirits). Whether participants tend to overestimate vs. underestimate the energy content may depend on the type of alcoholic beverage for some individuals, however results were not reported separately for each type of alcoholic beverage in Walker et al. (2019b).

Narrative synthesis of additional studies that assessed participants' energy estimates of alcoholic beverages

The remaining three studies (Lloyd-Richardson et al., 2008; Maynard et al., 2018b, Study 1; Walker et al., 2019a) were not included in the meta-analysis because they did not report the proportion of participants who were able to correctly estimate the absolute energy content of alcoholic beverages. Rather, these studies reported whether the majority were able to provide correct estimates (i.e., without providing exact proportions), or used different measures relevant to consumer understanding of the absolute energy content of alcoholic beverages. Additionally, two studies included in the meta-analysis also reported on other measures relevant to understanding of the absolute energy content (Bui et al., 2008 Pilot Study; Maynard et al., 2018a). The results of these studies are consistent with the findings of the meta-analysis, and are described below.

Maynard et al. (2018b, Study 1; low quality) conducted an online survey based on adult drinkers living in the UK. As in the studies included in the meta-analysis, participants were asked to estimate the number of calories in a range of alcoholic beverages (with volumes specified): cider, beer, alcopops (i.e., Ready-To-Drink alcoholic beverages; RTDs), wine, gin and tonic. The way in which participants could answer the question was not reported, however the group mean calorie estimates were reported for each beverage, indicating that a free-response format may have been utilised. Participants were generally poor at estimating the calorie content, which was consistently overestimated for all beverages (e.g., for beer: group mean estimate = 260 kcal; correct amount = 180 kcal[22]).

Walker et al. (2019a; medium quality) conducted a qualitative focus-group study based on New Zealand drinkers. At the start of the focus group, participants were asked to estimate the energy content of five different alcoholic beverages (by filling in

[21] In Bui et al. (2008, Pilot Study), participants estimated the calorie content for a range of different alcoholic beverages, including light beer, regular beer, wine and distilled liquor. The majority of participants overestimated (rather than underestimated) the energy content of regular beer, wine and distilled liquor. However, the majority of the response categories overestimated the calorie content for wine and distilled liquor, which is confounded with the direction of inaccuracy. Conversely, the majority of the response categories underestimated the energy content of beer, and therefore the response categories are not confounded with the direction of inaccuracy for beer. This was also the case for light beer, as most participants underestimated the energy content of light beer, even though most response categories overestimated the true energy value of light beer.

[22] These are approximate values based on the bar graph provided in Maynard et al. (2018b, Study 1).

a worksheet that had a free-response format). The different alcoholic beverages were: a 330mL bottle of beer; a 125mL glass of red wine; a 375mL RTD; a 30mL shot of spirits; and a 125mL glass of sparkling wine. Walker et al. (2019a) reported that only some participants (proportion not reported) were able to provide good estimates of the energy content of a glass of wine or a bottle of beer, and that these participants incidentally had prior experiences of dieting or sports training.

In contrast to the studies described thus far (which objectively measured participants' knowledge), three studies examined participants' *perceptions* of their knowledge regarding the absolute energy content of alcoholic beverages (Bui et al., 2008 Pilot Study; Lloyd Richardson et al., 2008; Maynard et al., 2018a).

In a study based in the USA, Lloyd-Richardson et al. (2008; low quality) asked undergraduate college students whether they knew how many calories were in the alcoholic beverages they typically consumed. Among the students who reported drinking in the past month (N = 206), the majority (65.7%) reported that they were unaware of the calorie content of the alcoholic beverages they typically consume[23]. There was also no significant difference in proportions between participants who were at a low risk of developing an alcohol use disorder vs. those who were at a moderate risk.[24] Additionally, participants in Maynard et al. (2018a; high quality) generally reported that they are unaware of the number of calories in alcoholic beverages (in response to the open-ended question: 'Do you have any other comments about calorie labelling?').

Finally, in addition to objectively examining participants' knowledge, Bui et al. (2008, Pilot Study; low quality) also examined how confident participants were that their calorie estimates were accurate (on a scale of 1 [not confident at all] to 7 [extremely confident]). Participants' level of confidence in their calorie estimates were consistently low (as the mean ratings across the different alcoholic beverages ranged from 2.60-3.41).

Summary

Findings from the meta-analysis and additional studies indicated that participants were generally poor at estimating the absolute energy content of alcoholic beverages (pooled proportion of participants with correct estimates = 18%). These findings are also consistent with studies that assessed participants' perceptions of their knowledge, as participants generally reported that they did not know the calorie content of alcoholic beverages and that they were not confident in their answers.

Few studies reported whether accuracy levels differed across different demographics (such as differences in at-risk drinking patterns, gender or countries). There were no differences in accuracy levels based on drinking patterns or gender. Although there were some differences across different countries, correct estimates were still

[23] Participants in Lloyd-Richardson et al.'s (2008) study rated their degree of knowledge using a Likert scale, however, there was no description of the Likert scale provided in the paper.

[24] Participants who scored equal to or greater than 8 on the AUDIT were classified as being at moderate risk of developing an alcohol use disorder (see Saunders et al., 1993).

consistently low. However, one study reported that some participants were able to provide good estimates; these participants tended to have prior experiences of dieting or sports training (Walker et al., 2019a).

Whether participants tended to underestimate or overestimate the *absolute* energy content of alcoholic beverages was mixed. However, this conclusion is only based on a small subset of the available studies, given that the majority used biased response categories or did not report how participants could respond (and therefore this could not be ruled out as a confound for most studies). The question of whether participants tend to underestimate or overestimate the energy content of a particular type of alcoholic beverage *relative to* another type of alcoholic beverage is further reviewed below.

Are consumers able to correctly rank the energy content of different alcoholic beverages?

Eight studies examined whether consumers are able to correctly rank the energy content of different alcoholic beverages (see Table A3.2 in Appendix 3). Two additional studies also examined whether consumers are able to correctly rank the energy content of an alcoholic beverage and a non-alcoholic beverage or food. To reiterate, participants in these 10 studies were not provided with energy content information, as the aim of these studies was to examine participants' general knowledge regarding the energy content of alcoholic beverages. Half of the studies were of low quality (5/10 = 50%), whereas the other half were either of medium (3/10 = 30%) or high (2/10 = 20%) quality. Only one study was based on a New Zealand sample; no studies were based on an Australian sample. The type of alcoholic beverages participants were required to rank in energy content differed across most studies, therefore separate descriptions are provided below for most studies (grouped by design). Eight studies used quantitative designs (surveys), whereas two studies used qualitative designs (focus-group methodologies).

Quantitative studies

In four of the quantitative studies, participants were provided with a list of different alcoholic beverages and were asked to select which one contains the most calories (Annunziata et al., 2015; Annunziata et al., 2016a; Annunziata et al., 2016b; GfK, 2014). These studies found that most participants were unable to select the correct answer, although there was some variability across different countries.

In Annunziata et al. (2016b; low quality), participants were provided with the following list of options: a 125mL glass of wine; a 330ml mug of beer, an alcopop, a 40mL shot of grappa (a type of Italian brandy). Only 34% of participants from both Italy and the USA selected the correct answer (an alcopop). The most common answer from USA participants was instead a 330mL mug of beer (48%), and a similar percentage of Italian participants selected the mug of beer (compared to the percentage of Italian participants that selected the alcopop). Italian and USA participants therefore overestimated the calorie content of beer relative to an alcopop. In contrast, the majority of French and Spanish participants correctly selected the alcopop (58% and 68%, respectively). Annunziata et al. (2015) conducted the same study (although only using Italian, French and Spanish participants) and found similar results, as did Annunziata et al. (2016a) who only used Italian participants.

In GfK (2014; low quality), participants were also provided with a list of different alcoholic (and non-alcoholic) beverages, however, in contrast to the above studies, the volume of the different beverages was the same. Participants were asked to select which of the following contained the most calories for the same volume: freshly squeezed orange juice; alcohol-free beer (less than 1% alcohol); regular beer (between 4.5% and 5.5% alcohol); wine (red or white wine); spirits (e.g. whiskey, vodka, gin, rum); Not sure. Overall, only 30% of participants correctly selected spirits (50% selected the wrong answer; 18% selected 'not sure'), indicating that most participants underestimated the relative calorie content of spirits. Participants in this study were from Germany, Poland, Denmark, the Netherlands, Spain and the UK; the percentage of participants selecting the correct answer was similarly low across all countries, except for Spain (where the majority [63%] selected the correct answer).

Consistent with Annunziata et al. (2016b), a fifth quantitative study (CSPI, 2003; low quality) found evidence to suggest that USA participants may overestimate the calorie content of beer relative to alcopops, as 41% of participants in this study incorrectly thought that alcopops contain the same number or fewer calories than beer. However, this study was rated as being of low quality due to an absence of methodological information. This study also did not report what the remaining 59% of participants thought, therefore it is unclear whether the 41% represents the most prevalent response from the sample.

The sixth quantitative study provided UK and French participants with a list of different alcoholic beverages (Barber et al., 2016; Study 3; medium quality). However in this study, participants were asked to select the beverage that is most likely to promote *weight gain* (out of: red wine; white wine; beer; cider; clear spirits [gin, vodka]; dark spirits [whiskey, rum]; alcopops [Smirnoff ice]; energy drinks [red bull]; all of the above). The most prevalent response among participants was either 'beer' (for all male participants [40-53%] and for the French female participants [46%]) or 'all of them' (for the UK female participants [40%]). Consistent with the above studies, these findings indicate that participants did not have a good understanding of the relative energy contributions of different alcoholic beverages.

The final two quantitative studies provided participants with statements that compared the energy content of an alcoholic beverage to the energy content of food (Winstock et al., 2020) or a non-alcoholic beverage (Isted et al., 2015).

In a study by Isted et al. (2015; high quality), UK participants were instructed to respond 'True' or 'False' to the statement: "A can of regular coke has more calories than a pint of beer." Approximately half (51%) of the participants incorrectly believed that a can of regular coke has more calories than a pint of beer. There was also no significant difference in proportions between participants who were at risk of developing an alcohol use disorder versus those who were not at risk[25].

In Winstock et al. (2020), participants were provided with the statement "A bottle of wine or 6 bottles of beer contain as many calories as a burger and fries", and were asked if this information was new to them (Yes or No). Approximately 36% of

[25] Participants who scored equal to or greater than 5 on the AUDIT-C were classified as at risk of an alcohol use disorder (Dawson et al., 2005).

participants stated that the information was new to them, suggesting that they previously did not know this information. Males, those under 25 years of age, and those who were at a low risk of developing an alcohol use disorder (vs. those who were at a high risk, as measured by the AUDIT) were more likely to say that the information was new, although proportions were still similarly low. However, in contrast to Isted et al. (2015), participants in Winstock et al. (2020) were not asked if the statement was true or false. Rather, it was implied that the information was true, and participants' responses may therefore have been prone to social-desirability bias (where participants may have changed their responses in order to appear more knowledgeable)[26]. It is therefore possible that the proportion of participants reporting that the information was new is underestimated in this study. Additionally, participants were recruited from an international annual web survey of people who use licit and/or illicit psychoactive drugs, therefore caution is warranted when generalising these results to other populations.

Qualitative studies

As previously described, Walker et al. (2019a; medium quality) conducted a qualitative focus-group study based on New Zealand drinkers. At the start of the focus group, participants were asked to estimate the energy content of five different alcoholic beverages (a 330mL bottle of beer; a 125mL glass of red wine; a 375mL RTD; a 30mL shot of spirits; and a 125mL glass of sparkling wine). Some focus groups specified the number of kilojoules/calories for each beverage, however, some of the focus groups decided to rank the energy content of the different alcoholic beverages by writing 'less' or 'more' or 'much more'. Walker et al. (2019a) reported that participants consistently underestimated the relative energy content of a serving of red wine, and overestimated the relative energy content of a bottle of beer. Walker et al. (2019a) suggested that these findings may be explained by the additional finding that participants tended to associate red wine with health benefits, and associate beer with a "beer belly."

Barber (2016, Study 2; high quality) also conducted a qualitative focus-group study based on UK and French participants. The focus groups were conducted across three regions in each country (Paris, Toulouse and Lyon in France and London, Manchester and Cardiff in the UK). Participants were asked to rate the healthiness of 24 different types of alcoholic beverages from unhealthy to healthy, and to explain how these values of healthiness were assessed. Some participants (those from the UK and Paris) mentioned calories and dieting; all of these participants perceived beer, cocktails and mixers in spirit mixer drinks as the most calorific. The UK participants perceived vodka as the least calorific. Although participants were not asked about particular volumes of the alcoholic beverages, it was clear that participants generally underestimated the absolute calorie content of vodka (consistent with GfK, 2014), as participants made comments such as: "obviously vodka is calorie-less isn't it so if you just drink straight vodka…". In contrast, participants from Paris perceived red wine as the least calorific.

[26] See Krumpal (2013) for a review on social desirability bias in surveys.

Summary

The above studies found that, using their general knowledge, participants were generally unable to correctly rank the energy content of different alcoholic beverages. Participants tended to underestimate the relative energy content of wine and spirits, and overestimate the relative energy content of beer. It is therefore likely that, in the absence of accurate energy content information, participants would be unable to make informed choices among different alcoholic beverages based on the energy content.

It is possible that participants were unable to correctly rank the energy content of different alcoholic beverages because they did not understand that the energy content is related to the alcohol content of alcoholic beverages. Whether there is sufficient evidence to support this hypothesis is reviewed in the next subsection.

Do consumers understand that the main source of energy in most alcoholic beverages comes from the alcohol itself?

Five studies examined whether consumers understand that the alcohol itself is the main source of energy in most alcoholic beverages (see Table A3.2 in Appendix 3). To reiterate, participants in these five studies were not provided with energy content information, as the aim of these studies was to examine participants' general knowledge regarding the energy content of alcoholic beverages. Two studies were of low quality and three studies were of medium quality. Three of these studies were based on Australian (n = 2) or New Zealand (n = 1) samples. One study used a qualitative design (a focus-group), whereas the remaining studies used a quantitative design (surveys).

Bazzani et al. (2020; medium quality) conducted an online survey based on red wine consumers living in Italy. Participants were instructed to respond 'True', 'False', or 'Don't Know' to the statement: "The amount of calories in wine is proportional to the alcohol percentage." Just under half of the participants (48.56%) correctly responded 'True'; 51.44% either responded 'False' (20.86%) or 'Don't Know' (30.58%).

Consistent with Bazzani et al. (2020), an Australian-based survey also found evidence to suggest that consumers do not understand that the amount of calories in beer is proportional to the alcohol percentage (Victoria Health Promotion Foundation, 2010; low quality). Participants in this study were low-carbohydrate beer consumers. When asked which beer they would consume to avoid weight gain, 87% reported they would choose low-carb beer over light, mid or full alcohol strength beer. Of the reasons why consumers choose to drink low-carb beer, the main reasons were that it is less bloating, less fattening, has less kilojoules (calories) and is healthier. These results indicate that low-carb beer consumers may mistakenly perceive carbohydrates as the main source of energy in beer, given that participants chose to drink low-carb beer over other types of beers (including light alcohol strength beer) because they mistakenly believed it to have less kilojoules and to be less fattening.

A qualitative focus-group study based on New Zealand drinkers also found that participants were not aware that the main source of energy in wine, beer and spirits was the alcohol itself (Walker et al., 2019a; medium quality). When asked where the

energy content in these alcoholic beverages comes from, participants tended to focus on sugar.

Consistent with Walker et al. (2019a), two quantitative studies found that participants incorrectly perceived sugar as higher in calories than alcohol (Patterson et al., 2012; Worsley, 2011). In Patterson et al. (2012; medium quality), UK adults were instructed to rank the following nutrients by calorie content: Fat, carbohydrates, sugar, aspartame, saturated fat, protein, alcohol, salt. Patterson et al. (2012) found that sugar was on average rated as more calorific than alcohol. Similarly, in a study based on Australian adults (Worsley, 2011; low quality), participants were asked: 'Which one of the following has the most kilojoules (i.e. calories, energy) for the same weight?' The response options were: Sugar, carbohydrate, dietary fibre, fat, alcohol. Responses were mixed, however the most prevalent response was sugar (27.2%)[27].

Summary

The above studies found that participants were generally unaware that the main source of energy in most alcoholic beverages (such as wine, beer and spirits) comes from the alcohol itself. Rather, one New Zealand-based study found that participants tended to focus on sugar as a main source of energy in these alcoholic beverages, and two additional studies found that participants perceived sugar as being higher in energy than alcohol in general. One study also indicated that low-carb beer drinkers may mistakenly perceive carbohydrates as the main source of energy in beer, given that participants chose low-carb beer over other types of beers (including light alcohol strength beer) because they mistakenly believed it to have less kilojoules and to be less fattening (Victoria Health Promotion Foundation, 2010).

Summary

The majority of the studies described in this overall section were of low quality, and only four studies were based on New Zealand (n = 2) or Australian (n = 2) populations. However, general conclusions may be made based on the consistency of the findings and the directness of measures, as in the previous section on consumer value.

Taken together, the studies summarised across all subsections found that, based on their general knowledge, participants generally have a poor understanding of the energy content of alcoholic beverages.

Findings from the studies described in the first subsection showed that only a minority of participants (pooled proportion = 18%) were able to correctly estimate the number of kilojoules or calories in alcoholic beverages using their general knowledge. Additionally, participants generally self-reported that they did not know the energy content of alcoholic beverages and that they were not confident in their answers.

[27] Prevalence of the other response categories in Worsley (2011): 22.9% Fat,; 20.2% Not sure; 14.4% Alcohol; 12.7% Carbohydrate; 2.7% Dietary fibre.

Findings from the second subsection also showed that participants were generally unable to correctly rank the energy content of different alcoholic beverages using their general knowledge. Rather, participants tended to underestimate the relative energy content of wine and spirits, and overestimate the relative energy content of beer.

Finally, findings from the third subsection showed that participants were generally unaware that the main source of energy in most alcoholic beverages (such as wine, beer and spirits) comes from the alcohol itself. Rather, participants tended to focus on sugar or carbohydrates as a main source of energy. This is consistent with findings from the previous subsection where participants were unable to accurately rank the energy content of different alcoholic beverages, and, in particular, that the energy content of spirits was relatively underestimated.

The overall finding that consumers are generally unable to correctly estimate the energy content (i.e. number of kilojoules or calories) in alcoholic beverages using their general knowledge is likely similar to that of food and non-alcoholic beverages (e.g., Brindal et al., 2012; Pettigrew et al., 2013). However, where the two may differ is that consumers generally understand that some foods are high in energy (Brindal et al., 2012). In contrast, consumers may not understand that alcohol is high in energy, as the evidence shows that consumers do not understand that alcohol is the main source of energy in most alcoholic beverages.

Whether providing energy content information enhances consumer understanding of the energy content of alcoholic beverages is further reviewed below.

Effects of energy content information on consumer understanding and consumption/purchasing behaviours

Sixteen studies reported findings relevant to the effects of energy content information on consumer understanding and/or consumption/purchasing behaviours. Five of the 16 studies used an experimental design, where the researchers examined the effect of energy labelling (vs. no energy labelling) on consumers' intentions to consume or purchase an alcoholic beverage. Three of the five experimental studies also examined the effect of energy labelling (vs. no energy labelling) on consumer understanding of the energy content of alcoholic beverages. These findings regarding consumer understanding are therefore reported in conjunction with the behavioural findings where available.

The remaining 11 studies used quantitative (survey) designs (n = 7) or qualitative (focus-group) designs (n = 4), where participants were asked whether they think energy labelling would influence their consumption of alcoholic beverages. In four of these studies, participants were not provided with any energy content information. Whereas in seven of these studies, the participants were provided with energy labels on alcoholic beverages, and were also asked questions regarding their perceptions of the labels.

Although experimental designs are the most suitable type of study design to answer questions regarding cause and effect, non-experimental studies (i.e., the studies that used quantitative cross-sectional designs or qualitative designs) were also included

in the current section on consumer behaviour, given the limited number of available experimental studies[28]. In addition to being limited in number, the experimental studies were also particularly limited in terms of the type of consumer behaviours that were measured and in terms of the format in which the energy content information was presented on the label to participants. That is, most experimental studies examined the effect of energy labelling (in calorie/kilojoule numerical format) on participants' self-reported likelihood of purchasing or drinking an alcoholic beverage. Few of these studies presented the energy content information on the label using other formats (that were potentially more interpretable than just stating the kilojoule/calorie content, e.g., stating the amount of exercise required to burn off the energy content), or measured other relevant behaviours such as choice among different types of alcoholic beverages. The inclusion of non-experimental designs provided further insight into consumer perceptions and understanding regarding other formats of energy content information, and the potential effects of this information on other relevant behavioural measures. However, it is acknowledged that non-experimental studies are limited in their ability to produce conclusions regarding cause and effect. Given the strengths and limitations of both the experimental and non-experimental studies, including both study types allowed a more thorough assessment of the effects of energy content information on consumer behaviour.

Each study is further described below (grouped by study design).

Experimental studies

The majority of the experimental studies (4/5) examined the effect of energy labelling (vs. no energy labelling) on proxy (i.e., indirect) measures of behaviour (i.e., participants' consumption/purchasing *intentions* or overall liking of the alcoholic beverage). One study examined the effect of energy labelling on the amount of alcohol consumed during a mock taste test. One study was low in quality, two studies were medium in quality and two studies were high in quality. Only one study was based on a New Zealand sample; no studies were based on an Australian sample. Given the differing methodologies, each study is described separately below.

In a study based on USA consumers, Martinez et al. (2015, Study 2; medium quality) investigated the effect of nutrition labels on self-reported future drinking intentions. Participants were randomised to one of four labelling conditions: no nutritional information; accurate nutritional information; nutritional information with increased vitamin C; nutritional information with decreased calories. After viewing an image of the label next to an image of a bottle of beer, participants reported their future drinking intentions (as measured by a two-item scale assessing the number of drinks participants intended to consume on a typical drinking day, and how often participants planned to engage in heavy drinking). The nutrition labels had no significant effect on participants' future drinking intentions. However, the study did not

[28] The decision to include non-experimental studies was made a priori (see Inclusion Criteria in Appendix 1), as it was anticipated prior to the literature search commencing that there may be a limited number of experimental studies available.

examine participants' understanding/perceptions of the labels, and the reduced calorie content was unrealistically low (148 calories vs. 49 calories).

Hayward and McSweeney (2020; medium quality) investigated the effect of differing calorie labels on Canadian consumers' overall liking of rosé wines. Over the course of four days, each participant tasted a range of rosé wine samples that differed in the (fabricated) calorie content that was stated on the label: 15 calories (low); 100 calories (normal); 180 calories (high); 240 calories (highest); No calorie information. Participants rated their overall liking of each wine following each tasting (on a scale of 1 ['extremely dislike'] to 9 ['like extremely']). The wine samples were presented in a small wine glass with the label on the wine glass. Consistent with Martinez et al. (2015, Study 2), there was no significant difference in participants' overall liking between the different calorie labelling conditions. However, the study did not examine the effect of the labels on participants' understanding/perceptions of the energy content of the wines, or on participants' actual consumption behaviours (rather, the study only sought to investigate the effect of differing calorific values on consumers' overall liking of an alcoholic beverage). It therefore remains unclear whether being able to compare energy content information among different alcoholic beverages would provide a sufficient context for consumers to be able to interpret the information, and whether this in turn would affect consumer behaviour. It is also unclear whether participants in this study registered the calorie information, as the authors did not instruct participants to read the information, nor did they examine whether participants were able to recall the information.

In a study based on New Zealand drinkers, Walker et al. (2019b; high quality) investigated the effect of various energy labelling formats (vs. no energy labelling) on consumers' intentions to consume or purchase an alcoholic beverage. Participants were randomly allocated to one of four labelling conditions: 1) NIP; 2) combined (energy content + % alcohol content + standard drink information); 3) interpretive (energy content presented in kilojoules and calories with the amount of exercise required to burn off the shown energy); 4) no energy control (% alcohol content + standard drink information only). After viewing an image of their preferred type of alcoholic beverage (either wine, beer, or sprits) that had the label on the bottle, participants reported their likely intentions of purchasing the product (on a scale of 0 [no chance/almost no chance] to 10 [certain/practically certain]), the number of bottles they are likely to purchase each week, and their likely intentions of consuming the product (on a scale of 0 to 10, as in the likelihood of purchasing measure). Overall, participants in the NIP condition reported a significantly higher likelihood of purchasing the product compared to participants in the control condition. Additionally, Māori participants in the interpretive label condition reported a significantly higher likelihood of purchasing the product compared to Māori participants in the control condition (the interpretative label format had no significant effects for other ethnicities[29]). There was no significant difference in reported likely purchase between the combined label condition vs. control. The authors suggested that the significant effects found in the study may be explained by the additional finding that participants perceived the NIP and interpretive energy labels as more expensive (and possibly more desirable) than the control label. Conversely, there were no significant

[29] Other ethnicities included Pacific and non- Māori/non-Pacific (New Zealand European or Asian).

differences in reported likely consumption or in the number of drinks participants were likely to purchase between any of the energy labelling conditions vs. the control condition, including for the Māori participants (which is consistent with the studies described thus far). However, heavy drinkers (who may be less motivated to reduce their alcohol consumption compared to low or moderate drinkers e.g., see Maynard et al., 2018a, as described in the 'Consumer value' section) were over-represented in this study. Thus the findings of this study may not be generalisable to individuals who use alcohol at a low to moderate level.

Walker et al. (2019b) also investigated the effect of the labelling conditions (vs. the control condition) on participants' energy estimates of the alcoholic beverages. Participants in the labelling conditions were significantly more accurate in their energy estimates than participants in the control condition (62-74% of participants in the labelling conditions provided estimates that were within 10% of the correct value [compared to 3% of participants in the control condition]). This finding indicates that most participants in the labelling conditions were able to accurately recall (or relay)[30] the energy content information. However, participants may still have found it difficult to interpret the energy content information in a meaningful way, as there were no significant differences between the labelling conditions vs. the control condition based on other, more subjective measures of understanding (perceived energy as measured on a scale from 'not very much' to 'a lot', or healthiness perceptions as measured on a scale from 'healthy' to 'unhealthy').

In contrast to the studies described thus far, Maynard et al. (2018a; high quality) investigated the effect of calorie information (vs. no calorie information) on the amount of alcohol consumed during a mock taste test within a laboratory setting. Participants were recruited from a university within the UK. Those in the calorie labelling condition received information regarding the calorie content of two identical glasses of beer (both beers were 128 calories), whereas those in the control condition did not receive any calorie information regarding the beers. The calorie information was presented on a piece of paper.

Participants in Maynard et al. (2018a) were then instructed to taste and rate the beers and report their future drinking intentions (as indicated by the number of half pints they would hypothetically choose to consume within an evening). Consistent with the findings of the other experimental studies, there was no significant difference in the volume of beer consumed during the mock taste test or in participants' future drinking intentions between the two conditions. However, participants in the calorie labelling condition were generally poor at recalling the calorie information (36.4% accurately recalled the calorie content; 53% were within 15% of the true estimate) [31], and therefore the authors concluded that participants may not have paid attention to the information. Additionally, the instruction to taste the beers did not provide a

[30] It is unclear whether participants generated their energy estimates while they were no longer viewing the labels (in which case their estimates would reflect their ability to recall (or remember) the information), or whether they generated their energy estimates while they were still viewing the labels (in which case their estimates would reflect their ability to relay the information).

[31] 0% of participants in the control condition were able to provide correct estimates of the calorie content (10.6% were within 15% of the true value).

realistic measure of overall alcohol consumption, and the study did not experimentally examine the effect of calorie information on other relevant behavioural measures, such as participants' choices between different types of alcoholic beverages, or the number of beverages consumed over longer periods of time. However, at the end of the experiment, participants were asked to self-report how calorie information would influence their alcohol consumption (response options were: not at all; drink less; switch to a lower calorie option; eat less before or during drinking; eat less after drinking). The most prevalent response among the female participants was 'switch to a lower calorie option' (over 40%), whereas the most prevalent response among the male participants was 'Not at all' (over 60%).[32] However, responses were not compared between the calorie information group and the control group.

Finally, in a study based on university students from the UK, Bui et al. (2008, Main Study; low quality) investigated the effect of nutrition labelling (vs. no nutrition labelling) on consumers' intentions to consume an alcoholic beverage. All participants viewed four types of alcoholic beverages (light beer, regular beer, wine and distilled liquor). Participants in the serving facts condition saw a label on the back of each alcoholic beverage that contained information on the alcohol content, calories, carbohydrates, fat, and serving sizes. Participants in the control condition saw a label without the nutritional information. All participants then rated whether the information would increase or decrease the amount they would drink (on a scale of 1 [would decrease consumption level] to 9 [would increase consumption level]), for each type of alcoholic beverage. In contrast to the studies described thus far, Bui et al. (2008, Main Study) found that the nutritional information significantly increased consumption intention levels for wine and distilled spirits. There was no significant difference in consumption intention levels between the serving facts condition and control condition for light beer or beer. The authors suggested that the beverage-specific effects may be explained by the possibility that participants had previously overestimated the calorie and/or carbohydrate content of wine and distilled liquor, and therefore viewing the true values caused an increase in consumption level intentions[33]. However, this study is limited in that participants in the serving facts condition also saw information on the (relatively low) carbohydrate and (zero) fat contents of the beverages. Therefore it is unclear whether the calorie content caused

[32] Prevalence of all response categories:
Males = over 60% 'not at all'; less than 30% 'drink less'; 20% 'switch to lower calorie option', less than 20% 'eat less before or during drinking'; less than 10% 'eat less after drinking.'
Females = just over 30% 'not at all'; 30% 'drink less'; over 40% 'switch to lower calorie option', over 20% 'eat less before or during drinking'; over 10% 'eat less after drinking.'
Note that these are approximate percentages taken from the bar graph provided in the paper, and responses were not reported separately for participants in the calorie information vs. control groups.

[33] Consistent with this hypothesis, participants in the serving facts condition estimated significantly lower calorie and carbohydrate contents for wine than those in the control group (on a scale of 1 [very low] to 9 [very high]). Additionally, participants in the serving facts condition estimated a significantly lower carbohydrate content for distilled liquor than those in the control group. There were no other significant differences in calorie or carbohydrate estimates for any of the beverages between the two groups, although fat content estimates were also significantly lower in the serving facts condition than in the control condition for all alcoholic beverages.

the increase in consumption intention levels[34]. Additionally, the authors did not report the mean consumption intention level ratings, therefore the extent to which the nutritional information increased consumption intention levels is unclear.

Summary

Most experimental studies (4/5) found that energy content information had no effect on participants' future drinking intentions (or overall liking of the alcoholic beverage, as measured by one study). Consistent with these indirect measures of consumption behaviour, one high quality study also found that energy content information had no effect on the amount of alcohol consumed during a mock taste test. In contrast to the majority, one low quality study (Bui et al., 2008, Main Study) found that nutritional information (which included energy content information) increased consumption intention levels, however it is not possible to definitively conclude that this was specifically caused by the energy content information (as opposed to the relatively low carbohydrate and zero fat content levels that participants were also exposed to).

One study also assessed the effect of energy content information on participants' purchasing behaviour. Walker et al. (2019b) found that an NIP significantly increased participants' likely intentions of purchasing an alcoholic beverage (compared to no nutritional information). This same effect was also found for a more interpretive energy label (that stated the amount of exercise required to burn off the energy content), however this effect of the interpretive label was limited to Māori participants. Walker et al. suggested that these findings may be explained by the additional finding that participants viewed the NIP and interpretive energy labels as more expensive and therefore possibly as more desirable. Conversely, Walker et al. found no effect of the labels on participants' likely consumption intentions, or on the number of drinks they were likely to purchase.

However, the studies described in this section were limited in several respects. Firstly, most studies only used proxy (i.e., indirect) measures of behaviour[35], and only considered the effect of energy content information on participants' overall consumption of a single alcoholic beverage. It therefore remains unclear whether energy content information has an effect on other relevant behaviours (such as consumer choice among different types of alcoholic beverages, or the number of drinks consumed over time).

Secondly, most studies presented energy content information in calorie or kilojoule numerical format, and the information was only presented for a single alcoholic beverage. It is possible that the participants in these studies were unable to interpret the energy content information in a meaningful way; most studies either did not examine participants' perceptions/understanding of the labels, or only tested

[34] However, Bui et al. (2008, Main Study) was still deemed eligible for inclusion in the current literature review, given that results were still reported specifically in relation to consumer understanding of the calorie content of alcoholic beverages.

[35] Although intended alcohol consumption is correlated with actual alcohol consumption (Cooke et al., 2016), it is well known that behavioural intentions do not always lead to actual behaviour change (Sheeran & Webb, 2016).

participants' ability to recall or relay the information, which does not provide a meaningful measure of consumer understanding. It therefore also remains unclear whether providing participants with energy content information in another (non-numerical) format, and/or for a range of different alcoholic beverages would provide a sufficient context for consumers to be able to interpret the information, and whether this in turn would affect consumer behaviour.

The non-experimental studies described below provided further insight into these questions.

Non-experimental studies

Consistent with the experimental studies, three quantitative (survey) studies found that participants did not believe that energy content information would influence their consumption of alcoholic beverages (Alcohol Concern, 2010; HPA, 2017; Wright et al., 2008). Participants in these three studies were not provided with energy content information on- or off-label, and they were asked about the effects of alcohol energy content information in general (i.e., not specifically in relation to labelling). In a survey based on drinkers in Wales, Alcohol Concern (2010; low quality) found that only 48% of participants agreed or strongly agreed that calorie content information would help them regulate their drinking levels[36]. Similarly, HPA (2017; high quality) found that only 34% of New Zealand drinkers agreed that energy content information (in calories or kilojoules) would influence how much they drink or what they choose to drink.[37] Finally, in a survey based on USA consumers, Wright et al. (2008; medium quality) found that participants generally rated calorie content as an unimportant factor when choosing an alcoholic beverage (*M* = 2.32; on a scale of 1 [not important at all] to 5 [extremely important]).

However, as noted above, participants were not provided with energy content information in any of the above studies. Additionally, only one of these studies (Alcohol Concern, 2010) examined participants' understanding of energy content information regarding alcoholic beverages, and found that in general participants had a poor understanding (as over 80% of participants were unable to provide correct calorie estimates for a standard pint of beer or a standard glass of wine; as previously described in the Findings section on Consumer Understanding). It is therefore unknown whether exposing the participants in these studies to energy content information would have enhanced their understanding of the energy content of alcoholic beverages, and in turn altered their views regarding the influence of the information on their drinking behaviours. Similarly, in a study that used a qualitative focus-group design, Barber et al. (2016, Study 2; high quality) found that the London-based female participants were already avoiding certain types of alcoholic beverages based on the energy content. However, their choices were often based on mistaken perceptions (e.g., vodka was perceived as calorie-less). It is therefore possible that providing those participants with correct energy content information may have

[36] The prevalence of other responses were not reported in the paper, nor was the format in which participants could respond.

[37] Response options were: Strongly agree; Agree; Neither agree nor disagree; Disagree; Strongly disagree; Don't know; Refuse to answer.

allowed them to make more informed choices among different alcoholic beverages. However, this was not examined in Barber et al. (2016, Study 2).

In contrast, seven additional studies did expose participants to energy content information regarding alcoholic beverages, and examined their perceptions of the labels as well as their beliefs regarding how the labels might influence their behaviour (Kelley et al., 2015; Martinez et al., 2015 Study 3; Maynard et al., 2018b Study 1; Pabst et al., 2019; Roderique-David et al., 2020 Study 2; Walker et al., 2019a; Winstock et al., 2020).

Pabst et al. (2019; medium quality) conducted focus-group discussions with German wine drinkers to examine consumers' perceptions of nutrition labels on wine. All participants were given bottles of wine that either had an NIP on the back label (including energy content information in both kilojoules and calories) or no nutritional information on the label. All participants stated that the energy labelling would not cause them to reduce their wine consumption, mainly because they consider wine to be a special treat. However, participants also stated that they found the energy content information hard to interpret, and so they did not know what they should do with the information.

Consistent with Pabst et al. (2019), Walker et al. (2019a; medium quality) also found that New Zealand drinkers found energy content information difficult to interpret. Participants in this focus-group study were provided with bottles of alcoholic beverages with various different labels. One bottle had an NIP on the label (which included calorie content information in both kJ and kcal), whereas the other labels had calorie information alone, both with and without percent daily intake information. All labels were presented on the front of the bottle, except for the NIP which was on the back of the bottle. Participants generally reported that terms such as kilojoules, calories and percent daily intake were confusing and hard to understand (except for the participants who happened to be heavily engaged with dieting). Only some participants (proportion not reported) said that the energy content information on the labels would cause them to change their purchasing or consumption behaviours (such as causing them to choose one drink over the other). Although heavy drinkers were much less likely to state that the labels would influence their behaviour.

Roderique-Davis et al. (2020, Study 2; low quality) also conducted focus-group discussions with drinkers from Wales, and found that calories were not mentioned as a factor that guides their purchasing behaviour (only price, brand and quality were mentioned as factors). As in the previously described focus-group studies, participants in Roderique-Davis et al. (2020, Study 2) had viewed labels that specified the number of calories in alcoholic beverages (in addition to other information, such as alcohol content and health warning labels). Participants still stated that the calorie information was important, but that the way it was presented was inadequate. One participant remarked: "I think it's quite important…but it's still tiny."[38] The finding that participants required the information to be more salient is

[38] It is unclear whether the calorie information was on the front or back of the alcoholic beverage in this study (although the authors state that the warning and unit information were on the front). The size of the calorie information was not reported.

consistent with a prior study conducted by the authors (Roderique-Davis et al. 2020, Study 1; low quality), where participants paid little attention to energy content information that was displayed on a sign below the product[39] (as measured by an eye tracker). Participants in this study instead paid attention to information that was on the beverage label, and few (8%) actually recalled seeing the energy content information on the signs. The authors therefore concluded that energy content information may be more effective on the label of an alcoholic beverage than on a sign. This conclusion is consistent with Vecchio et al. (2018), whose findings indicated that participants valued energy content information on the label of an alcoholic beverage more so than on a website (see the Findings section on Consumer Value for a more detailed description of Vecchio et al.).

Two additional studies assessed consumer perceptions of energy labelling using an online survey design (Kelley et al., 2015; Martinez et al., 2015 Study 3). However, in contrast to the non-experimental studies described thus far, these studies provided participants with energy content information for more than one alcoholic beverage, and so participants were able to make comparisons among different energy values.

In Kelley et al. (2015; low quality), wine drinkers from the USA were asked whether a lower calorie content (i.e., fewer than 80 calories per 5 oz. serving, compared to the current standard of 80-112 per 5 oz serving) would encourage them to increase their wine consumption. The authors reported that less than half of the participants responded that the lower calorie content would encourage them to increase their wine consumption.[40]

In Martinez et al. (2015, Study 3; low quality), UK participants were presented with images of five products (beer, wine, vodka, soda, pizza), and each product image was presented with four different labels: 1) an accurate nutrition label; 2) no label; 3) a nutrition label with increased vitamin C; 4) a nutrition label with decreased calories. Participants then reported their future drinking intentions[41] (only once, after viewing all of the labels) and selected the label that they most preferred on the alcoholic beverages. Participants tended to prefer the label with unrealistically fewer calories, although participants' future drinking intentions were not associated with their labelling preferences. When asked to openly write their opinions on the nutrition label

[39] In a mock supermarket shopping aisle, signs were placed on the shelves, just below the alcoholic beverages (i.e., where price signs typically are in real-world supermarkets). The size of the information was not reported.

[40] Proportions ranged from 40.2% (for those who purchase wine a few times a year) to 49.5% (for those who purchase wine at least once a week), however there were no significant differences in proportions among the different wine consumption frequency groups. The way in which participants could respond to the question regarding calorie content (i.e., whether they were given particular response options to choose from) was not reported.

[41] As measured by a two-item scale assessing the number of drinks participants intended to consume on a typical drinking day, and how often participants planned to engage in heavy drinking.

debate[42], participants commonly responded that the labels would help individuals know how many calories they are consuming, and that the labels would help individuals make informed decisions about what they are buying and consuming. However, 43% of participants also specifically stated that they felt the presence of the nutrition labels would not affect their drinking at all (which is consistent with the non-significant association between future drinking intentions and labelling preferences). These findings indicate that, although being able to compare between different energy values may have helped participants to understand the energy content among different alcoholic beverages, it may not have an influence on their behaviour. However, this study is limited in that the labels with the decreased calorie content were unrealistically low in calories[43].

Similarly to Kelley et al. (2015) and Martinez et al. (2015, Study 3), Winstock et al. (2020) provided participants with energy content information that may have allowed participants to make comparisons among different energy values. However in this study, participants were provided with energy content information via the statement: "A bottle of wine or 6 bottles of beer contain as many calories as a burger and fries." Participants were asked whether the statement would make them consider drinking less (response options were: No; Unsure; Maybe; Yes). Only 24.8% of participants responded that the information would make them consider drinking less. However, participants in this study were recruited from an international annual web survey of people who use licit and/or illicit psychoactive drugs, therefore caution is warranted when generalising these results to other populations. Additionally, only 29% of participants reported that the information was personally relevant.[44]

Finally, in a study based on UK drinkers, Maynard et al. (2018b, Study 1; low quality) investigated consumer perceptions of various types of energy labels on alcoholic beverages using an online survey. This study differed from the other non-experimental studies in that participants were presented with energy content information using more than just a numerical (calorie/kilojoule) format. All participants were presented with images of four labels: 1) No calorie information (a label with a large yellow tick with the word "Healthier choice"); 2) Calorie information with guideline amounts (e.g., "175ml serving contains 147 calories which is 7% of your guideline daily amount"); 3) Traffic lights (calorie information with a colour code scheme indicating whether the amount of calories is low, medium or high, e.g., an amber-coloured label stating: "175ml serving contains 147 calories [medium]. Green = low, amber = medium, red = high"); 4) Guideline amounts with traffic lights (labels 2 and 3 combined). Participants were also asked how many drinks they would normally

[42] The wording of the question was not reported in the paper, and therefore it is unclear whether the participants were provided with a further explanation of what was meant by "nutrition label debate."

[43] The authors did not clarify the extent to which the calories were reduced (compared to the accurate NIP condition). However, it is implied that the calories were reduced by 33%, as in a prior study conducted by the authors (Martinez et al., 2015, Study 2).

[44] Personal relevance was measured using the following scale: 1 = totally irrelevant; 2 = not very relevant; 3 = unsure; 4 = a bit relevant; 5 = very relevant. Participants were counted as viewing the information as personally relevant if they gave scores of 4 or 5.

consume on one occasion (based on their preferred drink out of beer/cider, wine, spirits, alcopops), and were then shown the number of calories this would equal.

Most participants (63%) in Maynard et al. (2018b, Study 1) preferred the fourth label with guideline amounts with traffic lights, and 85-90% stated that labels 2 to 4 helped them to understand the number of calories in a single drink. Consistent with other studies, only a minority of participants stated that the labels would make them drink less (22%, 19% and 17% for labels 4, 2 and 3, respectively). Additionally, after seeing the personalised calorie information, only a small proportion of the participants (16%) stated that the calorie information would cause them to reduce the number of drinks they have. Approximately 38% of participants stated that they would take no action based on the calorie content, however, similar proportions stated that they would either use diet/low-calorie mixers (30%) or do more exercise (36%) in response to the calorie content.

Maynard et al.'s (2018b, Study 1) findings indicate that energy labelling in the format of coloured traffic lights (alongside guideline amounts) may assist consumers to make informed decisions regarding their drinking behaviours. Although participants in this study reported that all of the calorie labels would help them make informed decisions, the label with traffic lights and guideline amounts was most preferred. Additionally, participants in Walker et al. (2019a) stated that they found percent daily intake information difficult to understand (which is in contrast to participants in Maynard et al. 2018b Study 1, where participants also saw the calorie information in a traffic light format), indicating that calorie information with percent daily intake information may need to be accompanied by a traffic light labelling format to enhance understanding. However, Maynard et al.'s (2018b) study was limited in that it did not experimentally assess the effects of the energy labels on consumer behaviour or understanding. That is, the study did not compare consumer understanding/behavioural measures for a group that saw the label vs. for a group that did not see the label. Additionally, the study was evaluated as being of low quality, largely due to an absence of methodological information.[45] Thus, it is not possible to make a definitive conclusion about energy labelling on alcoholic beverages in the format of coloured traffic lights (with guideline amounts) based on this single study.

Overall summary

The studies described in this section varied in quality, and only three studies were based on a New Zealand sample (no studies were based on an Australian sample). General conclusions may be made based on the consistency of the findings, however, caution is warranted when interpreting the findings due to the indirectness of measures (as most studies used proxy measures of consumer behaviour, such as consumption intentions). Additionally, some questions were only addressed by studies that used non-experimental designs, which are limited in their ability to

[45] The wording of the questions and the way in which participants could respond was not reported in the paper.

produce conclusions regarding cause and effect. The findings are further summarised below.

Most experimental studies found that energy content information (in kilojoule/calorie numerical format) had no effect on participants' likelihood of consuming an alcoholic beverage. However, this finding may be explained by the possibility that participants were unable to interpret energy content information when presented in calorie/kilojoule numerical formats. Consistent with this possibility, two non-experimental studies (including one based on a New Zealand sample) found that participants generally found calorie/kilojoule and percent daily intake information difficult to understand (Pabst et al., 2019; Walker et al., 2019a). Similar findings have been reported regarding consumer understanding of energy labelling on food and non-alcoholic beverages (Cowburn & Stockley, 2005; Watson et al., 2013). Additionally, given that most experimental studies examined the effect of energy content information on participants' likelihood of consuming a single alcoholic beverage, it remains unclear whether energy content information has an effect on other relevant behaviours (such as consumer choice among different types of alcoholic beverages, or the number of drinks consumed over time).

It is also unclear whether providing participants with energy content information for a range of different alcoholic beverages would provide a sufficient context for consumers to be able to interpret the information, and whether this in turn would affect consumer behaviour. One non-experimental study indicated that being able to compare between different energy values may have enabled participants to make informed decisions, even though the information may not have influenced their consumption behaviours (Martinez et al., 2015, Study 3). However, caution is warranted when interpreting these findings, as the study did not experimentally examine the effect of the energy content information on consumer understanding or behaviour. Secondly, the findings are based on participants' self-reported hypothetical behaviours, which may not necessarily correspond to their actual behaviours. Thirdly, participants in this study viewed labels with unrealistically low calorie contents (vs. accurate calorie information vs. no calorie information). It therefore remains unclear whether viewing accurate energy content information for a range of different types of alcoholic beverages would influence beverage choice.

It also remains unclear whether providing energy content information in other (non-numerical) formats enhances consumer understanding and subsequently influences consumer behaviour. However, one non-experimental study found that energy labelling in the format of coloured traffic lights with guideline amounts may help consumers to make informed choices regarding their alcohol consumption (Maynard et al., 2018b, Study 1). Additionally, the study also found that, although participants generally did not believe that calorie information would cause them to reduce their overall consumption, approximately a third believed that it would cause them to choose lower-calorie drink options (a similar proportion to those who believed that the information would have no effect on their consumption behaviour). However, as previously stated, caution is warranted when interpreting these findings, as the study did not experimentally examine the effect of the energy label (vs. no energy label) on consumer understanding or behaviour, and the findings are based on participants' self-reported hypothetical behaviours. It is therefore not possible to make a definitive conclusion about energy labelling on alcoholic beverages in the format of coloured traffic lights (with guideline amounts) based on this single study.

Effects of energy content information on the prevalence of "drunkorexia" behaviour

"Drunkorexia" is a non-medical term that is commonly used to describe the behaviour of restricting food intake to compensate for the energy from alcohol (Burke et al., 2010; Preonas, 2020). Few studies (n = 3) reported findings relevant to the effects of energy content information on the prevalence of drunkorexia behaviour.

In Maynard et al. (2018a), participants were asked to self-report how calorie information would influence their alcohol consumption (response options were: not at all; drink less; switch to a lower calorie option; eat less before or during drinking; eat less after drinking). The most prevalent response among the male participants was 'not at all' (over 60%). Less than 20% of the male participants stated that they would eat less before or during drinking and less than 10% stated that they would eat less after drinking. Thus, a minority of the male participants responded with drunkorexia-type behaviours (20+10 = 30%). The most prevalent response among the female participants was 'switch to a lower calorie option' (over 40%). Just over 20% of the female participants stated that they would eat less before or during drinking and just over 10% stated that they would eat less after drinking[46]. Thus, as with the male participants, a minority of the female participants responded with drunkorexia-type behaviours (20+10 = 30%). A similar study conducted by Maynard et al. (2018b, Study 1) also found that few participants (19% of males; 13% of females) stated that calorie content information regarding alcoholic beverages would cause them to reduce the amount of food they eat.

However, both of these studies were limited in that they did not experimentally examine the effect of energy content information (vs. no energy content information) on the prevalence of these behaviours. Secondly, the findings are based on participants' self-reported hypothetical behaviours, which may not necessarily correspond to their actual behaviours. Thirdly, both studies recruited participants from the UK, and therefore the findings may not be generalisable to Australian and/or New Zealand populations.

In contrast to the previous two studies, Walker et al. (2019a) conducted focus group discussions with New Zealand drinkers. Participants were asked whether they ever compensate for the number of calories they have consumed by drinking alcoholic drinks (either by eating less food, by exercising more, or by some other means). Most participants (proportion not reported) stated that they did not alter their food intake to compensate for what they drank, and for those that did, it was not by eating less food. Rather, these participants reported that they sometimes compensated for the calories consumed by engaging in physical activity or by eating well. However, whether providing energy content information would increase the prevalence of these behaviours was not examined in this study, and the study did not use a representative sample of the population.

[46] These approximate percentages reported for both the males and females are taken from the bar graph provided in the paper (exact figures were not reported).

In summary, there is limited evidence regarding the effect of energy content information on drunkorexia behaviour.

Limitations

The purpose of this review was to examine the evidence base regarding consumer value/motivation, understanding and behaviour in relation to energy content information about alcoholic beverages. The primary relevant demographic for this evidence review is Australian and New Zealand consumers. However, there was little research available that was based on Australian/New Zealand samples. Therefore the review has included studies based on international samples, which may not generalise to Australian/New Zealand populations. However, the fact that the available New Zealand- and Australian-based studies produced consistent results with the internationally-based studies reduces (but does not completely eliminate) this concern. Additionally, as in Australia and New Zealand, mandatory energy labelling is not implemented in any country.

Secondly, the studies included in the review varied in quality, and just over half (55%) were of low quality. The conclusions of this review may therefore change once a higher number of high quality studies become available. Nevertheless, the high degree of consistency in the findings (regardless of quality) and the directness of the measures used across studies increases the overall level of confidence in the findings relating to consumer value and consumer understanding.

Conversely, caution is advised when interpreting the findings relevant to consumer behaviour, as most studies used indirect measures of behaviour (i.e., self-reported behavioural intentions), and behavioural intentions may not necessarily correspond to actual behaviours. Additionally, there was a limited number of experimental studies that were available to answer questions regarding the effect of energy content information on consumer understanding/behaviour. As such, this review also included non-experimental studies that reported findings relevant to the effects of energy labelling on consumer understanding/behaviour. However, caution is warranted when interpreting the findings of these non-experimental studies, given that they are limited in their ability to produce conclusions regarding cause and effect.

The methodological approach of this review is also not without limitations. Firstly, relevant literature was found from searching six databases. While we selected databases based on their appropriateness for the search topic (and availability to FSANZ), it is possible that additional relevant literature was missed from other databases. However, this possibility was mitigated by searching for further literature via other sources (i.e., by emailing known researchers, searching the websites of known relevant agencies, and searching the reference lists and citing studies of all obtained studies).

Secondly, it is acknowledged that all aspects of the literature review process was carried out by only one officer. However, this was necessary in order to provide a timely evidence synthesis, and having only one reviewer screen, extract data and assess the quality of studies is a commonly used approach when conducting rapid systematic reviews (Tricco et al., 2015). Additionally, it should be noted that the

overall conclusions of the current review are consistent with the findings from a recent systematic review and meta-analysis that was undertaken by multiple researchers from the University of Liverpool (Robinson et al., 2021).

Conclusions

This review examined the existing literature (from the years 2003-2020) on consumer value/motivation, understanding and behaviour in relation to energy content information on alcoholic beverages. The review is based on 38 unique studies (from 32 documents), which varied in quality and methodology. The review is also largely based on international samples, as there was little research available that was based on Australian/New Zealand samples. Nevertheless, general conclusions may be drawn based on the consistency of the findings across studies.

Results from 18 studies showed that consumers generally value energy labelling on alcoholic beverages (pooled proportion of consumers supporting energy labelling = 69% [95% CI: 56-79%]). However, certain groups (such as heavy drinkers, people who are not health-/weight-conscious, males, people with lower-level education) are likely to value the information less than others. Additionally, although consumers generally value energy content information, other information may be valued on the label to a greater extent (e.g., alcohol content, ingredients, warnings about particular health risks that are associated with alcohol consumption) and this likely varies across different groups in the population.

Results from 22 studies showed that, based on their general knowledge, consumers generally have a poor understanding of the energy content of alcoholic beverages. Firstly, only a minority of consumers are able to correctly estimate the energy content (i.e. number of kilojoules or calories) in alcoholic beverages using their general knowledge (pooled proportion of correct estimates across studies = 18% [95% CI: 14-24%]). Secondly, consumers are generally unable to correctly rank the energy content of different alcoholic beverages using their general knowledge. Rather, consumers tend to underestimate the relative energy content of wine and spirits. That is, wine and spirits are mistakenly perceived as being lower in energy compared to other alcoholic beverages. Conversely, consumers tend to overestimate the relative energy content of beer. That is, beer is mistakenly perceived as being higher in energy compared to other alcoholic beverages. Thirdly, consumers are generally unaware that alcohol is the main source of energy in wine, beer, and spirits; rather, believing that sugar or carbohydrates are the main sources. Overall, these studies indicate that consumers are unable to make informed choices based on their general knowledge of the energy content of alcoholic beverages.

Sixteen studies reported findings relevant to the effects of energy content information on consumer behaviour and understanding. Most of these studies indicate that energy content information (in kilojoule/calorie numerical format) has no effect on consumers' likelihood of drinking an alcoholic beverage. However, this finding may be explained by the additional finding that consumers do not understand energy content information when presented in calorie/kilojoule numerical formats. There is limited evidence available regarding the effect of energy content information when presented in other (non-numerical) formats, or when presented for a range of

different alcoholic beverages. There is also limited evidence available regarding the effect of energy content information on other relevant behaviours, such as consumer choice among different types of alcoholic beverages, or the number of drinks consumed over time. It is possible that providing consumers with energy labelling in the format of coloured traffic lights with guideline amounts may help consumers to make more informed choices regarding their alcohol consumption. It is also possible that providing consumers with energy content information for a range of different alcoholic beverages may provide a sufficient context for consumers to be able to interpret the information. However, definitive conclusions cannot be drawn based on the current available evidence.

Finally, there was limited evidence available regarding the effect of energy content information on the prevalence of drunkorexia behaviour (reducing food intake to compensate for the energy from alcohol). Two available studies indicate that providing energy content information on alcoholic beverages may cause approximately 13-30% of consumers to reduce their food intake. However, definitive conclusions cannot be drawn based on the current available evidence.

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Appendices

Appendix 1: Literature review methods

All decisions regarding inclusion/exclusion criteria were made prior to the literature search commencing, except where otherwise stated.

Inclusion criteria

The review included studies that examined:

- Consumer motivation to use energy content information in relation to alcoholic beverages.
- Consumer value of energy content information in relation to alcoholic beverages.
- Consumer perceptions and understanding of the energy content of alcoholic beverages (in the absence of energy content information/labelling)
- Consumer behaviours, perceptions and understanding in response to energy content information/labelling regarding alcoholic beverages.

As outlined above, criteria were not limited to energy labelling in particular. That is, studies that examined *energy content information* more generally (i.e., energy content information presented off-label) were also eligible for inclusion. However, we note that the majority of available studies did assess energy labelling in particular – see Findings. Additionally, the third bullet-point criteria only included studies that examined consumers' general knowledge of the energy content of alcoholic beverages (i.e., in the absence of energy content information/labelling), whereas the fourth bullet-point criteria only included studies that examined consumers' behaviours and knowledge in response to being provided with energy content information/labelling.

No restrictions were placed with respect to study type (e.g., experiments, surveys, focus groups, interviews, observational studies), participant characteristics (e.g., age, geographic location, level of alcohol consumption) or specific outcome measures (e.g., hypothetical self-reported measures of alcohol consumption, actual volume of alcohol consumed within a lab setting, etc.). Rather, this information was coded for each study (see 'Data extraction' below). Studies were defined as primary research papers where empirical data were collected/reported. Grey literature was also included.

Exclusion criteria

Searches were limited to papers available in English and from January 2003. Research was restricted to 2003 onwards because the year 2003 best reflects when the current requirements for nutritional information panels were introduced to Australia and New Zealand (as industry had to comply with these requirements from

December 2002). Additionally, low-carbohydrate alcoholic beverages were introduced to the Australian and New Zealand market in the mid 2000's, which may play a role in how salient energy content information is to consumers' judgements about alcohol.

Studies assessing nutritional information more generally in relation to alcoholic beverages were excluded if findings were not reported specifically in relation to energy content information (for at least one of the research questions). For example, studies reporting the proportion of participants who supported the statement "nutritional information (e.g., sugar, carbohydrates, energy, etc.) should be included on the label of all alcoholic beverages" were excluded because they did not allow an assessment of consumer value of energy content information in particular. That is, it was not possible to determine whether participants valued all of the information, or only some of the information (e.g., only sugar). Studies assessing energy content information in relation to food and non-alcoholic beverages were also excluded from the systematic review[47]. However, relevant studies assessing consumer understanding of the energy content of food are briefly referred to within the report to provide additional context for interpreting the findings in relation to alcoholic beverages (see the overall summary sections for the Findings on 'Consumer understanding' and 'Effects of energy content information on consumer understanding and consumption/purchasing behaviours').

Studies assessing "drunkorexia" behaviour (calorie restriction to compensate for alcohol consumption) were required to examine whether providing energy content information would affect the prevalence of this behaviour. Thus, studies that solely reported on the prevalence of drunkorexia behaviour (i.e., without examining whether providing energy content information exacerbates this behaviour, or without examining any other research questions relevant to the literature review) were excluded.

Systematic reviews were not included. However, their reference lists were used to search for further in-scope studies.

Online database searches

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

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

[47] it was initially intended that the systematic review include studies that examined consumer perceptions and understanding regarding: 1) the nutrient content and general 'healthiness' of alcoholic beverages, and 2) energy content information in relation to food and non-alcoholic beverages. However, after initial screening of titles and abstracts, it became clear that including either of these criteria would have resulted in an unmanageable number of studies included in the review. A decision was therefore made at that point to limit the scope of the review to consumer perceptions and understanding specifically in relation to the *energy* content of *alcoholic beverages.*

- SocINDEX with Full Text
- EconLit with Full Text

Online database searches were undertaken using simple Boolean search term combinations. Two separate searches were undertaken in July 2020 as outlined below. The second search string was used because it was initially intended that the literature review also include studies that examined consumer perceptions and understanding of energy content information in relation to food and non-alcoholic beverages. However studies assessing food/non-alcoholic beverages were excluded at the abstract/title screening phase (see Footnote 47). The terms in bold are those which differed between the two search strings. Studies were limited to peer-reviewed journal articles in EBSCO Discovery.

Search string 1[48]:

TI (**alcohol* OR beer OR wine OR spirit* OR liquor**) AND AB consumer* AND AB (energy OR kilojoule* OR calorie* **OR carb* OR sugar* OR nutri* OR health***) AND AB (understand* OR know* OR aware* OR comprehen* OR value* OR motivat* OR belie* OR attitude* OR concern* OR behav* OR consum* OR purchas* OR deci* OR choice* OR drink* or intent* OR judg* OR perce* OR seek*) NOT (molecul* OR receptor* OR mice OR rat* OR ferment* OR "saccharomyces cerevisiae" OR bacteri*)

Search string 2:

TI (**food* OR beverage* OR drink***) AND AB consumer* AND AB (energy OR kilojoule* OR calorie*) AND AB (understand* OR know* OR aware* OR comprehen* OR value* OR motivat* OR belie* OR attitude* OR concern* OR behav* OR consum* OR purchas* OR deci* OR choice* OR drink* or intent* OR judg* OR perce* OR seek*) NOT (molecul* OR receptor* OR mice OR rat* OR ferment* OR "saccharomyces cerevisiae" OR bacteri*)

Other sources/Grey literature

To ensure the literature review incorporated a suitably broad range of references, further literature was sought by:

- Searching the FSANZ Behavioural and Regulatory Analysis section reference database.
- Emailing members from the International Social Science Liaison Group (ISSLG) requesting any published or unpublished research relevant to the review.
- Searching the websites of known relevant agencies. These agencies included:
    - The Alcohol and Tobacco Tax and Trade Bureau (TTB), USA
    - Alcohol Change UK
    - The Australian Government Department of Health
    - The Bureau of Alcohol, Tobacco and Firearms (ATF), USA

[48] 'TI' indicates that the terms must be in the title of the study. 'AB' indicates that the terms must be in the abstract of the study.

    - The Center for Science in the Public Interest (CSPI), USA
    - Cheers, New Zealand
    - The Department of Health and Social Care, UK
    - DrinkWise Australia
    - The Food Standards Agency (FSA), UK
    - The Foundation for Alcohol Research and Education (FARE), Australia
    - Health Canada
    - Health Promotion Agency (HPA), New Zealand
    - The International Alliance for Responsible Drinking (IARD), USA
    - The Ministry of Health of New Zealand
    - The Ministry for Primary Industries (MPI), New Zealand
    - The Tobacco and Alcohol Research Group (TARG)
    - The Victoria Health Promotion Foundation, Australia
- Searching the reference lists of all included studies.
- Searching for studies that have cited any of the included studies (using Google Scholar).

Research review process

The search process initially identified 4,506 potentially relevant documents. References were exported to EPPI-Reviewer 4, a web-based software program for managing and analysing data for literature reviews. Duplicates were removed using EPPI-Reviewer 4 duplicate management tools; references allocated a similarity score of at least 0.95 by the software were automatically excluded, and remaining potential duplicates identified by the software were manually screened and excluded by one officer.

Following removal of duplicates, out of scope papers were removed based on title and/or abstract. Finally, documents identified as out of scope on the basis of full-text review were excluded. This resulted in 32 full text documents (consisting of 38 unique studies) being included. All stages of the screening process were conducted by one officer.

Figure A1 shows the number of documents retrieved at various stages of the review process. The information depicted in Figure A1 is based on the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA; Moher et al., 2010).

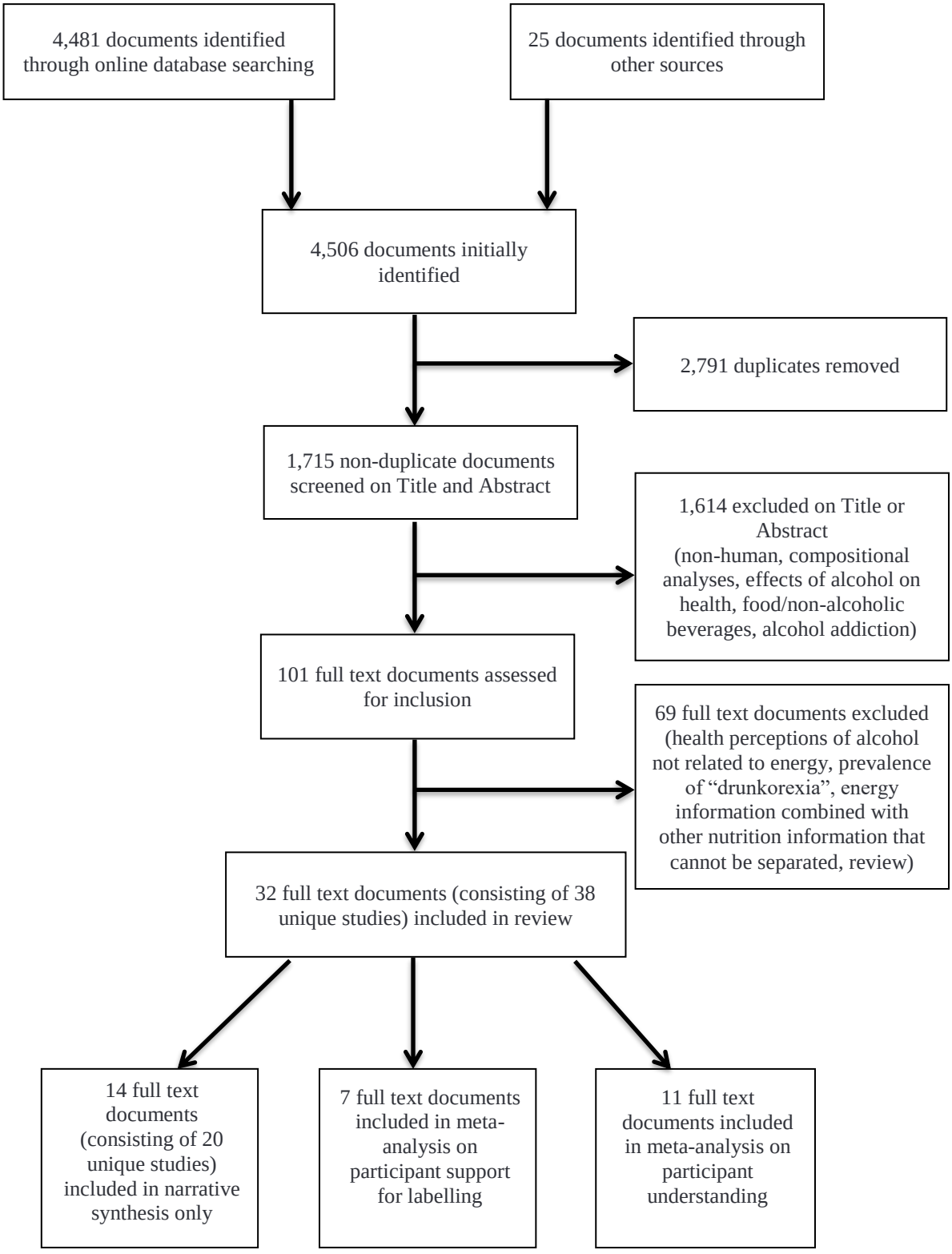

***Figure A1*: Number of documents retrieved at various stages of the review process.**

Data extraction

The data extracted from each study included: Study aims, study design, sample characteristics and sampling strategy, summary of data collection methods and analyses, relevant findings, research question(s) addressed relevant to the literature review, information relevant to the quality assessment (see Table A2 in Appendix 2). The data was summarised for each study and is presented in Appendix 3.

Appendix 3 summarises all 38 studies, grouped by the three overarching topics of the review (consumer value/motivation [Table A3.1], consumer understanding [Table A3.2], effects of energy content information on consumer behaviour and understanding [Table A3.3]). Note that some studies reported findings relevant to more than one topic, therefore some studies are repeatedly described across Tables A3.1-A3.3.

Data extraction was completed by one officer.

Appendix 2: Revised QATSDD

The original Quality Assessment Tool for Studies with Diverse Designs (QATSDD) has been shown to produce reliable and valid quality assessments for studies with diverse designs (Sirriyeh et al., 2012). However, recent criticism of the tool suggests there is a need to further define the language used (Fenton et al., 2015). Fenton et al. (2015) suggested that the criteria be further described, with specific examples incorporated for each criterion. The revised version of the QATSDD utilised in the current review therefore further elaborates on the criteria outlined in the original QATSDD tool. Additionally, items that were deemed to be assessing similar criteria were merged for ease of use, and an item assessing ethical approval was also added.

As with the original QATSDD, not all criteria in the revised QATSDD were applicable to all studies (as some criteria were only relevant to quantitative studies, or to qualitative studies). Therefore the maximum possible rating was higher for studies that used mixed designs (i.e., for studies that had both quantitative and qualitative components). However, this variance was accounted for when calculating overall ratings for each study (as the ratings of each criteria were summed and then divided by the maximum possible total rating; Sirriyeh et al., 2012; see also Footnote 5).

The revised QATSDD consists of a total of 14 items (12 items for quantitative or qualitative studies, 14 items for mixed-design studies). A full copy of the revised QATSDD is in Table A2 below.

Table A2. Revised Quality Assessment Tool for Studies with Diverse Designs (QATSDD)

Theme	Criteria number	Criteria	0 = Not at all	1 = Very slightly	2 = Moderately	3 = Complete
Research Back ground and Aims	1	Explicit theoretical or conceptual framework. Consider: • Review of previous relevant studies/literature • Rationale for the study and how it links together with the discussion of the results • Application of existing theory (e.g. Theory of planned behaviour, Health motivation theory) or descriptive consideration of key concepts and their inter-relationships	No mention at all.	Reference to broad theoretical basis i.e., some general details – very limited justification for the study and/or very limited discussion of how results related to the literature or theories.	Reference to a specific theoretical basis. i.e., more specific details than rating 1. E.g., strong justification for the study in the introduction based on existing literature or theories, but limited discussion of how the results of the study relate to literature or theories (or vice versa).	Explicit statement of theoretical framework and/or constructs applied to the research. Justifies what the current study will add to the existing body of evidence, with thorough discussion of consistencies/inconsistencies with results from prior studies (theorises possible reasons for inconsistencies/what all results taken together imply about a phenomenon/construct). Note that reference to a theoretical model may not be necessary for an applied study (descriptive consideration of key concepts and their inter-relationships may suffice).
	2	Statement of aims/objectives in main body of report.	No mention at all.	General reference to aim/objective at some point in the report including abstract.	Reference to broad aims/objectives in main body of report.	Explicit statement of aims/objectives in main body of report.
	3	Clear description of research setting. Consider: • Who (specific target population) • What (clear research problem/question being studied in the target population) • Where (where the research took place, e.g., in lab/online/at home, and where participants were from) • When (when the research took place) • This criteria is not about a description of the data collection procedure or tools.	No mention at all.	General description of research area and background. Very general target population for research question stated e.g., 'consumers of alcohol'. Most other dot points not covered.	General description of research problem in the target population. Most dot points covered.	Specific description of the research problem and target population in the context of the study. All dot points covered.

	4	Fit between stated research question and research design. Consider: • Research design e.g. experimental versus cross-sectional designs. This criteria is not about data collection tools. • Experimental designs are appropriate for establishing cause and effect e.g., the effect of labelling on behaviour. Whereas qualitative studies or surveys may be better suited to answer questions regarding consumer perceptions.	No research question/aim/objective stated.	Research design/approach can only address some aspects of the research question.	Research design/approach can address the research question but there is a more suitable alternative that could have been used or used in addition.	Research design/approach selected is the most suitable approach to attempt to answer the research question
Sampling and recruitment	5	Evidence of sample size considered in terms of analysis. Consider: • Discussion of smallest sample cell • Oversampling demographics of interest with low prevalence	No mention at all.	Basic explanation for choice of sample size. Evidence that size of the sample has been considered in study design. E.g., vague reference to other studies without further explanation.	Evidence of consideration of sample size in terms of saturation/information redundancy or to fit generic analytical requirements. E.g., mentions calculations or saturation requirements but the final sample was unable to completely meet these (e.g., necessary sample for main effect has been met but not for subgroup analyses, or numbers approach but don't quite meet the target), or mentions generic sample requirements that may not necessarily generalise to the current study requirements.	Explicit statement of data being gathered until information redundancy/saturation was reached or to fit exact calculations for analytical requirements. E.g., mentions exact calculations/saturation requirements and these were met.
	6	Representative sample of target group of a reasonable size Consider:	No statement of target group.	Sample is limited but represents some of the target group or	Sample is somewhat diverse but not entirely	Sample includes individuals to represent a cross section of the target population, considering factors such as

		• Online panels may limit ability to achieve a representative sample • Convenience samples may limit ability to achieve a representative sample • Demographic characteristics of the sample – is any subgroup over- or under-represented? E.g., if the aim of the study was to answer a research question regarding participants of various ages, then the sample is not representative if, for example, a very small percentage of the sample were young adults, and the majority were within an older age bracket.		representative but very small.	representative, e.g. inclusive of all age groups, experience but only one workplace. Requires discussion of target population to determine what sample is required to be representative.	experience, age and workplace.
	7	Detailed recruitment data • Describes the process of recruitment as well as response rates, drop-out rates etc.	No mention at all, or only final N reported.	Minimal recruitment data, e.g. no. of questionnaires sent and no. returned. Or only final N reported plus clear description of recruitment method.	Most recruitment information but not complete account, e.g. full recruitment figures but no information on strategy used. Or clear description of recruitment method and recruitment figures, except one figure missing (e.g., number dropped out and final N reported, but no information on N who declined to participate).	Complete data regarding no. approached, no. recruited, attrition/drop-out data where relevant, method of recruitment.
Procedural details	8	Description of procedure for data collection. Consider: • The order in which participants completed tasks/questionnaires. • Description of the data collection tools e.g., question wording/response options/stimuli given to participants. Note this is different from criteria 9 below which assesses whether the data collection tools were appropriate to use; criteria 8 assesses whether an adequate description was provided of the tools themselves.	No mention at all.	Very basic and brief outline of data collection procedure, e.g. 'using a questionnaire distributed to staff'.	States each stage of data collection procedure but with limited detail, or states some stages in details but omits others.	Detailed description of each stage of the data collection procedure.

Data collection tools **(Quantitative)**	9	Data collection tools justified, reliability and validity assessed. Consider: • Questionnaires, measures and stimuli used • Reliability indicates consistency e.g., if you tested a group of participants at time 1, then tested them again at time 2, the results should be the same/consistent between time 1 and time 2 (test-retest reliability). • Validity indicates that the measurement tool is measuring what it is intended to e.g., use of piloting or statistical assessment of tools where appropriate. • If ratings differ for different tools used, then take an average, e.g. if a measure is a 2, but stimuli are a zero, the rating will be 1.	No mention at all.	Very limited consideration of reliability/validity of data collection tool(s) e.g., generally and accurately explains why the construct to be measured is appropriate, without reference to the actual measurement tool(s) or any reliability/validity assessments. Or vaguely states that the tools were based on a review of the literature without citations or further elaboration.	Some evidence that the reliability/validity of the data collection tool(s) has been considered e.g. based on use in a cited prior similar study but without reference to any reliability/validity assessments. Or some attempt to assess reliability and validity but insufficient (e.g., unsuccessful attempt to establish test-retest reliability but no further action is taken).	Reliability and validity of all major tool(s) has been established. Note that the authors do not need to assess reliability and validity themselves; reporting these based on prior studies may suffice if based on similar populations.
Data collection tools **(Qualitative)**	10	Format and content of data collection tool justified. Consider: • Questions/schedules/stimuli/guides used for interview/focus groups • How were the questions/guides developed? Based on existing theory/literature? • Previously tested/piloted. • Consideration of leading/biased questions.	No mention at all	Very limited consideration of quality of data collection tool(s) e.g., generally and accurately explains why the topics are appropriate to include in the guide to answer the research question(s), but questions or guide not piloted or used in a prior study. Or vaguely states that the tools were based on a review of the literature without citations or further elaboration.	Some evidence that the quality of the data collection tool(s) has been considered e.g. based on use in a cited prior similar study without further explanation. No major concerns in terms of leading/biased questions, but could benefit from further consideration or elaboration of the dot points.	Quality of all major tool(s) has been established, e.g., clearly justified based on detailed explanation of a prior study/literature. No concerns regarding leading or biased questions. Note that if a mixed design study had one minor qualitative component where participants are simply given the opportunity to provide further comments on a construct/topic, e.g., "do you have any further comments about…." Then this may be rated here as a 3, as long as there are no concerns regarding leading/biased questions.
Data analysis **(Quantitative)**	11	Data analysis approach justified and undertaken appropriately Consider: • Do statistical tests match the type of data?	No mention at all, or the analytical approach does not even broadly match the type of data.	**Most of the dot points have NOT been considered**, reported on or correctly applied, but the analytical	**Most of the dot points have been addressed**. Analysis allows reasonable conclusions to be made from results	All dot points haven been considered where relevant. Method of analysis selected is the most suitable approach, and results are

		• Were multiple tests accounted for to control for type 1 error? e.g., via Dunnett's, Tukey or Bonferroni corrections. However less of a concern if p values are very high anyway (>0.05), or very small (<0.001). • Were confounding variables considered? (e.g., entered as covariates) • Were statistical assumptions acknowledged where relevant? (e.g., multicollinearity for regression, or tests of normality where relevant). Means and SDs are not appropriate for interpreting skewed data (medians and interquartile ranges would provide a more accurate representation of group data in this case) • Proportional data: Fisher's test should be used over Chi square test if low frequencies (n<5 in a group/cell). • Could the study benefit from additional analyses to provide greater insight? • Results adequately reported to support conclusions e.g., descriptive statistics, p values, etc.		approach broadly matches the type of data. E.g., use of a one-way between-subjects ANOVA is appropriate to analyse multiple group levels of a single independent variable. However correction for multiple testing/statistical assumptions/control for covariates not considered or reported on.	but could still benefit from further consideration from the list of dot points, (e.g., consideration of statistical assumptions, or additional analyses could provide greater insight). However note that if most points have been addressed, but serious concerns remain that would significantly impact confidence in results (e.g., confounding variables), then the study should not be granted a 2 for this criteria.	adequately reported to support conclusions.
Data analysis **(Qualitative)**	12	Analytical approach justified and assessment of reliability of analytic process Consider: • Approach to analysis described e.g., grounded theory, thematic coding. • how did they develop codes, themes. • techniques to increase trustworthiness in results e.g. multiple researchers, interrater reliability, member-checking (i.e., returning data to participants to check for accuracy and resonance with their experiences), audit trail, reflexive process, negative case search (i.e., searching for and discussing elements of the data	No mention at all of the approach to analysis	Basic description of approach to analysis (e.g., themes coded from the data vs. use of an existing coding scheme that was developed prior to data collection), but **most of the dot points missing, not considered or incorrectly applied,** i.e., no or limited description of techniques to increase trustworthiness in	**Most of the dot points have been addressed**. Analysis allows reasonable conclusions to be made from results but could still benefit from further consideration from the list of dot points. E.g., justified description of how themes were coded, but only use of one or two techniques to ensure trustworthiness in results, only a few	All dot points have been considered where relevant. Method of analysis selected is the most suitable approach. Use of a range of methods to enhance trustworthiness in results, and results are adequately reported to support conclusions.

		that do not support or appear to contradict patterns or explanations that are emerging from data analysis). • discussion of subjective influences of analysis • Results adequately reported to support conclusions e.g., use of participant quotes.		results, no further details of how codes were developed, missing information when reporting results.	instances where results could be reported more clearly to support conclusions.	
Ethics	13	Ethics approval	No mention at all.	N/A	N/A	Ethics approval obtained.
Strengths and limitations	14	Strengths and limitations critically discussed?	No mention at all.	Very limited mention of strengths and limitations with omissions of many key issues.	Discussion of some of the key strengths and weaknesses of the study but not complete.	Discussion of strengths and limitations of all aspects of the study including design, measures, procedure, sample & analysis.

Appendix 3: Table of study characteristics and quality ratings

Table A3.1. Studies examining consumer value (n = 18)

Study	Sampling approach	Participant characteristics	Design/stimuli/measures	Key findings	Quality
Annunziata et al. (2016a)	300 Italian wine consumers. Recruitment method not reported.	Consume wine at least once a month (35% drink once or twice a week, 2 glasses per occasion on average). No further consumption information provided. 51% female Aged 18+ 48% average annual income between €15,000-€20,000 (23% €10,000-€15,000, 14% <€10,000, 14% >€20,000) 48% university educated 64% had medical disorders that influences food choices - cardiovascular problems (21%), obesity/overweight (15%), diabetes (10%), gastro-intestinal problems (9%), intolerances or allergies (8%)	Quantitative (online and in-person) survey with conjoint design. Participants were provided with various picture cards of different wine labels that varied in the information presented, including type of nutritional information (NIP with % guideline daily amounts vs. kcal per glass vs. no nutritional information). The information on the labels also varied in numerous other attributes such as price. Participants were asked to rate each profile combination from 1 (not preferable at all) to 5 (totally preferable). Mean part worth utilities were calculated for each attribute level.	Participants preferred the kcal per glass label (as opposed to the NIP or no nutritional information).	Low Missing methodological information (question wording and response format not reported for most questions, missing procedural information)

Study	Sampling approach	Participant characteristics	Design/stimuli/measures	Key findings	Quality
Annunziata et al. (2016b)	1,016 wine consumers (330 from Italy, 185 from France, 195 from Spain, 306 from USA). Recruited from existing online panel.	Consume wine at least once a month. French consumers reported the highest frequency of consumption (58% at least 3-4 times a week), followed by Spanish (52% at least 3-4 times a week), followed by Italian participants (38% at least 3-4 times a week), followed by USA participants (35% at least 3-4 times a week). Drinking more than 3 glasses per occasion was more prevalent among the French participants compared to Italian, Spanish and USA, however the most prevalent response for all countries was two glasses per occasion. 51% female Aged 18+ 63-68% had a "medium" income (no further information provided). 31-43% university educated. Italy: 36% no health disorder; 22% cardiovascular problems; 15% obesity/overweight. Spain: 32% no health disorder; 18% cardiovascular problems; 24% obesity/overweight. France: 45% no health disorder; 16% cardiovascular problems; 12% obesity/overweight. USA: 8% no health disorder; 28% cardiovascular problems; 32% obesity/overweight.	Same as Annunziata et al. (2016a), except % daily guideline amounts were not stated as being included with the NIP.	Both Italian and Spanish participants preferred the kcal per glass label (as opposed to the NIP or no nutritional information). Participants from the USA preferred the NIP label. French participants preferred no nutritional information.	Low Missing methodological information (question wording and response format not reported for most questions, missing procedural information)

Study	Sampling approach	Participant characteristics	Design/stimuli/measures	Key findings	Quality
Barber (2016) Study 4	14 self-declared binge drinkers (7 from the UK, 7 from France) Students recruited from universities via email. Others were recruited via word-of-mouth or from posting on social media. Snowball sampling also used. Participants were required to have a good internet connection.	Self-declared binge drinkers. 50% female. Young adults (ages 18-24 years) Income not reported. Ethnicity not reported. 8/14 current university students. Remaining participants part-time or full-time workers (no other education information provided). No health information provided.	Qualitative (Semi-structured interviews online via skype). No stimuli provided. Participants were asked what they consider the main health effects of drinking to be.	Only female participants from the UK were concerned about the calorie content of alcohol.	Medium Rated highly on most criteria. Thematic analysis clearly justified, coded themes examined by more than one researcher. However, some instances where results could be reported more clearly to support conclusions (i.e., use of quotes).
CSPI (2003)	600 Americans. Recruitment method not reported.	Level of alcohol consumption not reported. Consisted of both men and women, but proportions not reported. Aged 18+ No further information reported.	Quantitative (telephone) survey. No stimuli provided. “Please tell me if you would strongly support, somewhat support, somewhat oppose or strongly oppose requiring producers to include calorie content on the labels of alcoholic beverages."	89% strongly supported or somewhat supported labelling of calorie content (65% strongly supported)	Low Rated poorly on most criteria. Missing methodological information (question wording and response format not reported for most questions, missing procedural information).

Study	Sampling approach	Participant characteristics	Design/stimuli/measures	Key findings	Quality
Maynard et al. (2018a)	Approximately 153 UK beer consumers (the authors reported that 58% of the total sample of 264 wrote an answer to the question of relevance) Recruited from University database which included students, staff, and the public.	Drank at least two units per week and no more than 35 units per week if female or 50 units per week if male. Hazardous or harmful drinkers (AUDIT mean scores ranged from 10.2-11.5). 50% female. Aged 18+ Income not reported. Ethnicity not reported. 72% completed high school. Most participants were current undergraduate students (no other education information provided). No health information provided.	Qualitative component of an experimental study. Participants were asked the open-ended question: “do you have any comments about calorie labelling?” Prior to this question, participants were randomised to one of two calorie information conditions (present vs. absent for beer – see Table A3.3). However, responses to the open-ended question were not compared between groups.	Participants indicated that they do not value energy content information when their motivations for drinking are to get drunk or to socialise.	High Rated highly on most criteria. Thematic analysis clearly justified, coded themes examined by more than one researcher.
Maynard et al. (2018b) Study 1	450 UK consumers. Majority (68%) recruited from an existing online panel, some were recruited from the general public via networks and public areas e.g., libraries.	AUDIT scores: 53% low risk of developing an alcohol use disorder, 36% excess of low risk, 11% harmful/hazardous drinking, possible dependence. 54% female, 46% male, 1% other Aged 18+ Income not reported. 86% white British or Irish, 14% Black or minority ethnic. 65% university educated. BMI: 4% underweight, 53% normal, 26% pre-obesity, 16% obesity	Quantitative (online) survey. No stimuli provided prior to the question. “Calorie information on alcoholic drinks is a good idea” (response options: agree or disagree)	81% stated calorie information on alcoholic drinks is a good idea.	Low Missing methodological information (question wording and response format not reported for most questions).

Study	Sampling approach	Participant characteristics	Design/stimuli/measures	Key findings	Quality
Maynard et al. (2018b) Study 2	1,884 UK consumers. Recruited from existing online panel.	Group mean AUDIT score was 7 (SD = 5), indicating low-risk consumption. 50% female Aged 18+ (mean age = 35 years [SD = 11.9]) Income not reported. Ethnicity not reported. 58% university educated (13% currently students) No health information provided.	Quantitative (online) survey. No stimuli provided. Participants were asked to what extent they agree with the statement: "Alcoholic beverages should include more nutritional information (i.e., calorie information)." Participants answered using a 100-point visual analogue scale that ranged from 'strongly disagree' to 'strongly agree'	Mean group rating of support for calorie information was 66.01 (SD = 28.05)	Medium Rated highly on most criteria. However, relevant conclusions only rely on descriptive statistics (means and SDs), with no mention of checking for skewness of data to examine whether these are appropriate.
Moore (2010)	503 Americans Recruited via existing panel	Consisted of people who drink alcohol as well as of people who do not drink alcohol (proportions and level of alcohol consumption not reported). Consisted of both men and women, but proportions not reported. Aged 18+ Consisted of people with incomes of both <$60,000 and ≥$60,000 (no further income information reported). Ethnicity not reported. Consisted of people with both a university degree and no university degree (proportions not reported). No health information provided.	Quantitative (online) survey. No stimuli provided. "How important is it to you to have the following information on an alcoholic beverage label?: The number of calories in each drink" (response options not fully reported).	84% of participants reported that including calorie information was either very important/somewhat important.	Low Rated poorly on most criteria (e.g., non-representative sample, lack of recruitment data, missing procedural information, response options not fully reported).

Study	Sampling approach	Participant characteristics	Design/stimuli/measures	Key findings	Quality
Nikolaou et al. (2015)	1,440 undergraduate students from Scotland The online questionnaire was sent to first-year undergraduate students on admission to Glasgow University	Level of alcohol consumption not reported. 67% female Mean age = 20.3 (SD = 2.9) Income not reported. Ethnicity not reported. Current undergraduate students. Mean BMI = 23.0 (SD = 4.6), indicating a healthy weight.	Quantitative (online) survey. No stimuli provided. Participants were asked a multiple-choice question on calorie-labelling on alcohol (wording of the question and response options not reported).	Half of the female participants and a third of the male participants reported that they would like to see calorie information on alcohol.	Low Missing methodological information (question wording and response options not reported).
Pabst et al. (2019)	21 German wine consumers Recruited via various non-wine related private and professional networks	46% consume wine more than once a week, 25% consume wine once a week, 29% consume wine 2-3 times a month. 48% female Aged 18+ Income not reported. Ethnicity not reported. 76% university educated. No health information provided.	Qualitative (focus groups) Participants were provided with bottles of wine that either had a NIP on the back label (including energy content information in both kilojoules and calories) or no nutritional information on the label. Participants were asked about the importance of the label information.	Overall participants concluded that energy value information is only relevant for consumers with weight or health problems	Medium Rated poorly on some criteria (e.g., no discussion of techniques to enhance reliability of coding). However general inductive coding approach justified, and other aspects of the procedure clearly described.

Study	Sampling approach	Participant characteristics	Design/stimuli/measures	Key findings	Quality
Roderique-Davis et al. (2020) Study 1	25 consumers from Wales Staff and students recruited from the University of South Wales	64% hazardous drinkers, and 12% had AUDIT scores indicative of dependency. 56% female Mean age = 37.96 (SD = 11.90). Range = 23-63. Income not reported. Ethnicity not reported. Consisted of both staff and current students recruited from a university (no further education information reported). No health information provided.	Observational study with qualitative component (in the form of open-ended questions). In a mock supermarket shopping aisle, signs were placed on the shelves, just below the alcoholic beverages (i.e., where price signs typically are in real-world supermarkets). Some signs displayed the calorific value of alcoholic beverages compared to food alongside a related statement (type of food and wording of the statement not reported). While other signs displayed a short paragraph outlining a serious health consequence of alcohol consumption with a related image. A third set of signs only displayed alcohol unit information. Labels on the products contained various types of information, such as alcohol by volume, ingredients and units and health information (type of health information not reported). 20 of the participants viewed all of the signs, whereas 5 of the participants (control group) only viewed the signs that stated alcohol unit information. Participants were instructed to imagine they were buying enough alcohol for a weekend party and encouraged to select a range of products, and to spend their usual amount. Participants' attention to the products and signs was measured using eye tracking glasses. Participants were also asked a series of open-ended questions regarding calorie and health warning information for alcoholic beverages (question wording not reported).	Responses to the post-task questionnaire: Although including calorie information on the label was recommended by participants, most participants suggested focusing on long-term risks such as addiction, liver failure and mental health. Eye tracking data: Participants gazed longer at the signs with calorie information (mean gaze time = 1.41 milliseconds, SD = 1.75) compared to the other signs (mean gaze times ranged from 0.14 to 0.77, SDs = 0.39-1.39). However participants paid little attention to the signs overall. The products were attended to much more than the signs (mean gaze time for the products = 111.66 milliseconds, SD = 56.06). The authors concluded that the signs may have been more effective on the product label.	Low Missing methodological information (e.g., exact content of the signs and question wording not reported).

Study	Sampling approach	Participant characteristics	Design/stimuli/measures	Key findings	Quality
Roderique-Davis et al. (2020) Study 2	10 consumers from Wales Staff members recruited from the University of South Wales	Level of alcohol consumption not reported. 80% female Mean age = 33.9 (SD = 12.40) No further information provided.	Qualitative (focus groups). Participants were provided with labels that are commonly used on alcoholic beverages in Wales (i.e., labels without calorie content information), and also with re-designed labels that contained additional information (including calorie content information and warnings about dinking while pregnant and drinking while driving). Unclear whether the calorie information was on the front or back of the alcoholic beverage (warning and unit information were on the front). 12 items were discussed, including "what factors guide your purchase?" and "what information is listed on the label?" (additional items not reported).	Participants valued the inclusion of calorie content information because they felt that it raised awareness of the calorie content of the drink. One participant remarked: "People are more conscious of weight and obesity and I don't think they necessarily draw the link between the drink and their calorie intake."	Low Missing methodological information, e.g., items discussed not fully reported, no discussion of techniques to enhance reliability of coding
RSPH (2014)	2,117 UK adults Recruitment method not reported.	No information provided.	Survey (no further methodological information reported).	67% of participants supported the addition of calorie labels on packaging of alcoholic drinks and only 3% of participants opposed them (the remaining individuals had no opinion either way).	Low Rated poorly on most criteria. Missing methodological information (question wording and response format not reported).

Study	Sampling approach	Participant characteristics	Design/stimuli/measures	Key findings	Quality
Tricas-Sauras et al. (2015)	7,631 consumers living in Europe Recruited via use of social media, email lists, snowball technique.	6.5% drink on a daily basis, 38% drink several times a week, 33.1% drink 1-2 times per month, 13% a few times a year, and 9.4% never drink. 54.7% female Aged 18+ Income not reported. Ethnicity not reported. 73% reported completing higher education or university. No health information provided.	Quantitative (online) survey. No stimuli provided. “Would you like to be provided with more information regarding calorie content?” (response options: yes or no)	Overall 43.2% responded that they would like to be provided with more information regarding calorie content. This response was more prevalent among the female participants (64.5%) than among the male participants (35.5%) This response was also more prevalent among participants who reported completing higher-level education (primary education = 3.2%; upper secondary education = 17.8%; university education = 79%).	Medium Rated poorly on some criteria (e.g., non-representative sample, no discussion of theories or prior literature, does not clarify inferential statistics used – unclear if used chi square tests). Otherwise clear methodological approach and reporting of results – proportions are largely different among subgroups examined (no major concerns).
Vecchio et al. (2018)	103 Italian wine consumers Recruitment method not reported.	15% consume wine once a day, 37% more than once a week, 22% once a week, 9% less than one a week, 17% only on a special occasion. 51% female Mean age = 29.12 years (SD = 7.12) 45.6% belong to the middle-income range (€30,000–50,000 per year) 60% university educated. 63% claimed to regularly follow a balanced diet, while 54% consider it very important to follow a low fat diet. 33% stated that they do not worry much about the healthiness of food.	Quantitative (within-subjects experiment). Non-hypothetical auction where consumers committed to buying the product if they won. All participants viewed four bottles of red wine that differed in the nutritional information provided on the back label (kcal content per glass vs. NIP for 100mL vs. a link to an external website to obtain the nutritional information vs. energy, carbohydrate and sugar content with guideline daily amounts), and were asked to write a sealed bid for each product.	Bids were significantly higher for all nutritional labelling conditions (including for kcal per glass) compared to the no nutritional labelling condition (i.e., the label that only contained the website link). Bids also significantly increased as the amount of nutritional information increased (i.e., bids were highest for the NIP [M = €4.97; Mdn = €5.00], followed by the daily guideline amounts [M = €4.71; Mdn = €4.50], followed by the kcal per glass [M = €4.27; Mdn = €4.50], followed by the website link [M = €3.92; Mdn = €4.00]).	Low Some missing methodological details, inappropriate statistical analysis (use of Mann Whitney tests for within-subjects design; focus on means instead of medians to interpret non-parametric statistical test).

Study	Sampling approach	Participant characteristics	Design/stimuli/measures	Key findings	Quality
Victoria Health Promotion Foundation (2009)	44 Australian consumers. Recruitment method not reported.	Level of alcohol consumption not reported. Three groups: under-aged drinkers aged 16-17 years; young adult drinkers aged 18-25 years; parents of 15-18 year olds. No further information provided.	Qualitative (focus groups). Participants viewed four labels with different health warning messages. All labels also included a nutrition information panel. Unclear if the labels were on an actual alcoholic beverages (and, if so, whether the label was on the front or back of the beverage), or if participants just saw images of the labels.	Opinion was mixed regarding the value of nutritional information on alcoholic beverages. However the main perceived value was in relation to the calorie content for those who were concerned about their weight. This was of more value amongst the female groups than the male groups.	Low Missing methodological information (unclear how themes were coded).
Walker et al. (2019a)	35 New Zealand drinkers. Recruited via existing panel. Ethnicity prioritised by Maori, then Pacific, then non-Maori/non-Pacific.	Level of alcohol consumption was mixed across participants (mild to moderate use and heavy use, based on AUDIT-C scores). However, overall mild to moderate users were underrepresented, and the Maori group only included participants with heavy alcohol use. 46% female Ages ranged from 18 to 59 years. 54% had incomes less than $80,000 (46% had incomes equal to or greater than $80,000). Ethnicity: Maori N = 7; Pacific N = 7; Non-Maori/non-Pacific (i.e., New Zealand European or Asian) N = 21. 66% university educated or trade qualification (34% secondary school only). No health information provided.	Qualitative (focus groups). Participants were assigned to one of six focus groups based on age and alcohol use (although the mild to moderate use groups also included some participants at the lower end of the heavy drinking category, due to difficulties in finding participants with mild to moderate alcohol use). A seventh focus group was for Maori participants only. All participants were given four non-branded bottles with four different labels. The labels included: 1) a NIP, 2) energy content information alone [in kilojoules and calories, both with and without % daily intake information], and 3) a combination label with energy, standard drinks, and percent alcohol content presented in one panel. Alll labels were presented on the front of the bottle, except for the NIP which was on the back of the bottle. Participants were asked how useful they find the information on each label, and to write what types of information they wanted on labels for alcoholic beverages.	Participants generally desired having additional information on the label (including the energy content), however, some felt that the energy content was only relevant for a particular subgroup of people (those who were concerned about their weight).	Medium Rated poorly on some criteria (e.g., non-representative sample/no discussion of techniques to enhance reliability of coding). However general inductive coding approach justified, and full interview guide provided in appendix.

Study	Sampling approach	Participant characteristics	Design/stimuli/measures	Key findings	Quality
Walker et al. (2019b)	615 New Zealand drinkers Recruited via existing online panel. Ethnicity prioritised by Maori, then Pacific, then other.	78% met criteria for heavy alcohol use (based on AUDIT-C scores). 58% female Mean age = 41.2 years (SD = 15.1) Income: 18.1-20.8% < $40,000; 27.3-33.6% = $40,001-$80,000; 32.9-41.6% > $80,000; 10.4-18.2% = unknown. Ethnicity: Similar proportions of Maori, Pacific people and non-Maori/non-Pacific. Participants in the non-Maori/non-Pacific group were mostly New Zealand European (78%; the remaining 22% were Asian [i.e., Chinese, Indian or Other Asian]). 52.6%-63.8% university educated or trade qualification (36.2%-46.8% secondary school only). No health information provided.	Quantitative (between-subjects online experiment). Participants viewed an image of their preferred alcoholic beverage that had a label on the bottle. Participants were randomly allocated to one of four labelling conditions: 1) NIP; 2) combined (energy content + % alcohol content + standard drink information); 3) interpretive (energy content presented in kilojoules and calories with the amount of exercise required to burn off the shown energy); 4) no energy control (% alcohol content + standard drink information only). All participants were asked: “How much do you agree or disagree that alcoholic drinks should provide energy (kilojoule (kJ)/calorie) content information on labels?” Response format: on a 7 point scale ranging from “strongly disagree” to “strongly agree”.	51% to 53% of participants agreed that alcoholic drinks should provide energy content information on labels, while 17% to 22% disagreed (remaining participants were neutral). There were no significant differences in proportions between the different labelling conditions.	High Rated highly on most criteria. Full questionnaire provided in appendix. Clear reporting of results (no major concerns). Non-representative sample.

Table A3.2. Studies examining consumer understanding (n = 22)

Study	Sampling approach	Participants characteristics	Relevant research question	Design/measures	Key findings	Quality
Alcohol Concern (2010)	1,000 drinkers from Wales Recruitment method not reported.	Approximately 20% drank alcohol 3 to 4 times a week on average (no further consumption information provided). No further information provided.	Are consumers able to correctly estimate the absolute energy content of alcoholic beverages?	Quantitative (telephone) survey. Participants were asked to choose, from a range of answers, the correct number of calories in a standard pint of beer/lager. The same question was asked about the number of calories contained in a standard glass (175ml) of wine. The range of answers available to select were not reported.	Over 80% were unable to correctly identify the number of calories in a standard pint of beer/lager and standard glass of wine. Only 18% correctly chose that beer/lager contains between 150 and 200 calories. 31% stated they did not know the correct answer. Only 14% correctly chose that wine contains between 100 and 149 calories.	Low Rated poorly on most criteria. Missing methodological information (response options not reported).

Study	Sampling approach	Participants characteristics	Relevant research question	Design/measures	Key findings	Quality
Annunziata et al. (2015)	500 wine consumers (180 from Italy, 160 from France, 160 from Spain). Recruited by a marketing company via email.	Level of alcohol consumption not reported. 51% female. Age range = 35-54 years. 63-66% had a "medium" income (no further information provided). 39-40% university educated. No health information provided.	Are consumers able to correctly estimate the absolute energy content of alcoholic beverages? Are consumers able to correctly rank the energy content of different alcoholic beverages?	Quantitative (survey). Participants were asked to indicate the amount of kcal contained in a glass of 125 ml of red wine with a medium alcoholic content (12 vol.). Based on how the results were categorised, it is assumed that the response options were: none, <65, 66-85, 86-105, 106-125, >125 (the correct answer was 86-105). However this is not clarified in the paper. Participants were asked to indicate which alcoholic drink contains the most kcal (out of an alcopop, 330mL mug of beer, 125mL glass of red wine, a small glass of grappa [40mL])	22% of Italian participants identified the correct kcal content in a glass of wine (51% underestimated the kcal content; 12% indicated that wine has no kcal at all). 34% correctly identified that the alcopop had the most kcal (32% incorrectly indicated that the mug of beer contains the most kcal) More than 30% of Spanish participants identified the correct kcal content in a glass of wine (50% underestimated). 68% correctly identified that the alcopop had the most kcal. 36% of French participants identified the correct kcal content in a glass of wine (but tended to underestimate less; proportion not reported). 57% correctly identified that the alcopop had the most kcal.	Low Missing methodological information (response options unclear). Potentially uneven response categories that are confounded with the underestimation/overestimation findings.

Study	Sampling approach	Participants characteristics	Relevant research question	Design/measures	Key findings	Quality
Annunziata et al. (2016a)	300 Italian wine consumers. Recruitment method not reported.	Consume wine at least once a month (35% drink once or twice a week, 2 glasses per occasion on average). No further consumption information provided. 51% female Aged 18+ 48% average annual income between €15,000-€20,000 (23% €10,000-€15,000, 14% <€10,000, 14% >€20,000) 48% university educated 64% had medical disorders that influences food choices - cardiovascular problems (21%), obesity/overweight (15%), diabetes (10%), gastro-intestinal problems (9%), intolerances or allergies (8%).	Are consumers able to correctly estimate the absolute energy content of alcoholic beverages? Are consumers able to correctly rank the energy content of different alcoholic beverages?	Same as Annunziata et al. (2015)	20% of participants identified the correct kcal content in a glass of wine (60% underestimated the kcal content; 20% overestimated). 34% correctly identified that the alcopop had the most kcal (33% incorrectly indicated that the mug of beer contained the most kcal; 10% indicated the glass of wine; 23% indicated the shot of grappa)	Low Missing methodological information (response options unclear). Potentially uneven response categories that are confounded with the underestimation/overestimation findings.

Annunziata et al. (2016b)	1,016 wine consumers (330 from Italy, 185 from France, 195 from Spain, 306 from USA). Recruited from existing online panel.	Consume wine at least once a month. French consumers reported the highest frequency of consumption (58% at least 3-4 times a week), followed by Spanish (52% at least 3-4 times a week), followed by Italian participants (38% at least 3-4 times a week), followed by USA participants (35% at least 3-4 times a week). Drinking more than 3 glasses per occasion was more prevalent among the French participants compared to Italian, Spanish and USA, however the most prevalent response for all countries was two glasses per occasion. 51% female Aged 18+ 63-68% had a "medium" income (no further information provided). 31-43% university educated. <u>Italy:</u> 36% no health disorder; 22% cardiovascular problems; 15% obesity/overweight. <u>Spain:</u> 32% no health disorder; 18% cardiovascular problems; 24% obesity/overweight.	Are consumers able to correctly estimate the absolute energy content of alcoholic beverages? Are consumers able to correctly rank the energy content of different alcoholic beverages?	Same as Annunziata et al. (2015) and Annunziata et al. (2016a)	22% of Italian participants identified the correct kcal content in a glass of wine (51% underestimated the kcal content; 12% indicated that wine has no kcal at all). 34% correctly identified that the alcopop had the most kcal (33% incorrectly indicated that the mug of beer contains the most kcal) 30% of Spanish participants identified the correct kcal content in a glass of wine (50% underestimated). 68% correctly identified that the alcopop had the most kcal. 36% of French participants identified the correct kcal content in a glass of wine (but tended to underestimate; proportion not reported). 58% correctly identified that the alcopop had the most kcal. 28% of USA participants identified the correct kcal content in a glass of wine (43% underestimated the kcal content; 29% overestimated). 34% correctly identified that the alcopop had the	Low Missing methodological information (response options unclear). Potentially uneven response categories that are confounded with the underestimation/overestimation findings.

Study	Sampling approach	Participants characteristics	Relevant research question	Design/measures	Key findings	Quality
		France: 45% no health disorder; 16% cardiovascular problems; 12% obesity/overweight. USA: 8% no health disorder; 28% cardiovascular problems; 32% obesity/overweight.			most kcal (48% incorrectly indicated that the mug of beer contains the most kcal).	
Barber (2016) Study 2	96 consumers (48 from France, 48 from the UK). Recruited via research companies (no further information).	Drank alcohol on at least a weekly basis. 50% female 18-24 years of age No further information provided.	Are consumers able to correctly rank the energy content of different alcoholic beverages?	Qualitative (focus groups). Participants were asked to rate the healthiness of 22 different types of alcoholic beverages from unhealthy to healthy, and to explain how these values of healthiness were assessed (the volume of the different types of alcoholic beverages were not stated).	Some participants mentioned calories and dieting; all of these participants perceived beer, cocktails and mixers in spirit mixer drinks as the most calorific. The UK participants perceived vodka as the least calorific. Participants made comments such as: "obviously vodka is calorie-less isn't it so if you just drink straight vodka…" In contrast, participants from Paris perceived red wine as the least calorific.	High Rated highly on most criteria. Thematic analysis clearly justified, coded themes examined by more than one researcher.

Study	Sampling approach	Participants characteristics	Relevant research question	Design/measures	Key findings	Quality
Barber et al. (2016) Study 3	392 consumers (191 from France, 201 from the UK) Recruited via existing online panel.	Majority reported drinking either one day per week (40.7-63% across gender and nationality) or 2-6 days per week (34-53.8%). Every day was not common (1.7-4.8%). France: 100 females UK: 117 females UK: mean age = 21.1 years (SD = 2.1) France: mean age = 22.5 years (SD = 1.9) Monthly income: < £500 = 49% UK; 42% France. £500-£1000 = 25% UK; 32% France. ≥ £1000 = 25% UK; 25% France. Ethnicity not reported. UK: 54% current students; France: 49% current students (no further information provided. No health information provided.	Are consumers able to correctly rank the energy content of different alcoholic beverages?	Quantitative (online) survey. Participants were asked: "According to you, to what extent can alcohol consumption contribute to weight gain. Also, for the drinks listed below, which one do you think has the biggest impact?" Drinks listed: red wine, white wine, beer, cider, clear spirits (gin, vodka), dark spirits (whiskey, rum), alcopops (smirnoff ice), energy drinks (red bull), all of the above.	UK males: 53.2% selected beer which was the most prevalent response; 26.2% selected 'all of them'; 6% selected white spirits; 0% selected dark spirits. French males: 40.7% selected beer which was the most prevalent response; 11% selected white spirits; 12.1% selected dark spirits. UK females: 39.7% selected 'all of them' which was the most prevalent response. French females: 46% selected beer which was the most prevalent response.	Medium Rated highly on most criteria. Clear methodology (no major concerns). Incomplete reporting of results; although the most prevalent response was reported, the proportion of participants selecting each response category was not fully reported.

Study	Sampling approach	Participants characteristics	Relevant research question	Design/measures	Key findings	Quality
Bazzani et al. (2020)	278 Italian consumers of red wine Recruited via existing online panel.	Consumed red wine at home more than once a month (no further consumption information provided). 52.52% female. Age range = 18-74+ years (74+ years category only 0.72% of the sample) Annual household net income was low to medium. The most prevalent responses were: €20,001–€30,000 (23.74%); €10,000–€20,000 (21.22%); < €10,000 (14.75%); €30,001–€40,000 (14.39%). Remaining response categories ranged from €40,000 to >€90,000 (where proportions ranged from 1.8% to 4.68%) 35.98% university educated Weight consciousness: 44.24% reported that they are trying to maintain their weight; 35.25% reported that they are trying to lose weight; and 20.50% reported that they don't do anything to regulate their weight.	Do consumers understand that the main source of energy in most alcoholic beverages comes from the alcohol itself?	Quantitative (online) survey. Participants were provided with the statement: "The amount of calories in wine is proportional to the alcohol percentage." Response options: True/False/Don't know.	48.56% responded 'True'; 20.86% responded 'False'; 30.58% responded 'Don't know'.	Medium Rated poorly on some criteria (e.g., non-representative sample, lack of recruitment data, missing minor procedural details). However clear description of scale question and reporting of results (no major concerns).

Study	Sampling approach	Participants characteristics	Relevant research question	Design/measures	Key findings	Quality
Bui et al. (2008) Pilot Study	58 undergraduate students from the USA Recruitment method not reported	85% of participants reported consuming alcohol in the past month. Mean number of drinks consumed for drinkers in the past week = 14 (range = 0-67). 58% female Mean age = 23 years (range = 20-23). Income not reported. Ethnicity not reported. Current undergraduate students enrolled in upper-division business courses No health information provided.	Are consumers able to correctly estimate the absolute energy content of alcoholic beverages?	Quantitative (survey). Participants estimated the calorie content for a range of alcoholic beverages (12 oz for beer, 5 oz for wine, and 1.5 oz for distilled liquor). Based on how the results were categorised, it is assumed that the response options were: <50; 50–74; 75–99; 100–125; 126–150; 151–199; 200–299; 300 or more. However this is not clarified in the paper. Correct answers were: Light beer = 103; regular beer = 153; wine = 102; distilled liquor = 97. Participants also estimated their level of confidence in the accuracy of their estimates (on a scale of 1 [not confident at all] to 7 [extremely confident]).	Light beer: 31% of participants provided correct estimates; 30% overestimated; 39% underestimated. Regular beer: 5% of participants provided correct estimates; 54% overestimated; 41% underestimated. Wine: 31% of participants provided correct estimates; 38% overestimated; 31% underestimated. Distilled liquor: 16% of participants provided correct estimates; 49% overestimated; 40% underestimated.	Low Rated poorly on most criteria. Missing methodological information (response options unclear). Potentially uneven response categories that are confounded with the underestimation/overestimation findings.

Study	Sampling approach	Participants characteristics	Relevant research question	Design/measures	Key findings	Quality
CSPI (2003)	550 Americans. Recruitment method not reported.	Level of alcohol consumption not reported. Consisted of both men and women, but proportions not reported. Aged 18+ No further information reported.	Are consumers able to correctly estimate the absolute energy content of alcoholic beverages? Are consumers able to correctly rank the energy content of different alcoholic beverages?	Quantitative (telephone) survey. Questions/response format not reported.	Only 10% of respondents correctly identified the approximate number of calories in a regular beer. 58% either didn't know (46%) or thought that a beer has fewer calories than it actually has (12%). 79% either didn't know (47%) the calorie content of flavoured malt beverages ["alcopops"] or thought they have fewer calories than they actually have (32%). 41% incorrectly thought that alcopops (flavoured malt beverages) have the same number or fewer calories than beer.	Low Rated poorly on most criteria. Missing methodological information (question wording and response format not reported, missing procedural information).

Study	Sampling approach	Participants characteristics	Relevant research question	Design/measures	Key findings	Quality
GfK (2014)	5,395 adults from six countries in the European Union (Germany, Poland, Denmark, the Netherlands, Spain and the United Kingdom). Recruitment method not reported.	Level of alcohol consumption not reported. 49.83% female (averaged across countries) Ages ranged from 18-65 years. Income not reported. Ethnicity not reported. 12-41% university educated (varies by country; DK to ES). No health information provided.	Are consumers able to correctly estimate the absolute energy content of alcoholic beverages? Are consumers able to correctly rank the energy content of different alcoholic beverages?	Quantitative (online) survey. Participants were asked: "How many calories (in kcal) do you think are provided by each of the following products?" List of products (all 100mL): Alcohol-free beer, regular beer, white wine, red wine, whiskey. Answer categories: <50kcal, 51-100kcal, 101-150kcal, 151-200kcal, 201-250kcal, 251-300kcal, >300kcal, I don't know. Correct answers were: alcohol-free beer = <50kcal; regular beer = <50kcal; white wine = 51-100kcal; red wine = 51-100kcal; whiskey = 201-250kcal Participants were also asked: "Which one of the following beverages has the most calories for the same volume?" Answer categories: 1. Orange juice (freshly squeezed orange juice); 2. Alcohol free beer (less than 1% alcohol); 3. Regular beer (between 4.5% and 5.5% alcohol); 4. Wine (red or white wine); 5. Spirits (e.g. whiskey, vodka, gin, rum); 6. Not sure.	Alcohol-free beer: 23% of participants provided correct estimates; majority overestimated. Regular beer: 6% of participants provided correct estimates; majority overestimated. White wine: 17% of participants provided correct estimates; majority overestimated. Red wine: 15% of participants provided correct estimates; majority overestimated. Whiskey: 13% of participants provided correct estimates; majority underestimated. Overall, 30% of participants correctly selected spirits as the beverage containing the most calories for the same volume (50% selected the wrong answer; 18% selected 'not sure'). The percentage of participants selecting the correct answer was similarly low across all countries (range: 13-30%), except for Spain (where the majority [63%] selected the correct answer).	Low Rated poorly on most criteria (e.g., no reference to prior literature or theories, non-representative sample, lack of recruitment data, missing procedural information). Uneven response categories that are confounded with the underestimation/overestimation findings.

Study	Sampling approach	Participants characteristics	Relevant research question	Design/measures	Key findings	Quality
Isted et al. (2015)	179 adults in London. Recruited while waiting for an appointment at a general practice in London.	17.9% reported that they never drink alcohol. 33.5% reported drinking patterns consistent with hazardous drinking and risk of alcohol dependence (based on AUDIT-C score greater than or equal to 5). Of these, 55% drank to a level consistent with binge drinking (based on NHS recommendations). 69.7% female Median age = 46 years (ranged = 18-88 years) Income not reported. 40.1% Caucasian (most were minor ethnic groups). 13.7% university educated. No health information provided.	Are consumers able to correctly rank the energy content of different alcoholic (and non-alcoholic) beverages?	Quantitative (written, in-person) survey Participants were provided with the statement: "A can of regular coke has more calories than a pint of beer." Response options: True/False.	51% believed incorrectly that a can of regular coke has more calories than a pint of beer. There was no significant difference in proportions between participants who were at risk of developing an alcohol use disorder versus those who were not at risk.	High Rated highly on most criteria. Generally only issues with representativeness of the sample. Clear methodology and reporting of results (no major concerns).

Study	Sampling approach	Participants characteristics	Relevant research question	Design/measures	Key findings	Quality
Lloyd-Richardson et al. (2008)	206 USA college freshmen who drink alcoholic beverages. Recruitment method not reported, but all attended a university in the northeast and lived on campus.	65% defined as low-risk drinkers (AUDIT score of 1-7), 35% defined as moderate-risk drinkers (AUDIT score ≥8, typically reported drinking an average of 4-5 drinks per episode on 1-3 days per week with monthly binge drinking episodes defined as greater than or equal to 6 drinks). 61% female Mean age = 18.6 (SD = 0.04) Income not reported 59% Caucasian Current first-year university students Mean BMI = 22.9 (SD = 3.1), indicating a healthy weight.	Are consumers able to correctly estimate the absolute energy content of alcoholic beverages?	Quantitative survey. Participants were asked whether they knew how many calories were in the alcoholic beverages they typically consumed. Participants rated their degree of knowledge using a Likert scale, however, there was no description of the Likert scale provided in the paper.	65.7% of participants reported that they were unaware of the calorie content of the alcoholic beverages they typically consume.	Low Missing methodological information (unclear response format).

Study	Sampling approach	Participants characteristics	Relevant research question	Design/measures	Key findings	Quality
Maynard et al. (2018a)	132 UK beer consumers for the quantitative component of the study (these were participants who were in the control conditions of interest out of the total sample of 264) Approximately 153 UK beer consumers for the qualitative component of the study (the authors reported that 58% of the total sample of 264 wrote an answer to the question of relevance) Recruited from University database which included students, staff, and the public.	Drank at least two units per week and no more than 35 units per week if female or 50 units per week if male. Hazardous or harmful drinkers (AUDIT mean scores ranged from 10.2-11.5). 50% female. Aged 18+ Income not reported. Ethnicity not reported. 72% completed high school. Most participants were current undergraduate students (no other education information provided). No health information provided.	Are consumers able to correctly estimate the absolute energy content of alcoholic beverages?	Mixed design (quantitative [cross-sectional] and qualitative [open-ended question] components of an experimental design). Quantitative component: Participants were required to guess the number of calories in a 284mL glass of beer (using a free-response format). Findings are reported for the control conditions that saw no calorie information. Qualitative component: Participants were asked the open-ended question: “do you have any comments about calorie labelling?” Prior to this question, participants were randomised to one of two calorie information conditions (present vs. absent for beer – see Table A3.3). Findings are therefore reported based on participants who both did and did not see calorie information (responses were not compared between groups).	Quantitative component: 0% of participants were able to provide correct estimates of the calorie content (and only 10.6% were within 15% of the true value). Qualitative component: In general, participants reported being unaware of the number of calories in their drinks.	High Rated highly on most criteria. Clear methodological approach and reporting of results (no concerns). Thematic analysis clearly justified, coded themes examined by more than one researcher.

Study	Sampling approach	Participants characteristics	Relevant research question	Design/measures	Key findings	Quality
Maynard et al. (2018b) Study 1	450 UK consumers. Majority (68%) recruited from an existing online panel, some were recruited from the general public via networks and public areas e.g., libraries.	AUDIT scores: 53% low risk of developing an alcohol use disorder, 36% excess of low risk, 11% harmful/hazardous drinking, possible dependence. 54% female, 46% male, 1% other Aged 18+ Income not reported. 86% white British or Irish, 14% Black or minority ethnic. 65% university educated. BMI: 4% underweight, 53% normal, 26% pre-obesity, 16% obesity.	Are consumers able to correctly estimate the absolute energy content of alcoholic beverages?	Quantitative (online) survey. Participants were asked to estimate the number of calories in a range of alcoholic beverages (with volumes and alcohol strength by volume specified): cider, beer, alcopop, wine, gin and tonic. The way in which participants could answer the question was not reported, however the group mean calorie estimates were reported for each beverage, indicating that a free-response format may have been utilised.	Calories were consistently over-estimated for all beverages. Cider: group mean estimate = ~270 kcal (correct amount = ~250 kcal). Beer: group mean estimate = ~260 kcal (correct amount = ~180 kcal). Alcopop: group mean estimate = ~275 kcal (correct amount = ~170 kcal). Wine: group mean estimate = ~210 kcal (correct amount = ~150 kcal). Gin and tonic: group mean estimate = ~160 kcal (correct amount = ~110 kcal). The group mean calorie estimates and correct amounts are approximate values based on the bar graph provided in the paper.	Low Rated poorly on most criteria E.g., non-representative sample, relevant conclusions only rely on descriptive statistics (means and SDs) with no mention of checking for skewness of data to examine whether these are appropriate, missing methodological information (response format unclear).

Study	Sampling approach	Participants characteristics	Relevant research question	Design/measures	Key findings	Quality
Pabst et al. (2019)	21 German wine consumers. Recruited via various non-wine related private and professional networks	46% consume wine more than once a week, 25% consume wine once a week, 29% consume wine 2-3 times a month. 48% female Aged 18+ Income not reported. Ethnicity not reported. 76% university educated. No health information provided.	Are consumers able to correctly estimate the absolute energy content of alcoholic beverages?	Qualitative (focus groups). Participants were asked to write down an estimate of the amount of calories in a range of alcoholic beverages (using individual free-response sheets). The beverages were: white wine (100 ml), red wine (100 ml), beer (300 ml) and gin and tonic (200 ml).	76% of the calorie estimates were incorrect. 16/21 participants estimated that alcoholic beverages in general have high energy values, and therefore overestimated these values. E.g., one participant remarked: “I estimate 500 [calories] for a beer. I have no idea about the values, I just guessed that.” Many (proportion not reported) were surprised when informed of the correct values. E.g., one participant remarked: “My expectation was different; I expected that wine has many more calories.”	Medium Rated poorly on some criteria (e.g., no discussion of techniques to enhance reliability of coding). However general inductive coding approach justified, and other aspects of the procedure clearly described.

Study	Sampling approach	Participants characteristics	Relevant research question	Design/measures	Key findings	Quality
Patterson et al. (2012)	367 UK adults Recruited via existing research company's consumer database.	Level of alcohol consumption not reported. 84% female Age range = 18-70 years Described as relatively 'savvy' consumers who claimed to regularly read food labels. No further information provided.	Do consumers understand that the main source of energy in most alcoholic beverages comes from the alcohol itself?	Quantitative (online) survey. Participants were instructed to rank the following nutrients by calorie content: Fat, carbohydrates, sugar, aspartame, saturated fat, protein, alcohol, salt.	Responses varied. However the most prevalent response for sugar was to incorrectly rank it as first on the list (23.6% of participants). Whereas the most prevalent response for alcohol was to rank it third on the list (23.2%). Sugar was on average rated as more calorific than alcohol (sugar mean score [i.e., from 1 to 8 on the list] = 3.3; alcohol mean score = 3.7).	Medium Rated poorly on some criteria (e.g. Limited discussion of theories/prior literature, non-representative sample, lack of recruitment data). However clear procedure and reporting of results (no major concerns), full questionnaire provided in the appendix.
RSPH (2014)	2,117 UK adults Recruitment method not reported.	No information provided.	Are consumers able to correctly estimate the absolute energy content of alcoholic beverages?	Survey (no further methodological information reported).	Over 80% of people did not know or underestimated the number of calories in a large glass of wine. Over 60% of people did not know or underestimated the number of calories in a pint of lager. Although women were less likely than men to state that they did not know the number of calories in a large glass of wine or in a pint of beer, there was little difference in the number of men and women who correctly identified the calorie content.	Low Rated poorly on most criteria Missing methodological information (questions and response format not reported).

Study	Sampling approach	Participants characteristics	Relevant research question	Design/measures	Key findings	Quality
Victoria Health Promotion Foundation (2010)	500 low-carbohydrate beer drinkers in Australia Recruited from an existing online panel.	13% binge drink (no further consumption information provided). 75.5% female. Mean age = 39 years. Income not reported. Ethnicity not reported. 35% university educated. No health information provided.	Do consumers understand that the main source of energy in most alcoholic beverages comes from the alcohol itself?	Quantitative (online) survey Participants were asked to report the top five reasons for choosing low-carb beer (multiple responses allowed). Response options: its less bloating, its less fattening, it has less kilojoules (calories), it tastes better, its healthier. Participants were asked which type of beer they would drink if they wanted to avoid weight gain (response format not reported). Participants were asked: "'is low-carb beer healthier than other types of beer?" Participants responded Yes/No/Don't Know for each of the following types of beer: healthier than full-strength; healthier than mid-strength; healthier than light-beer.	When asked the top five reasons for choosing low-carb beer, 50% responded that it is less bloating, 44% responded that it is less fattening, 37% responded that it has less kilojoules, 36% responded that it tastes better, and 30% responded that it is healthier. When asked which type of beer they would drink if they wanted to avoid weight gain, 87% said they would choose low carb over mid-strength, full-strength or light beer. 71% responded Yes to low-carb beer being healthier than full-strength (16% No; 13% Don't Know) 59% responded Yes to low-carb beer being healthier than mid-strength (22% No; 20% Don't Know) 38% responded Yes to low-carb beer being healthier than light beer (36% No; 26% Don't Know)	Low Rated poorly on most criteria Missing methodological information (some response formats not reported, missing procedural detail).

Study	Sampling approach	Participants characteristics	Relevant research question	Design/measures	Key findings	Quality
Walker et al. (2019a)	35 New Zealand drinkers. Recruited via existing panel. Ethnicity prioritised by Maori, then Pacific, then non-Maori/non-Pacific.	Level of alcohol consumption was mixed across participants (mild to moderate use and heavy use, based on AUDIT-C scores). However, overall mild to moderate users were underrepresented, and the Maori group only included participants with heavy alcohol use. 46% female Ages ranged from 18 to 59 years. 54% had incomes less than $80,000 (46% had incomes equal to or greater than $80,000). Ethnicity: Maori N = 7; Pacific N = 7; Non-Maori/non-Pacific (i.e., New Zealand European or Asian) N = 21. 66% university educated or trade qualification (34% secondary school only). No health information provided.	Are consumers able to correctly estimate the absolute energy content of alcoholic beverages? Are consumers able to correctly rank the energy content of different alcoholic beverages?	Qualitative (focus groups). Participants were assigned to one of six focus groups based on age and alcohol use (although the mild- to moderate-use groups also included some participants at the lower end of the heavy drinking category, due to difficulties in finding participants with mild to moderate alcohol use). A seventh focus group was for Maori participants only. Participants were asked to estimate the energy content of five different alcoholic beverages (by filling in a worksheet that had a free-response format). The different alcoholic beverages were: a 330mL bottle of beer; a 125mL glass of red wine; a 375mL RTD; a 30mL shot of spirits; and a 125mL glass of sparkling wine.	Only some participants (proportion not reported) were able to provide good estimates of the calorie content of a glass of wine or a bottle of beer, and these participants tended to have prior experiences of dieting or sports training. Some of the focus groups decided to rank the energy content of the different alcoholic beverages by writing ‘less’ or ‘more’ or ‘much more’ (rather than by writing calorie or kilojoule estimates). Participants consistently underestimated the relative energy content of a serving of red wine, and overestimated the relative energy content of a bottle of beer. Participants tended to associate red wine with health benefits, and associate beer with a “beer belly.”	Medium Rated poorly on some criteria (e.g., non-representative sample/no discussion of techniques to enhance reliability of coding). However general inductive coding approach justified, and full interview guide provided in appendix.

Study	Sampling approach	Participants characteristics	Relevant research question	Design/measures	Key findings	Quality
Walker et al. (2019b)	154 New Zealand drinkers (these were participants who were in the control condition of interest out of the total sample of 615) Recruited via existing online panel. Ethnicity prioritised by Maori, then Pacific, then other.	78.6% met criteria for heavy alcohol use (based on AUDIT-C scores). 53.9% female Mean age = 40.3 years (SD = 14.3) Income: 18.8% < $40,000; 29.2% = $40,001-$80,000; 33.8% > $80,000; 18.2% = unknown. Ethnicity: 33.1% Maori; 33.1% Pacific people; 33.8% non-Maori/non-Pacific (i.e., New Zealand European or Asian). 52.6% university educated or trade qualification (46.8% secondary school only). No health information provided.	Are consumers able to correctly estimate the absolute energy content of alcoholic beverages?	Quantitative (cross-sectional component of an experimental design). Participants were shown an image of their preferred alcoholic beverage (either a 750mL bottle of wine, a 330mL bottle of beer, or a 1000mL bottle of vodka). Participants were asked: “On a scale ranging from 1 (not confident at all) to 7 (very confident), how confident are you that you can estimate the energy (kilojoule (kJ)/calorie) content of the displayed alcoholic drink?” Participants could also respond “don’t know”. Participants were also asked: “What is the energy (kilojoules (kJ) or calories) content per serve for this drink?” A free-response format was used where participants generated an amount in calories or kilojoules. Findings and participant characteristics are reported for participants in the control condition of the study that saw no calorie information on the label.	Participants were generally not confident in their ability to estimate the energy content of the displayed drink (mean rating = 2.49 [SD = 1.89]). Only 3% of participants were able to provide kilojoule estimates that were within 10% of the true value. The exact percentage of correct estimates in calories was not reported, however the bar graph provided in the paper indicates that this was less than 10%.	High Rated highly on most criteria. Full questionnaire provided in appendix. Clear reporting of results (no major concerns). Non-representative sample.

Study	Sampling approach	Participants characteristics	Relevant research question	Design/measures	Key findings	Quality
Winstock et al. (2020)	75,969 consumers from 30 different countries (most [39.6%] were from Germany; only 2.3% and 2.5% were from Australia and New Zealand, respectively) Responses were taken from an annual web survey of people who use licit and illicit psychoactive drugs.	Mean AUDIT score = 8. 45.6% were defined as low-risk drinkers (AUDIT scores of 0-7), whereas 13.5% were defined as high-risk drinkers (AUDIT scores of 16+). 35.7% female. Mean age = 27.0 (SD = 10.5). No further information provided.		Quantitative (online) survey. Participants were provided with the statement "A bottle of wine or 6 bottles of beer contain as many calories as a burger and fries" and asked if the information was new to them (response options: Yes/No).	Overall, 36.1% of participants said the calorie information was new. Males, under 25 years of age (vs. 25+) and low-risk drinkers (vs. high-risk drinkers) were significantly more likely to say this.	Medium Rated poorly on some items, however clear methodological approach and reporting of results. No major concerns regarding internal validity, however the study lacks external generalisability to the current literature review because participants were users of licit and illicit psychoactive drugs. The wording of the question is also prone to social desirability bias if the findings are to be interpreted as providing insight into consumer understanding, however measuring consumer understanding of the information was not the aim of this study.
Worsley (2011)	2,022 Australian adults	Level of alcohol consumption not reported. 50.4% male 31.6% university educated. No further information reported.	Do consumers understand that the main source of energy in most alcoholic beverages comes from the alcohol itself?	Quantitative (survey). Participants were asked: "Which one of the following has the most kilojoules (i.e. calories, energy) for the same weight?" Response options were: Sugar, Carbohydrate, Dietary Fibre, Fat, Alcohol, Not sure.	Prevalence of each response: Sugar: 27.2% Fat: 22.9% Not sure: 20.2% Alcohol: 14.4% Carbohydrate: 12.7%	Low Rated poorly on most criteria (e.g., No reference to prior literature or theories, non-representative sample, lack of recruitment data, missing procedural detail).

Table A3.3. Studies examining the effects of energy information on understanding and/or behaviour (n = 16)

Study	Sampling approach	Participants characteristics	Relevant research question	Design/stimuli/measures	Key findings	Quality
Alcohol concern (2010)	1,000 drinkers from Wales Recruitment method not reported.	Approximately 20% drank alcohol 3 to 4 times a week on average (no further consumption information provided). No further information provided.	The effect of energy information on consumers' consumption of alcoholic beverages.	Quantitative (telephone) survey. No stimuli provided. Participants were asked whether calorie content information on alcohol packaging would help them regulate their drinking levels (exact wording of question and response format not reported).	48% either agreed or strongly agreed that calorie content information on alcohol packaging would help them regulate their drinking levels	Low Rated poorly on most criteria. Missing methodological information (question wording and response format not reported).
Barber (2016) Study 2	96 consumers (48 from France, 48 from the UK). Recruited via research companies (no further information).	Drank alcohol on at least a weekly basis. 50% female 18-24 years of age No further information provided.	The effect of energy information on consumers' consumption of alcoholic beverages.	Qualitative (focus groups) No stimuli provided. Participants were asked to rate the healthiness of 22 different types of alcoholic beverages from unhealthy to healthy, and to explain how these values of healthiness were assessed.	Females in London and Manchester (percentage not reported) reported avoiding certain types of drinks when on a diet and that calorific value influences beverage preference (e.g., avoid cocktails/choose vodka with lime and soda/beer has the highest calorie content). However, these choices may have been based on mistaken perceptions (e.g., vodka was perceived as calorie-less).	High Rated highly on most criteria. Thematic analysis clearly justified, coded themes examined by more than one researcher.

Bui et al. (2008) Main Study	230 university students from the USA Recruited from two universities.	The number of drinks consumed over the past seven days ranged from zero (24% of participants) to more than 50. For drinkers, the average number of drinks consumed over the past 7 days was 14.2 (SD = 13.9). Gender not reported. Mean age = 25 years (range = 20-36) Current university students. No further information provided.	The effect of energy information on consumers' understanding of the energy content of alcoholic beverages. The effect of energy information on consumers' consumption of alcoholic beverages.	Quantitative (experiment with both between-subjects and within-subjects factors). Within subjects factor: All participants viewed four types of alcoholic beverages (light beer [12oz], regular beer [12oz], wine [5 oz glass] and distilled liquor [1.5 oz]). Between subjects factor: Participants in the serving facts condition saw a label on the back of each alcoholic beverage that contained information on the alcohol content, calories, carbohydrates, fat, and serving sizes. Participants in the control condition saw a label without the nutritional information. Participants were asked to rate each nutrient level for each alcoholic beverage: "A '1' indicates that you think the level of the nutrient is very low and a '9' indicates that the level is very high" Participants were also asked: "Given the information shown on the front and the back of the mock bottle, would the available information increase or decrease the amount you would drink, that is, your consumption level?" (on a scale of 1 ["would decrease consumption level"] to 9 ["would increase consumption level"]).	<u>Calorie estimates:</u> Significantly lower in the serving facts condition (M = 4.81) than in the control condition (M = 5.57) for wine. No significant differences between groups for other beverage types. <u>Carbohydrate estimates:</u> Significantly lower in the serving facts condition than in the control condition for wine (Ms = 4.41 vs. 5.64) and distilled liquor (Ms = 3.41 vs. 5.14). No significant differences between groups for other beverage types. <u>Fat estimates:</u> Significantly lower in the serving facts condition than in the control condition for all beverages (wine: Ms = 2.91 vs. 4.02; distilled liquor: Ms = 2.96 vs. 3.92; regular beer: Ms = 4.00 vs. 5.42; light beer: Ms = 3.35 vs. 4.12). Participants in the serving facts condition had significantly higher consumption intention levels (compared to participants in the control condition), but only for wine and distilled spirits. There were no significant differences in consumption intention levels between the serving facts condition and control condition for light beer or beer (means not reported).	Low Rated poorly on most criteria. Did not consider potential confounding variables (did not examine potential differences in baseline characteristics between groups).

Study	Sampling approach	Participants characteristics	Relevant research question	Design/stimuli/measures	Key findings	Quality
Hayward and McSweeney (2020)	260 Canadian wine drinkers Recruited from a Nova Scotia community via posted advertisements and word of mouth.	Consumed wine within the last two weeks, and regularly buy and drink wine (definition of "regularly" not reported). 70% female 19-69 years of age Income: 26% < $25,000; 8% = $25,00-$44,999; 7% $45,000-$64,999; 22% = $65,000-$99,999; 12% = $100,000-$149,000; 12% = $150,000+; 12% = prefer not to say. Ethnicity not reported. Level of education not reported. No health information provided.	The effect of energy information on consumers' consumption of alcoholic beverages.	Quantitative (within-subjects experiment). Over the course of four days, each participant tasted a range of rosé wine samples that differed in the (fabricated) calorie content that was stated on the label: 15 calories (low); 100 calories (normal); 180 calories (high); 240 calories (highest); No calorie information. Participants tasted wines with no calorie information first, then tasted the wines with calorie labels in a randomised order. The wine samples were presented in small wine glasses with labels on the wine glasses. Participants rated their overall liking of each wine following each tasting (on a scale of 1 ['extremely dislike'] to 9 ['like extremely']).	There were no significant differences in participants' overall liking between the different calorie labelling conditions	Medium Rated poorly on some criteria (e.g., non-representative sample, lack of recruitment data) however clear methodological approach. Some incomplete reporting of results (main effects/interactions), but post hoc tests were non-significant regardless.

Study	Sampling approach	Participants characteristics	Relevant research question	Design/stimuli/measures	Key findings	Quality
HPA (2017)	2,666 New Zealand drinkers Recruited via the 2013 New Zealand census data.	Consumed alcohol in the past year. Aged 18+ No further information provided.	The effect of energy information on consumers' consumption of alcoholic beverages.	Quantitative (face-to-face, in-home) survey. No stimuli provided. Participants were provided with the statement: "Having nutrition information about energy content (that is, calories or kilojoules) on alcoholic beverages would influence how much I drink, or what I choose to drink". Response options: Strongly agree; agree; neither agree nor disagree; disagree; strongly disagree; don't know; refused to answer.	34% of participants agreed that energy content information on alcoholic beverages would influence how much they drink, or what they choose to drink. 13% were neutral and 51% disagreed. Females (39%) were significantly more likely than males (28%) to agree. Those aged under 54 years (36%) were significantly more likely to agree than those aged 55 years and over (28%). Agreement did not vary by ethnicity or by drinking frequency.	High Rated highly on most criteria. Included discussion of sampling and weighting. Full questionnaire included.

Study	Sampling approach	Participants characteristics	Relevant research question	Design/stimuli/measures	Key findings	Quality
Kelley et al. (2015)	910 wine drinkers from the USA Recruited via existing panel.	28.8% consume wine several times a week, 23.1% consume wine at least once a week, 48.1% consume wine less than once a week (18.2% = 2-3 times a month; 13.7% = about once a month; 16.2% = a few times a year). 71.9% female Aged 21-64 years Income: 7.4% = <$25,000; 23.2% = $25,000-$49,999; 23.2% = $50,000-$75,999; 17.7% = $76,000-$99,999; 17.7% = $100,000-$150,000; 7.6% = $150,001-$200,000; 3.3% = >$200,000. Ethnicity not reported. 54.8% university educated. No health information provided.	The effect of energy information on consumers' consumption of alcoholic beverages.	Quantitative (online) survey. Participants were asked whether a lower calorie content (i.e., fewer than 80 calories per 5 oz. serving, compared to the current standard of 80-112 per 5 oz serving) would encourage them to increase their wine consumption (response format not reported).	Less than half of the participants responded that the lower calorie content would encourage them to increase their wine consumption. Proportions ranged from 40.2% (for those who purchase wine a few times a year) to 49.5% (for those who purchase wine at least once a week), however there was no significant difference in proportions among the different wine consumption frequency groups.	Low Missing methodological information (response format not reported).

Study	Sampling approach	Participants characteristics	Relevant research question	Design/stimuli/measures	Key findings	Quality
Martinez et al. (2015) Study 2	98 USA consumers Recruited at a coffee shop in a small rural town.	7.5% reported plans for heavy drinking at least twice a week or more. 42.6% female	The effect of energy information on consumers' consumption of alcoholic beverages.	Quantitative (between-subjects experiment). Participants viewed an image of a label next to an image of a bottle of beer. Participants were randomised to one of four labelling conditions: 1) no nutritional information; 2) accurate nutritional information (148 calories); 3) nutritional information with increased vitamin C; 4) nutritional information with decreased calories (49 calories). The 'low calorie' information was inaccurate. Participants were informed that the products may or may not include information (which may or may not be accurate). After viewing the label and bottle of beer, participants reported their future drinking intentions (as measured by a two-item scale assessing the number of drinks participants intended to consume on a typical drinking day, and how often participants planned to engage in heavy drinking).	The nutrition labels had no significant effect on participants' future drinking intentions.	Medium Rated highly on some criteria (e.g., clear methodological approach, consideration of potential confounds), however inadequate reporting of results (no statistics reported for the effect of labelling on future drinking intentions).

Martinez et al. (2015) Study 3	191 consumers (majority [88.3%] were from the USA). Recruited via existing online panel.	Level of alcohol consumption not reported. 59.2% female. Aged 19-76 years (Mean = 36.49, SD = 11.01). Income not reported. Ethnicity: 78.6% white/non-Hispanic Level of education not reported. No health information provided.	The effect of energy information on consumers' consumption of alcoholic beverages. The effect of energy information on consumers' understanding of the energy content of alcoholic beverages.	Mixed design (quantitative correlational component + qualitative component in the form of an open-ended question). Participants viewed images of 5 products (beer, wine, vodka, soda, pizza), and each product image was presented with four different labels: 1) an accurate nutrition label; 2) no label; 3) a nutrition label with increased vitamin C; 4) a nutrition label with decreased calories. The authors did not clarify the extent to which the calories were reduced (compared to the accurate NIP condition). However, it is implied that the calories were reduced by 33%, as in a prior study conducted by the authors (Martinez et al., 2015, Study 2). Participants reported their future drinking intentions (only once, after viewing all of the labels) and selected the label that they most preferred on the alcoholic beverages. Participants were asked to openly write their opinions on the nutrition label debate (wording of the question not provided, therefore it is unclear whether the participants were provided with a further explanation of what was meant by "nutrition label debate.").	<u>Quantitative component:</u> Participants tended to prefer the label with unrealistically fewer calories. Participants' future drinking intentions were not significantly associated with their labelling preferences. <u>Qualitative component:</u> When asked to openly write their opinions on the nutrition label debate, participants commonly responded that the labels would help individuals know how many calories they are consuming, and that the labels would help individuals make informed decisions about what they are buying and consuming. 43% (83/191) wrote that they felt the presence of nutrition labels would not affect their drinking at all.	Low Missing methodological information (e.g., the extent to which the calories were reduced was not clarified, unclear how the open-ended question was worded, unclear how themes were coded).

Maynard et al. (2018a)	264 UK beer consumers (although only approximately 153 provided a response for the qualitative component) . Recruited from University database which included students, staff, and the public.	Drank at least two units per week and no more than 35 units per week if female or 50 units per week if male. Hazardous or harmful drinkers (AUDIT mean scores ranged from 10.2-11.5). 50% female. Aged 18+ Income not reported. Ethnicity not reported. 72% completed high school. Most participants were current undergraduate students (no other education information provided). No health information provided.	The effect of energy information on consumers' consumption of alcoholic beverages. The effect of energy information on consumers' understanding of the energy content of alcoholic beverages. The effect of energy information on the prevalence of drunkorexia behaviour	Mixed design (quantitative between-subjects design + qualitative component in the form of an open-ended question). Participants in the calorie labelling condition received information regarding the calorie content of two identical glasses of beer (both beers were 128 calories), whereas those in the control condition did not receive any calorie information regarding the beers. The calorie information was presented on a piece of paper alongside the beer. Participants were then instructed to taste and rate the beers and report their future drinking intentions (as indicated by the number of half pints they would hypothetically choose to consume within an evening). As a manipulation check, participants were asked to report, or guess, the number of calories in the beer (free-response format). Participants were asked how calorie information would influence their alcohol consumption (response options: not at all; drink less; switch to a lower calorie option; eat less before or during drinking; eat less after drinking)	<u>Quantitative component:</u> There was no significant difference in the volume of beer consumed during the mock taste test or in participants' future drinking intentions between the two conditions. Prevalence of responses to the question of how calorie information would influence their alcohol consumption: Males: over 60% 'not at all'; less than 30% 'drink less'; 20% 'switch to lower calorie option', less than 20% 'eat less before or during drinking'; less than 10% 'eat less after drinking.' Females: just over 30% 'not at all'; 30% 'drink less'; over 40% 'switch to lower calorie option', over 20% 'eat less before or during drinking'; over 10% 'eat less after drinking.' Responses were not reported separately for participants in the labelling condition vs. the control condition. Responses were not reported separately for the calorie labelling vs. control groups, and percentages are approximate estimates taken from a bar graph provided in the paper. Participants in the calorie labelling condition were generally poor at recalling the	High Rated highly on most criteria. Clear methodological approach and reporting of results (no concerns).

Study	Sampling approach	Participants characteristics	Relevant research question	Design/stimuli/measures	Key findings	Quality
				Participants were asked the open-ended question: "do you have any comments about calorie labelling?"	calorie information (36.4% accurately recalled the calorie content; 53% were within 15% of the true estimate). 0% of participants in the control condition were able to provide correct estimates of the calorie content (10.6% were within 15% of the true value). <u>Qualitative component:</u> In response to the open-ended question "do you have any comments about calorie labelling?", in general participants reported being unaware of the number of calories in their alcoholic beverages. Responses were not reported separately for participants in the labelling condition vs. the control condition.	

Maynard et al. (2018b) Study 1	450 UK consumers. Majority (68%) recruited from an existing online panel, some were recruited from the general public via networks and public areas e.g., libraries.	AUDIT scores: 53% low risk of developing an alcohol use disorder, 36% excess of low risk, 11% harmful/hazardous drinking, possible dependence. 54% female, 46% male, 1% other Aged 18+ Income not reported. 86% white British or Irish, 14% Black or minority ethnic. 65% university educated. BMI: 4% underweight, 53% normal, 26% pre-obesity, 16% obesity	The effect of energy information on consumers' understanding of the energy content of alcoholic beverages. The effect of energy information on consumers' consumption of alcoholic beverages. The effect of energy information on the prevalence of drunkorexia behaviour	Online survey (unclear if data were quantitative or qualitative as response formats not reported). Participants were presented with images of four labels: 1) No calorie information (a label with a large yellow tick with the word "Healthier choice"); 2) Calorie information with guideline amounts (e.g., "175ml serving contains 147 calories which is 7% of your guideline daily amount"); 3) Traffic lights (calorie information with a colour code scheme indicating whether the amount of calories is low, medium or high, e.g., an amber-coloured label stating: "175ml serving contains 147 calories [medium]. Green = low, amber = medium, red = high"); 4) Guideline amounts with traffic lights (labels 2 and 3 combined). Participants also saw unit information on labels 2-4, presented in the same way as the calorie information. Participants were asked about the potential impact of the labels on their drinking behaviour, as well as which label they would most like to see on the alcohol products that they drink (question wording and response format not reported). Participants were asked which of the four drinks	Most participants (63%) preferred the fourth label with guideline amounts with traffic lights, and 85-90% stated that labels 2 to 4 helped them to understand the number of calories in a single drink. Only 22% said Label 1 would help them understand the number of calories in a drink. 22%, 19% and 17% said that labels 4, 2, and 3 would make them drink less, respectively. Only 16% stated that the calorie information would cause them to reduce the number of drinks they have. Approximately 38% of participants stated that they would take no action based on the calorie content. Similar proportions stated that they would either use diet/low-calorie mixers (30%) or do more exercise (36%) in response to the calorie content. 15% of participants said that they would probably (or definitely) reduce the amount of food they eat based on information about calories in alcohol.	Low Missing methodological information (question wording and response format not reported, unclear if quantitative or qualitative data).

Study	Sampling approach	Participants characteristics	Relevant research question	Design/stimuli/measures	Key findings	Quality
				(beer/cider, wine, spirits, alcopops) they would normally drink and how many of these drinks they would normally have on one occasion. Based on this information, participants were shown the number of calories and units this would be equal to. Participants were then asked the extent to which they think the unit/calorie information would influence their own drinking behaviour.		
Pabst et al. (2019)	21 German wine consumers Recruited via various non-wine related private and professional networks	46% consume wine more than once a week, 25% consume wine once a week, 29% consume wine 2-3 times a month. 48% female Aged 18+ Income not reported. Ethnicity not reported. 76% university educated. No health information provided.	The effect of energy information on consumers' understanding of the energy content of alcoholic beverages. The effect of energy information on consumers' consumption of alcoholic beverages.	Qualitative (focus groups) Participants were provided with bottles of wine that either had a NIP on the back label (including energy content information in both kilojoules and calories) or no nutritional information on the label. Participants were asked about the importance of the label information, and whether they would change their wine consumption behaviour if nutrition information became obligatory.	Participants stated that they found the energy information hard to interpret, and so they did not know what they should do with the information. All participants stated that the energy labelling would not cause them to reduce their wine consumption, mainly because they consider wine to be a special treat.	Medium Rated poorly on some criteria (e.g., no discussion of techniques to enhance reliability of coding). However general inductive coding approach justified, and other aspects of the procedure clearly described.

Study	Sampling approach	Participants characteristics	Relevant research question	Design/stimuli/measures	Key findings	Quality
Roderique-Davis et al. (2020) Study 2	10 consumers from Wales Staff members recruited from the University of South Wales	Level of alcohol consumption not reported. 80% female Mean age = 33.9 (SD = 12.40) No further information provided.	The effect of energy information on consumers' purchasing of alcoholic beverages.	Qualitative (focus groups). Participants were provided with labels that are commonly used on alcoholic beverages in Wales (i.e., labels without calorie content information), and also with re-designed labels that contained additional information (including calorie content information and warnings about dinking while pregnant and drinking while driving). Unclear whether the calorie information was on the front or back of the alcoholic beverage (warning and unit information were on the front). 12 items were discussed, including "what factors guide your purchase?" and "what information is listed on the label?" (additional items not reported).	Calories were not mentioned as a factor that guides participants' purchasing behaviour (participants only mentioned price, brand and quality as factors). Although participants argued that the calorie information was inadequate. One participant remarked: "I think it's quite important…but it's still tiny."	Low Missing methodological information (e.g., items discussed unclear). No discussion of techniques to enhance reliability of coding.

Walker et al. (2019a)	35 New Zealand drinkers. Recruited via existing panel. Ethnicity prioritised by Maori, then Pacific, then non-Maori/non-Pacific.	Level of alcohol consumption was mixed across participants (mild to moderate use and heavy use, based on AUDIT-C scores). However, overall mild to moderate users were underrepresented, and the Maori group only included participants with heavy alcohol use. 46% female Ages ranged from 18 to 59 years. 54% had incomes less than $80,000 (46% had incomes equal to or greater than $80,000). Ethnicity: Maori N = 7; Pacific N = 7; Non-Maori/non-Pacific (i.e., New Zealand European or Asian) N = 21. 66% university educated or trade qualification (34% secondary school only). No health information provided.	The effect of energy information on consumers' understanding of the energy content of alcoholic beverage. The effect of energy information on consumers' consumption of alcoholic beverages. The effect of energy information on the prevalence of drunkorexia behaviour	Qualitative (focus groups). Participants were assigned to one of six focus groups based on age and alcohol use (although the mild to moderate use groups also included some participants at the lower end of the heavy drinking category, due to difficulties in finding participants with mild to moderate alcohol use). A seventh focus group was for Maori participants only. All participants were given four non-branded bottles with four different labels. The labels included: 1) a NIP, 2) energy content information alone [in kilojoules and calories, both with and without % daily intake information], and 3) a combination label with energy, standard drinks, and percent alcohol content presented in one panel. All labels were presented on the front of the bottle, except for the NIP which was on the back of the bottle. Participants were asked how useful they find the information on each label, whether the labels would influence their purchasing/drinking behaviour, and whether they ever compensate for the number of calories they have consumed by drinking alcoholic drinks (either by eating less food,	Participants generally reported that terms such as kilojoules, calories and percent daily intake were confusing and hard to understand (except for the participants who happened to be heavily engaged with dieting). Only some participants (proportion not reported) said that the labels would cause them to change their purchasing or consumption behaviours (such as causing them to choose one drink over the other). Although heavy drinkers were much less likely to state that the labels would influence their behaviour. Most participants (proportion not reported) stated that they did not alter their food intake to compensate for what they drank, and for those that did, it was not by eating less food. Rather, these participants reported that they sometimes compensated for the calories consumed by engaging in physical activity or by eating well.	Medium Rated poorly on some criteria (e.g., non-representative sample/no discussion of techniques to enhance reliability of coding). However general inductive coding approach justified, and full interview guide provided in appendix.

Study	Sampling approach	Participants characteristics	Relevant research question	Design/stimuli/measures	Key findings	Quality
				by exercising more, or by some other means)		

Walker et al. (2019b)	615 New Zealand drinkers Recruited via existing online panel. Ethnicity prioritised by Maori, then Pacific, then other.	78% met criteria for heavy alcohol use (based on AUDIT-C scores). 58% female Mean age = 41.2 years (SD = 15.1) Income: 18.1-20.8% < $40,000; 27.3-33.6% = $40,001-$80,000; 32.9-41.6% > $80,000; 10.4-18.2% = unknown. Ethnicity: Similar proportions of Maori, Pacific people and non-Maori/non-Pacific. Participants in the non-Maori/non-Pacific group were mostly New Zealand European (78%; the remaining 22% were Asian [i.e., Chinese, Indian or Other Asian]). 52.6%-63.8% university educated or trade qualification (36.2%-46.8% secondary school only). No health information provided.	The effect of energy information on consumers' understanding of the energy content of alcoholic beverages. The effect of energy information on consumers' consumption/purchasing of alcoholic beverages.	Quantitative (between-subjects online experiment). Participants viewed an image of their preferred alcoholic beverage that had a label on the bottle. Participants were randomly allocated to one of four labelling conditions: 1) NIP; 2) combined (energy content + % alcohol content + standard drink information); 3) interpretive (energy content presented in kilojoules and calories with the amount of exercise required to burn off the shown energy); 4) no energy control (% alcohol content + standard drink information only). All participants were asked the following questions: "Imagine you are buying this alcoholic drink from a supermarket or liquor store. If this was one of the drinks available, how likely or unlikely would you be to buy it?" Response format: on a scale ranging from 1 (certain, practical certain [99 in 100 chance]) to 11 (No chance, almost no chance [1 in 100 chance]). "How many of these alcoholic drinks would you buy from a supermarket or liquor store each week?" (free-response format).	Participants in the labelling conditions were significantly more accurate in their calorie estimates than participants in the control condition (62-74% of participants in the labelling conditions provided estimates that were within 10% of the correct value [compared to 3% of participants in the control condition]). There were no significant differences in perceived energy estimates (on the scale from 'not very much' to 'very much') or in the perceived healthiness of the beverage between the labelling conditions vs. the control condition. However, participants perceived the NIP and interpretive energy labels as significantly more expensive than the control label. Overall, participants in the NIP condition reported a significantly higher likelihood of purchasing the product compared to participants in the control condition. Maori participants in the interpretive label condition also reported a significantly higher likelihood of purchasing the product compared to Maori participants in the control condition (the interpretative label format had no significant	High Rated highly on most criteria. Full questionnaire provided in appendix. Clear reporting of results (no major concerns). Non-representative sample.

Study	Sampling approach	Participants characteristics	Relevant research question	Design/stimuli/measures	Key findings	Quality
				"How likely or unlikely would you be to consume this alcoholic drink?" Response format: on a scale ranging from 1 (certain, practical certain [99 in 100 chance]) to 11 (No chance, almost no chance [1 in 100 chance]). "On a scale ranging from 1 (not very much) to 7 (a lot), do you think this energy (kilojoule (kJ)/calorie) content is:" "What is the energy (kilojoules (kJ) or calories) content per serve for this drink?" A free-response format was used where participants generated an amount in calories or kilojoules. Participants also rated the displayed product on various attributes, including expensiveness (1 = cheap, 7 = expensive) and healthiness (1 = healthy, 7 = unhealthy).	effects for other ethnicities). There was no significant difference in reported likely purchase between the combined label condition vs. control, irrespective of ethnicity. There were no significant differences in reported likely consumption or in the number of drinks participants were likely to purchase between any of the energy labelling conditions vs. the control condition, irrespective of ethnicity.	

Study	Sampling approach	Participants characteristics	Relevant research question	Design/stimuli/measures	Key findings	Quality
Winstock et al. (2020)	75,969 consumers from 30 different countries (most [39.6%] were from Germany; only 2.3% and 2.5% were from Australia and New Zealand, respectively) Responses were taken from an annual web survey of people who use licit and illicit psychoactive drugs.	Mean AUDIT score = 8. 45.6% were defined as low-risk drinkers (AUDIT scores of 0-7), whereas 13.5% were defined as high-risk drinkers (AUDIT scores of 16+). 35.7% female. Mean age = 27.0 (SD = 10.5). No further information provided.	The effect of energy information on consumers' consumption/purchasing of alcoholic beverages.	Quantitative (online) survey. Participants were asked whether the statement "A bottle of wine or 6 bottles of beer contain as many calories as a burger and fries" would make them consider drinking less (response options were: No; Unsure; Maybe; Yes). Participants also rated whether the statement was personally relevant (1 totally irrelevant; 2 = not very relevant; 3 = unsure; 4 = a bit relevant; 5 = very relevant). Participants were counted as viewing the information as personally relevant if they gave scores of 4 or 5	Only 24.8% of participants responded that the information would make them consider drinking less. Only 29% of participants reported that the information was personally relevant.	Medium Rated poorly on some items, however clear methodological approach and reporting of results. No major concerns regarding internal validity, however the study lacks external generalisability to the current literature review because participants were users of licit and illicit psychoactive drugs. The wording of the question is also prone to social desirability bias if the findings are to be interpreted as providing insight into consumer understanding, however measuring consumer understanding of the information was not the aim of this study.

Study	Sampling approach	Participants characteristics	Relevant research question	Design/stimuli/measures	Key findings	Quality
Wright et al. (2008)	325 USA consumers Recruited at commercial breweries at three locations in the USA.	Consume at least 1 alcoholic beverage per year (no further consumption information reported). 50% female. 39% aged 21-30 years, 61% aged 31+ years. Income not reported. Ethnicity not reported. Level of education not reported. 78% stated that they try to follow a healthy and balanced diet. However 65% also stated that beverage healthiness has little impact on beverage choice.	The effect of energy information on consumers' consumption/purchasing of alcoholic beverages.	Quantitative (written) survey. Participants rated the importance of calories as a factor when choosing an alcoholic beverage. Response format: on a scale from 1 (not an important influence) to 5 (extremely important influence).	Participants generally rated calorie content as an unimportant factor when choosing an alcoholic beverage (M = 2.32).	Medium Rated poorly on some criteria (e.g., non-representative sample, lack of recruitment data). However clear description of scale question (no major concerns).

Appendix 4: Meta-analyses methods

Proportion calculations

Raw data from each study (i.e., the number of participants who supported energy labelling/could accurately estimate the energy content and the total number of participants in the sample) was entered into Comprehensive Meta-Analysis software (CMA version 3; Borenstein et al., 2013) to calculate exact proportions for each study. If raw data were not available, then this information was estimated based on the percentages reported in the study.[49]

Overview of analyses

A random effects model was used for the overall analysis (as recommended by Borenstein et al., 2009), given that true between-study variation in proportions was expected (and this was confirmed by heterogeneity statistics – see Findings). Each proportion was weighted by the inverse of its variance, and 95% confidence intervals were calculated for the weighted average (pooled) proportion. All meta-analytic procedures were conducted using CMA software (Borenstein et al., 2013), which applies a logit transformation to the proportions for analyses, then back-transforms the summary statistics (i.e., the pooled proportion and confidence intervals) to proportions for ease of interpretation.[50]

Multiple proportions within the same study

Multiple proportions from the same sample:

Several studies reported multiple, statistically-dependent proportions (Alcohol Concern, 2010; Bui et al., 2008 Pilot study; CSPI, 2003; GfK, 2014; RSPH, 2014; Walker et al., 2019b). For example, GfK (2014) reported the proportion of participants with accurate energy estimates separately for several alcoholic beverages. As these proportions were from the same sample of participants, they are statistically-dependent, which violates the assumption of independence in meta-analyses and may produce bias by assigning more weight to studies with more proportions (Lipsey & Wilson, 2001). Multiple, statistically-dependent proportions within a study were therefore averaged.

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[49] RSPH (2014) only provided an approximate percentage of participants with accurate energy estimates (“less than 30%”). In this case, the percentage was estimated as 29%.

[50] It is necessary to apply transformations to proportions that are skewed (i.e., proportions that are extremely high or extremely low, as is the case for the proportions used in the current meta-analyses), in order to make them conform to a normal distribution as much as possible (Barendregt et al., 2013). The logit transformation is preferred over the Freeman-Tukey double arcsine transformation, as the latter can lead to seriously misleading results in a meta-analysis (see Schwarzer et al., 2019 for further discussion).

Multiple proportions from independent subgroups:

Nikolaou et al. (2015) reported the proportion of participants supporting energy labelling separately for different subgroups (i.e., females and males). Additionally, Annunziata et al. (2015) and Annunziata et al. (2016b) reported the proportion of participants with accurate energy estimates separately for participants from different countries. For these studies, the independent subgroups were entered as subgroups in CMA software, and the study was used as the overall unit of analysis. That is, proportions from subgroups within the same study were combined, as recommended by Borenstein et al. (2009) [51].

Although it is recommended that subgroups within the same study be treated as unique studies when running moderator analyses, it was not possible to conduct moderator analyses within either meta-analysis due to the small number of studies reporting on participant characteristics (Borenstein et al., 2009; Lipsey & Wilson, 2001).[52]

[51] CMA software combines independent subgroups within the same study by performing a fixed-effect meta-analysis on the subgroups for that study. However, the overall results of both meta-analyses did not largely differ depending on whether the independent subgroups were treated as subgroups (i.e., combined) or as unique studies.

[52] Moderator analyses are formal statistical tests performed within a meta-analysis that determine whether the variability in proportions across studies may be explained by particular study characteristics (e.g., participant characteristics).