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# Pregnancy warning labels on packaged alcohol

A review of recent literature

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## Executive summary

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FSANZ undertook a literature review to inform the development of risk management options for a pregnancy warning label on packaged alcoholic beverages. The literature review covered the period from November 2008 to July 2019. This period starts from the end of the search date for the FSANZ commissioned literature review by Wilkinson et al. (2009). The review was not limited to peer-reviewed papers, but includes studies from the grey literature, primarily government and non-government organisation (NGO) commissioned reports, as these are highly relevant to Australia and New Zealand populations. A total of 46 studies were included in the review.

We adopted the framework of Argo and Main (2004) to summarise relevant information. They identify five dimensions of warning label effectiveness: attention; reading and comprehension, recall, judgement, and behavioural compliance. We have discussed attention and recall together in this review.

### Attention

To be effective, a warning label has to be noticed. It must draw the attention of a consumer. Prompted awareness of existing pregnancy warning labels across the general Australian and New Zealand public ranged from about 26% to 53% and 25% to 29%, respectively. Prompted awareness was generally higher (around 33% to 74%) for specific populations focussed on women (e.g. women with children, women who are pregnant or planning to have a child or have had a child in the previous 18 months). Experience in the countries with mandated warning labels indicates that the level of awareness of warning labels and recall of their content will increase over time.

The reviewed literature shows trends in awareness with some consumer characteristics. The proportion of populations who are aware of pregnancy warning labels decreases as age increases. Those who drink at higher levels or who drink directly from packaged alcoholic containers were more likely to be aware of pregnancy warning labels than those who drink at lower levels or didn't drink directly from the container. There was also some evidence of those with higher levels of formal education being more likely to be aware of pregnancy warning labels than those with lower levels of formal education.

### Design factors influencing attention

Consumers attention to warning labels is influenced by a range of design factors. These design factors can be manipulated to enhance the noticeability of warning labels such that consumers are more likely to notice the warning.

### Size

For a pregnancy warning label to be effective it first must be noticed and the consumer direct their attention to it. That the size of an element in a label is related to the attention it receives has been long established in consumer and marketing research. The experimental studies using warning labels on alcohol found that increasing the size of warnings led to an increase in the noticeability of the warning. This was also supported by the findings of qualitative studies. There is likely to be a ceiling effect above which increasing the warning size will have only marginal additional benefit. The size and type of font used impacts its readability with larger fonts being more easily read than smaller fonts. Sentences in all capitals can be

harder to read than those in sentence case. A clear and large font is particularly important for the visually impaired.

## Location/Placement

There were few studies identified in the review that tested the impact of warning location on attention for alcohol products experimentally. Despite this there was evidence from qualitative studies that supports the general contention that location of a pregnancy warning label on the front of alcoholic beverages would receive quicker and/or more attention than those placed elsewhere on the packaging. This was also supported by the tobacco warning research where many studies have highlighted the greater effectiveness of tobacco warnings when placed on the front of tobacco packages compared with the back and side of packages. Borders have been used to draw attention to a warning. Studies highlighted that the context in which the warning is placed can impact attention, hence the border can be used to distinguish and separate the warning from other information that competes for attention.

## Colour/Contrast

Colour has been used in warnings to enhance the attention they receive. Experimental studies identified in the review have primarily tested red and black options. Using red in a warning can increase the speed at which the warning is identified and also increase the reported level of attention the warning receives. The use of the red pictogram was also considered more noticeable in contrast to the black pictogram. Colour operates as a cue that in combination with an appropriate signal word is perceived as implying a greater hazard than the equivalent signal word in black text. Some colour combinations produce contrast that is difficult to read (e.g. yellow on white), and legibility is reduced when the contrast between characters and the background is low. Dark lettering on a white background, or vice versa, rather than similar shades of a similar colour has been recommended to enhance legibility.

## Signal words

There were no studies identified in the review that experimentally tested the influence of signal words on attention. However, a broader research literature has demonstrated that signal words are important in drawing attention to a warning. Signal words can also connote different levels of hazard. In some circumstances the use of authoritative sources can increase the credibility of warnings, but they may also result in a level of reactance<sup>1</sup> in response to the message. A search of the literature for use of 'pregnancy warning' or 'pregnancy caution' did not locate any studies.

## Pictorials

Pictorials have been used in warnings to both draw attention to the warning and to convey information. Types of pictorial content include representative drawings, such as the standard pictogram, actual photographs, or more abstract symbols (as often used in road signs). Studies generally find that the addition of a pictorial element to a textual warning enhances the level of attention that the warning receives in comparison with a text only warning. Additionally, pictorial elements can bridge literacy and other educational gaps. Some studies have explored graphic warnings (realistic photographs) with pictorial warnings to find that

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<sup>1</sup> Reactance is a negative state of arousal that can be triggered when individuals feel some perceived or actual loss of freedom.

graphic warnings may be more effective in altering judgements, however others have found increased resistance to messages as a reaction to graphic warnings. No literature was found that explored graphic warnings in the context of FASD.

## Comprehension

Most of the relevant information on the comprehension of pregnancy warning labels in Australia and New Zealand has been conducted on behalf of government and NGOs. The research on the standard pictogram suggests it is well understood by participants across target populations of women of childbearing age and young women, as well as the general population. When the pictogram is red and black it is interpreted more like a warning than when other colour combinations are used.

Comprehension of the voluntary warning statement of *It's safest not to drink while pregnant* has been explored in cross sectional surveys showing varying degrees of comprehension across studies. While some studies found very high levels of comprehension, others have identified a small, but significant proportion of key target populations who interpret the text as meaning *you can drink when pregnant but it is safer not to*. A degree of ambiguity was identified in focus groups where the word 'safest' gave rise to the varying interpretations.

Few other text messages have been tested in Australian and New Zealand populations. However, research findings suggest it is important to personalise the message to make it more relevant, and to avoid using definitive language (*will cause*) about causal connections.

## Judgement

Wilkinson et al. (2009) concluded that the impact of warning messages on judgements was equivocal highlighting results that both increased risk perceptions in some populations, and decreasing risk perceptions in others. The studies we identified showed that warnings can influence judgements participants hold about alcohol, and about its risks. In particular, combinations of graphic warnings with text enhance the risk perceptions of products over the risk perceptions from text only warnings and those without warnings at all. Multiple exposure to the same warning across different situations can lead to stronger beliefs in alcohol as a risk factor in some chronic illnesses. The size of warnings also appeared to impact product evaluations such that larger warnings are more likely to reduce positive product evaluations than smaller warnings.

When considering warning message believability, convincingness and relevance, some types of warnings perform better than others. Positively framed warnings were rated more believable than those using fear appeals and those using numerical evidence. Language such as *increases risk* was also considered more believable than language like *can cause*.

## Behaviour

The literature on the impact of warning labels on behaviour was limited. The experimental studies reviewed indicated that warning labels can have an impact on self-reported intentions to reduce alcohol consumption. Studies also identified other behaviours such as seeking further information, visiting a website, and talking to others about the risks of harm from alcohol. There was no strong evidence to suggest that where warning labels have been mandated there has been an impact on levels of consumption. Researchers typically note that the current mandated warnings do not incorporate relevant design factors to enhance their effectiveness.

## Conclusion

FSANZ undertook a literature review to inform the design and development of the pregnancy warning label. The review confirmed that multiple design elements (size, location, colour, pictorials, signal words) can be used in varying combinations to enhance the noticeability of warning labels. Thus larger, front of pack, warnings using colour, signal words and pictorial elements are likely to attract more attention than warning labels lacking those elements. While some studies have explored the interactions between several design elements, none have done so comprehensively. It is likely that some enhancement in attention level can be achieved through the application of different design factors, or to those design factors to varying degrees. For example a smaller front of pack warning may be as noticeable as a larger back of pack warning, or a larger black and white warning may be as noticeable as a smaller red warning. This provides risk managers with some degree of flexibility to optimise the level of attention that a warning receives.

The literature review identified research on comprehension of existing warning statements and the standard pictogram on alcohol in Australian and New Zealand populations. There was limited research on new warning statements and pictograms. However, while the research findings are not definitive in terms of what statements would work best in Australia and New Zealand, they do provide some guidance for statements that can be tested. The literature on judgements and behaviour was similarly limited with respect to FASD. While a number of different types of behavioural response have been reported (e.g. changed alcohol consumption patterns, seeking further information, visiting websites, prompting discussions and conversations), these reports are generally self-reported and correlational. It is generally accepted that where alcohol warnings labels have been introduced, they have had limited impact on consumption behaviour. It was also noted that current mandatory warnings in place in other countries have not been designed with a view to optimise the attention they receive.

## Introduction

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In October 2018, the Australia and New Zealand Ministerial Forum on Food Regulation (the Forum) noted a Decision Regulation Impact Statement (DRIS) with options for progressing pregnancy warning labels on packaged alcoholic beverages. The Forum requested Food Standards Australia New Zealand (FSANZ) consider mandatory pregnancy warning labelling, and that the warning label should include a pictogram and relevant warning statement.

The Forum reiterated government advice in Australia and New Zealand that 'pregnant women do not consume any alcohol'. They further noted that 'pregnancy warning labels on packaged alcoholic beverages can raise awareness and prompt discussions about the risks of consuming alcohol during pregnancy and may also support the establishment of cultural norms in relation to pregnant women not drinking alcohol' (Australia and New Zealand Ministerial Forum on Food Regulation, 2018).

Warnings are a special type of communication that have several purposes. Laughery and Wogalter (2016) identify four purposes for warnings. They *provide information* about a hazard, and its consequences, and provide instructions to manage the hazard. Warnings also seek to *influence behaviour* through the instructions included in the warning. Warnings also act as a *reminder*. Individuals may be aware of the hazard and how to manage it, but they need to be aware of that at the appropriate time; a warning can draw attention to the hazard at the right time. A warning can also serve a broader society purpose contributing to a *safer world*.

A pregnancy warning label as envisioned by the Forum acts across these four purposes. A pregnancy warning label may provide information about the hazard of alcohol when consumed while pregnant, as well as the consequences and instructions to reduce the risk that the hazard poses to the unborn baby. A pregnancy warning label on packaged alcohol can provide that information at an appropriate time being at the time of purchase and also at the time of consumption, so the warning label can act as a reminder to women and others of the hazard. The pregnancy warning label can also influence behaviour, such as reducing alcohol intake or abstaining from consuming alcohol while pregnant, thus reducing or eliminating the risk alcohol poses. In addition, it can influence other behaviours, such as seeking further information and discussing options to manage the risk of alcohol with others. Finally, a pregnancy warning label can assist in creating new social norms around consumption of alcohol while pregnant, and in doing so it may serve a broader societal role.

This document reviews and summarises the evidence about the effectiveness of warning labels on packaged alcohol as one thread of evidence to inform the design of pregnancy warning labels. This review does not commence from a blank page, rather it acknowledges and builds upon the various strands of works that have proceeded it. Of particular note is the literature review commissioned by FSANZ: *Alcohol warning labels: Evidence of impact on alcohol consumption amongst women of childbearing age* (Wilkinson et al., 2009). Additionally the evaluation of the voluntary labelling initiative commissioned by the Australian Department of Health (Siggins Miller, 2014, Siggins Miller, 2017) and research commissioned by New Zealand's Health Promotion Agency were also key sources (Rout & Hannan, 2016).

In this document we use the term *warning label* as a generic term to refer to a printed text and/or graphical statement affixed to a consumer product that provides information about a hazard related to the product and/or information about how to manage that hazard to reduce risks.

The *standard pictogram* refers to the pictogram with a silhouette of a pregnant woman holding a drinking glass enclosed within a circle with a diagonal strikethrough (Figure 1). The standard pictogram may come in various colour combinations (e.g. black with red strikethrough, monochrome, greyscale). The standard pictogram is used as part of DrinkWise Australia and Cheers voluntary warning label initiatives.



**Figure 1: Standard pictogram**

The *voluntary warning statement* refers to the warning statement of '*It's safest not to drink while pregnant*'. This statement was derived from the Australian guidelines to reduce health risks from drinking alcohol (National Health and Medical Research Council, 2009) and used as part of DrinkWise Australia and Cheers voluntary warning label initiatives.

## Approach to this summary

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FSANZ has undertaken a literature review of the available evidence on the effectiveness of warning labels to inform the design of pregnancy warning labels. The peer-reviewed literature regarding pregnancy warnings on alcohol is limited in quantity and quality. In their review for FSANZ, Wilkinson et al. (2009) identified 35 papers regarding pregnancy warning labels on alcohol over the period from 1990 until October 2008. When repeating this search for the period November 2008 until July 2019 few relevant papers reporting new empirical studies were identified. Accordingly we extended the search to include warnings on alcohol more generally.

The search terms and results are described in detail in Appendix A. Following the search and removal of duplicate items, titles and abstracts of papers were screened, resulting in 49 papers for full text review. Editorial, commentary and papers which did not report empirical findings were excluded. We also excluded papers that reported empirical results on alcohol advertising, enhanced nutritional labelling on alcohol, warning signs in premises and other unrelated topics (see Table A4 in Appendix A). This resulted in 34 empirical peer-reviewed papers (See Figure A1). Details of the peer-review papers included are in Table A1 in Appendix A.

The search identified two systematic reviews. Hassan and Shiu (2018a) reviewed 15 papers identified from the period 2000 to 2015 on the effectiveness of alcohol warning labels, Scholes-Balog, Heerde, and Hemphill (2012) reviewed 10 papers on alcohol warning labels and adolescents. Where relevant the conclusions from these literature reviews, and those from Wilkinson et al. (2009) are included.

There is a broader peer-reviewed literature on warnings across other consumer products. Literature reviews from the broader warning literature have been included. These summarise earlier research that identified and empirically tested many of the design factors related to the effectiveness of warnings (Argo & Main, 2004; Laughery & Wogalter, 2016; Wogalter, 2006; Wogalter & Leonard, 1999). Eight papers that reported on systematic or narrative reviews were included in this review. Details of these are included in Table A2 in Appendix A.

There also exists a set of studies and reports that are not published in the peer review literature. These include reports commissioned by government agencies (e.g. Rout & Hannan, 2016; Siggins Miller, 2017), and both public health and industry advocacy groups (Hall & Partners, 2018; GALKAL, n.d.; Quantum Market Research, 2019). It is acknowledged that some of this grey literature may be lacking the methodological rigour and reporting standards of the peer-reviewed literature. However this literature also represents some of the few studies undertaken with Australian and/or New Zealand populations exploring alcohol warning labels in the context of pregnancy. These studies have also been included in the literature review. Five studies from the grey literature were included in this review. Details of the grey literature is included in Table A3 in Appendix A.

In total 46 papers were included, comprising 32 empirical peer-reviewed papers, 9 papers reporting on systematic or narrative reviews and 5 papers from the grey literature were included in this summary of evidence.

The quality of the included empirical literature was assessed using a consistent approach resulting in a quality rating of low, medium or high for each study. The rating was based on assessment of the following elements of the study: theory, aims & justification for the study; the population of interest and the sampling techniques used; the methods and measures that are used; the analysis of data both quantitative and qualitative approaches; the reporting of

the results and interpretations including discussion of any limitations; whether peer review was undertaken; and if there is potential for perceived or actual conflict of interest. See Appendix A for details.

The literature review is structured by the framework developed by Argo and Main (2004). They identify five dimensions of warning label effectiveness: attention; reading and comprehension; recall; judgement; and behavioural compliance. These represent the sequential stages of information processing when consumers are exposed to warnings. The five dimensions are:

- **Attention:** in order for a warning to have any impact on a consumer it must be noticed; without noticing a warning the information of the warning cannot be engaged with, it cannot be understood.
- **Reading and Comprehension:** after noticing a warning, the consumer needs to read and understand the content of the message. If the message is unclear or has multiple interpretations, or the consumer does not have the literacy skills to read and understand the message it is unlikely to be correctly followed.
- **Recall:** in addition to noticing and then reading and understanding a warning message, its encoding in memory will assist the subsequent retrieval and use of that information at an appropriate time. Recall is measured by participants correct recollection of warning label detail.
- **Judgement:** Warnings provide new information, or remind people, about some hazard associated with a product. Individuals may make new judgements about the risks of consuming the product and evaluate the product in light of the new information provided by the warning.
- **Behavioural Compliance:** Warnings seek to encourage safe behaviours and to discourage unsafe behaviours. Warnings may also encourage behaviours that contribute ultimately to a desired behavioural outcome indirectly. For example, a warning may encourage someone to seek further information or talk with someone else about the warning, that may lead to behaviour change.

## Attention & Recall

Attracting the attention of women, and the general community, is a necessary initial step in the process of attending to, and acting upon, a pregnancy warning label. The warning label competes with other visual elements on the label, and needs to cut-through in order to attract attention of the consumer. Attention must initially switch to the warning label, to be noticed, and then be maintained upon the warning, in order for information to be extracted and comprehended. A warning label that is not noticed by its intended audience fails at the first step. Attention is the first dimension that Argo and Main (2004) identify in their 5-dimensions of warning label effectiveness.

Recall refers to the ability to remember and recall the details of a warning message from memory. Once a warning message has been encoded, it's information may be available as a future source of guidance in subsequent judgements and decisions (Argo & Main, 2004).

While both attention and recall are different dimensions of effectiveness, they have been discussed together in the literature review as they are often measured similarly in surveys of consumers awareness of warning labels. Recall is typically measured through the accurate description a participant is able to give of a warning label, that is an unprompted recall. Attention is measured through confirmation of participants' awareness or having previously seen a particular warning from a prompted display of options, that is a prompted awareness or recall.

This section initially reports on the level of attention and recall that warning labels have achieved in Australia and New Zealand. This generally draws on cross-sectional surveys to provide an estimate for the level of awareness that a particular population or population of interest has. This section then explores various design factors that can be used to enhance the noticeability of warnings, and thus increase the attention and recall they receive.

### Level of attention and recall

This section provides an overview of the studies identified that reported levels of attention or recall warning labels receive (Table 1). Studies have used both prompted and unprompted approaches. A prompted approach provides a picture or description of the warning label and asks participants if they are aware or recognise the warning (e.g. Quantum Market Research, 2019; Rout & Hannan, 2016). An unprompted approach would seek a description from the participant in response to a more general question about warning labels or alcohol more generally, which, if the response adequately describes the warning would be a positive indication of recall (e.g. Rout & Hannan, 2016; Siggins Miller, 2017).

In their 2016 study of adult New Zealanders, Rout and Hannan (2016), found that 7% were aware of pregnancy warning messages without visual prompting. The level of awareness among young women<sup>2</sup> and women with children<sup>3</sup> were higher, at 17% and 13% respectively. Prompted awareness for three warning messages: 1) the standard pictogram; 2) the voluntary warning statement; and 3) an alternative warning statement of *'Don't drink pregnant'* were 25%, 29% and 19% respectively for the New Zealanders. Young women reported significantly higher levels of awareness than New Zealanders across the three warnings, at 46%, 49% and 29% respectively. Further demographic analysis revealed that

<sup>2</sup> Young women was defined as women aged 18 – 34 years.

<sup>3</sup> Women with children was defined as all women with children aged 15 years and younger.

awareness of the warning was highest among younger participants, those in higher income households, those with university qualifications, and those with higher or moderate risks of alcohol dependency<sup>4</sup>.

As part of the evaluation of the voluntary labelling initiative to place pregnancy warning labels on alcoholic beverages, Siggins Miller collected data in 2014 and again in 2017 about the level of awareness of the standard pictogram and the voluntary warning statement (Siggins Miller, 2014, Siggins Miller, 2017). They found prompted awareness decreased from 42.2% to 38.9% for the standard pictogram and increased from 26.3% to 32.5% for the voluntary warning statement between 2014 and 2017 for women who were pregnant, planning to become pregnant in the next two years, or had a child under 18 months<sup>5</sup>. While women in this group were aware of warning messages about alcohol, few were aware of the standard pictogram or the voluntary warning statement until they were prompted<sup>6</sup>.

In an online survey of Australian adult drinkers, Coomber, Mayshak, Curtis, and Miller (2017) reported 52.7% of the 18-45 year olds were aware of any warning label among the DrinkWise Australia *Get the Facts*<sup>7</sup> suite of warning labels. Note that this will include those individuals not aware of the pregnancy warning labels but aware of other elements of the suite of warnings. The same study found that the approximately two-thirds of 18-45 year olds considered that 'harm to unborn babies' was likely to be a 'definitely true' consequence of consuming alcohol. Those who were aware of any element of the warning suite were 87% more likely to consider that 'harm to unborn babies' was likely to be a 'definitely true' consequence of consuming alcohol than those who were not aware of at least one warning label element (OR=1.87; 95%CI=1.42-2.46; p<0.001).

An earlier online survey by the same research group found approximately 37.9% of Australian adult drinkers were aware of any of the pregnancy warning labels (standard pictogram, voluntary warning statement) (Coomber, Martino, Barbour, Mayshak, & Miller, 2015). Older participants (35-45 years) were significantly less likely to be aware of the warning labels than younger participants (18-24 years) (OR=0.31, 95%CI=0.18-0.54, p<0.001). Those who more frequently binge drank (OR=1.40, 95%CI=1.13-1.72, p=0.002), and those who drank directly from the can or bottle (OR=1.75, 95%CI=1.10-2.77, p=0.018) were more likely to be aware of pregnancy warning labels than those who did not.

DrinkWise Australia have commissioned two studies that reported awareness of their warning label suite (GALKAL, n.d.; Quantum Market Research, 2019). GALKAL (n.d.) found that 45% of adult Australians that had purchased packaged alcohol in the previous 12 months were aware of at least one of images from their suite of warning labels. There was an apparent trend of decreasing awareness with increasing age, such that 89% of those aged 18-24 were aware of at least one of the warning labels. This dropped to 80% for those aged 25-30; 68% for those aged 31-35; 53% for those aged 36-40; and 50% for those aged 41-45 years.

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<sup>4</sup> Risk of alcohol dependency was defined as women with a score of 3-12 or men with a score of 4-12 on the AUDIT-C scale.

<sup>5</sup> The equivalent data for the total sample were: standard pictogram: 33.3% in 2014 to 30.8% in 2017; voluntary message text: 19.9% in 2014 to 25.9% in 2017.

<sup>6</sup> Unprompted awareness for 'target women': standard pictogram 4.3% in 2014 to 6.8% in 2017; messages on alcohol products: 5.7% in 2014 to 11.4% in 2017. Note that this is not directly comparable to the prompted awareness of the voluntary message statements as it includes a range of recalled texts statements.

<sup>7</sup> This suite included the 'Get the Facts' logo, the standard pictogram, the standard warning text, and two additional warning statements: 'Is your drinking harming yourself or others?' and 'Kids and alcohol don't mix'.

In a similar on-line survey for DrinkWise Australia, Quantum Market Research (2019) reported 40% of Australian adults had seen at least one of the DrinkWise labels from the suite of voluntary warning labels DrinkWise promote. They reported that 59% of women aged 18-44 years had seen at least one warning label, and 56% of those who were pregnant, breastfeeding or planning a pregnancy<sup>8</sup> had seen at least one warning label. A similar trend in awareness with age was found with the proportion who reported their awareness decreasing as age increased.

Jones and Gregory (2010) used focus groups with student participants (aged 18-22 years) from a regional Australian university to examine their attitudes and likely impact of four text warnings using examples of international alcohol products as stimuli. Three of the four warnings used as stimuli included warnings to avoid drinking while pregnant. The warnings also covered cancer, drink-driving and operating machinery. Prior to being exposed to the stimuli, participants noted they had previously seen warnings on international products but not on Australian produced products. Note that data collection occurred prior to the launch of DrinkWise Australia's voluntary labelling initiative. After being shown the examples of international warnings they were asked if they thought exposure to them would influence their attitudes or behaviours. The majority didn't believe they would be effective as they perceived the warnings were more relevant to those who drank more than them or to some other demographic group. Participants consistently mentioned the formatting of the stimuli stating that the warning label looks like an ingredients list and would not be noticed, contained too much text, or that it was too small to be noticed. Suggested improvements to warning labels were to increase the size and include more colour, use clearer or larger text, and to include pictures, with participants comparing the warnings to graphic cigarette warnings.

Coomber, Hayley, and Miller (2018) used a qualitative approach with Australian university students aged 18-25 years, to explore their response to the DrinkWise suite of warnings. This included the standard pictogram and the voluntary warning statement. Using stimuli of enlarged versions of the warnings, and also images of alcohol products with warnings, focus groups were used to discuss the warnings. Some participants had reported seeing warnings whilst drinking in the past, while others had not noticed them prior to participating in the focus groups. Upon first viewing the warnings, most participants commented on the small size of the warning relative to the overall product brand labels.

We have included the findings from a study of French postpartum and pregnant women. The French experience is relevant as the standard pictogram in Australia and New Zealand is based on the French pictogram, and is a similar size and in similar locations on packaged alcohol (Dumas, Toutain, Hill, & Simmat-Durand, 2018; Siggins Miller 2017). The French pictogram has been required on packaged alcohol sold in French Territories since 2007 (Dumas et al. (2018)). Using a cross-sectional survey Dumas et al. (2018) reported awareness of the French pictogram among French postpartum and pregnant women at 66.1%. Drinkers were significantly more likely to be aware of the pictogram than non-drinkers (77.3% versus 54.3%;  $P < 0.001$ ). When drinking behaviour was controlled, older women were less likely to be aware of the pictogram, as were women with a low level of education and single women.

These findings regarding attention are consistent with those reached in the literature review by Wilkinson et al. (2009). They note that the level of awareness of warning labels in the US had increased over time despite concerns about the noticeability of the warning labels. Younger people were more likely to be aware of labels than were older groups, and those

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<sup>8</sup> It is unclear from the results slide deck if this group is limited to women or if it includes male partners of pregnant or breastfeeding women or males involved in planning a pregnancy.

who drank at higher levels or more frequently were more likely to be aware than those who didn't. In focussing on an adolescent and young adult population, the review by Scholes-Balog et al. (2012) also reported increased awareness of pregnancy warning labels following their introduction.

Qualitative studies enabled a more in-depth investigation of the factors underpinning the levels of attention that existing pregnancy warning labels received. These highlighted a range of aspects related to the size, location and lack of noticeability in the manner in which warning labels had been implemented (Coomber et al., 2018; Jones & Gregory, 2010). The following section discusses the findings with respect to these design factors.

## **Design factors that influence attention**

In their meta-analysis, Argo and Main (2004) found that the presence of vividness-enhancing characteristics in warnings is more likely to attract consumers' attention than when absent. Vividness-enhancing features are design features and physical characteristics that enhance the vividness of the warning and include font size, colour, spacing, level of specificity, symbols, pictures, and warning location. Laughery and Wogalter (2016) refer to these as design factors and have identified: size, location/placement, colour/contrast, signal word, pictorials, message length and physical interactivity. The following sections discuss each design feature in turn drawing on the empirical literature. In some cases additional literature has been drawn in as recent studies may be lacking.

### **Size**

Laughery and Wogalter (2016) note that 'bigger is generally better', but qualify it is generally the relative size of the warning relative to other displayed information. Size also incorporates font size and the size of pictures or images used in the warning. There is a large research literature within advertising and marketing that have shown that large objects are more likely to be noticed, noticed more quickly and receive more attention than smaller objects (Peschel & Orquin, 2013).

**Table 1: Prompted and unprompted awareness of pregnancy warning labels**

Study	Population	Unprompted		Prompted	
		Pict.	Text	Pict.	Text
GALKAL (n.d.)	Women aged 18-40 yrs (AU)	n/a		74%	
GALKAL (n.d.)	All respondents (AU)	n/a		45%	
Rout and Hannan (2016)	Women (18-34 yrs) (NZ)	17% <sup>9</sup>		46%	49%
Rout and Hannan (2016)	Women with children (NZ)	13%		30%	36%
Rout and Hannan (2016)	All respondents (NZ)	7%		25%	29%
Coomber et al (2015)	Australians (AU) 18-45	16.1%		37.9%	
Coomber et al (2017)	Australians (AU) 18-45	n/a		52.7%	
Siggins Miller (2017)	Women who are currently pregnant, planning a pregnancy or have a child under 18 months (AU)	6.8%	11.4%	38.9	32.5%
Siggins Miller (2017)	All respondents (AU)	4.9%	8.6%	30.8%	25.9%
Quantum Market Research (2019)	Women (AU) 18-44	n/a		59%	
Quantum Market Research (2019)	Pregnant, breastfeeding or planning pregnancy	n/a		56%	
Quantum Market Research (2019)	Australians (AU) 18+	n/a		40%	
Dumas et al (2018)	French pregnant and postpartum women	n/a		66.1%	

<sup>9</sup> Unprompted awareness for Rout and Hannan (2016) relates to pregnancy warning message, rather than the pregnancy warning specifically (from Table 9).

Several studies identified in this literature review explored the impact of size on the dimensions of warning label effectiveness. Some studies used experimental designs so that the influence of size on effectiveness can be measured. There was also a number of qualitative studies where size was a part of the research design. There were a number of studies that explored the impact of warning size on other dimensions of effectiveness, but did not report measures of attention. These studies are discussed in subsequent sections of the literature review (e.g. Al-hamdani & Smith, (2017a); Al-hamdani & Smith, (2017b) report on the impact of warning size on judgement).

Pham, Rundle-Thiele, Parkinson, and Li (2018) combined an online survey and eye tracking approach in a mixed-methods study exploring impacts of size and colour of warning labels on attention with Australian participants. The stimuli used were the front and back labels of a bottle of wine with the standard pictogram and the 'get the facts' label. Three experimental conditions were tested: 1) colour: using a red strikethrough in the pictogram and red text in the logo; 2) size: increased size by 50% and 3) colour and size: incorporating both the colour changes and size increases. The control condition used a black and white pictogram and 'get the facts' label in the standard size recommended in DrinkWise guidance. The control and experimental conditions were identical for both the survey and the eye tracking components of the study.

Pham et al. (2018) reported a significant effect in the level of attention as measured by a self-report composite scale, with participants exposed to the colour and size condition reporting the highest level of attention compared to the smaller monochrome control ( $F_{3,555}=3.566$ ,  $p=0.014$ ; control mean=5.0, colour and size mean=5.4). There was a trend of increasing attention from the control condition to the colour condition to size and finally the colour and size condition.

The eye tracking component of the study provides an accurate measure of what components of the label participants look at. Pham et al. (2018) recorded the number of fixations, time to first fixation, and duration of fixations. Importantly, the eye-tracking component revealed that not all participants looked at the warning component of the stimuli. Of the control group, 59% of participants looked at the warning in contrast to 81% of participants in the colour and size condition. However there were no significant differences between the control and other treatment groups across time to first fixation, the number of fixations or the fixation duration across the treatment conditions. The sample sizes for the four groups ranged from  $n=11$  to  $n=17$  (total  $n=42$ ) and as such the study would be underpowered to detect anything but very large effects.

Kersbergen and Field (2017) used an eye-tracking approach to objectively measure the level of attention that participants paid to package areas of existing alcohol packaging on the UK market. The beverage labels were divided into three 'areas of interest' (AOI): 1) *health*: comprising pregnancy warning and any calorie information; 2) *brand*: comprising brand information and logos; and 3) the *rest*: covering everything else (e.g. barcode, recycling logo and blank space). Participants viewed 40 beverage containers (20 alcohol and 20 soft drink containers) on a screen and their gaze recorded. The experiment found that participants looked at the warning information for an average of 1.03 seconds ( $SD=0.89$ ) over the 15 second viewing time, with *brand* AOI receiving most attention followed by the *rest* of the packaging. Analysis suggested that the warning labels were attended to for longer periods when they were larger in size and less complex<sup>10</sup>, however size was not a manipulated variable as the study used existing UK alcohol packaging. Kersbergen and Field (2017) note that the UK warning labels on average take up less than 5% of the packaging, and attention

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<sup>10</sup> Complexity was measured by using a ratio of the compressed file size for the AOI to uncompressed file size.

is roughly proportional to their size. In exploring individual differences, participants who were high in their motivation to reduce drinking paid less attention to *brand* and *health* AOIs and more attention to *rest* AOI.

The font used in warning messages is another articulation of a warning's size. The size and type of font used impacts its readability with larger fonts being more easily read than smaller fonts. Sentences in all capitals can be harder to read than those in sentence case. A clear and large font is particularly important for the visually impaired (Wogalter & Leonard, 1999).

As noted above in qualitative studies by Jones and Gregory (2010) and Coomber et al. (2018) small size was a characteristic of existing warning labels that participants in their research considered to reduce the effectiveness of current voluntray warnings.

In their literature review on the effectiveness of alcohol warning labels, Wilkinson et al. (2009) note that alcohol warning labels represent a small proportion of the size of an overall label and have not been designed for impact. They cite a number of papers from research on tobacco warnings that smokers are more likely to recall larger warnings than they are smaller warnings. They further note that larger warnings have impacts on judgements and behavioural intent and these are discussed in later sections of this report. In the literature reviews by Scholes-Balog et al. (2012) and Hassan and Shiu (2018a) size as a design element was not discussed.

That the size of an element in a label is related to the attention it receives has been long established in consumer and marketing research (e.g. Peschel & Orquin, 2013; Peschel, Orquin, & Mueller Loose, 2019) This literature search revealed two experimental studies that explored the impact of warning size on the level of attention. Both studies suggest increasing the size of warnings on alcoholic beverages will lead to an increase in the noticeability of the warning (Pham et al., 2018; Kersbergen & Field, 2017). This was also supported by the findings of qualitative studies.

## Location/Placement

Laughery and Wogalter (2016) note that, as a general principle, warnings located close to the hazard both physically and in time are more likely to be noticed and encoded in memory than warnings that are not located proximally to the hazard. Thus a warning that is located on the alcohol package being referred to when making purchase and/or consumption decisions is more likely to be noticed than a warning that is not located on the alcohol package being referred to. Warnings in the field of vision when looking at an alcoholic beverage (i.e. front of pack) are more likely to capture attention than those that are not directly in the field of vision (i.e. side or back of package, not on primary package). There were no recent studies that experimentally tested the location of warnings on alcoholic beverages, though one older study was described. Two qualitative studies reported on issues related to the location of warnings on alcoholic beverages.

Coomber et al. (2018) undertook a study with young adults (18-25 years) who consumed alcohol using focus groups (n=26 across 4 focus groups) recruited from an Australian university. The study was focussed on participants' responses to options for pictorial and graphic warnings, but also collected data on their responses to existing warnings. Participants commented that the proposed warnings were more noticeable than the existing ones, and that the placement of existing warnings on the lower back label reduced the visibility of the warning. Others noted that the warning was placed alongside other back label elements (e.g. barcode, ingredients list) which further obscured the information conveyed.

Dossou, Gallopel-Morvan, and Diouf (2017) used in-depth interviews (n=26) with a youth sample (15-29 years) to explore the location of pregnancy warnings on alcohol products in

France. As noted above, the French experience is relevant as the standard pictogram has been mandatory since 2007 on alcoholic beverages sold in France and French Territories. They used examples of a well-known brand of spirit carrying the pictogram as stimuli in the interviews, and asked about the elements that attracted their attention. The pictogram was 'barely mentioned' in the participants top-5 lists of elements they noticed. When asked why the pictogram had not drawn their attention the participants noted its location (on the back of the bottle), its size (too small) and its context (surrounded by other elements hindering visibility).

One quantitative study, identified through hand searching was particularly relevant to the impact of warning location/placement on attention. The study by Laughery, Young, Vaubel, and Brelsford Jr (1993) used a series of existing alcoholic beverage containers before and after the introduction of the mandatory warning labels in the US. Participants were required to indicate if a warning was on the product or not. Warnings printed on the front were found significantly more quickly than those printed on the left hand side, then the back and then the right hand side ( $F_{3,31}=4.96$   $p<0.01$ ). They also found that warning orientation significantly influenced the time taken to notice a warning, where horizontal warnings were noticed more rapidly than vertically orientated warnings ( $F_{1,40}=14.1$   $p<0.001$ ). This study also found that when the labels are filled with non-warning information, locating the warnings took longer.

Laughery et al. (1993) explored the impact of using a border around a warning to enhance its noticeability. They found no significant effect of the presence of the border over its absence in the time taken to identify the presence or not of a warning. Subsequent research by Wogalter and Rashid (1998) found that in the context of warning signs, a thick and colourful border was more likely to attract attention than no border or a thin border.

There were few studies identified in our search that tested the impact of warning location on attention for alcohol products experimentally. Despite this there was evidence that supports the general contention that location of a pregnancy warning label on the front of alcoholic beverages would receive quicker and/or more attention than those placed elsewhere on the packaging. This is also supported by the tobacco warning research. Wilkinson et al. (2009) cite numerous studies that highlight the greater effectiveness of tobacco warnings when placed on the front of tobacco packages compared to the back and side of packages.

## Colour/Contrast

Generally colour and/or other forms of contrast are associated with the greater noticeability of warnings (Laughery & Wogalter, 2016). In addition to attracting attention, some colours also convey additional meaning, thus the colour red has been a common indicator of hazard and assists understanding that the warning is, in fact, actually a warning; while green can be ambiguous and confusing in the context of warnings.

Only one study identified as part of the search used colour as a manipulated variable in their experimental design to measure the effect of colour on attention (Pham et al., 2018). Several qualitative studies identified colour was an attribute of warning design that participants discussed and commented upon in respect of attention to warning labels (e.g. Coomber et al., 2018; Hall & Partners, 2018). Other studies explored the impact of colour on other dimensions of effectiveness (e.g. comprehension) and are discussed in the relevant sections (Rout & Hannan, 2016).

In Pham et al.'s (2018) study (described above) participants gave the highest score for attention to the condition that used the red circle and strikethrough in the standard pictogram combined with an size increase of 50% (mean =5.4, 95%CI 0.1-0.2) compared to the control condition of a smaller, black/grey standard pictogram (mean = 5.0, 95%CI 6.5-11.9). They reported a significant difference in the mean attention score that participants gave to each

condition across three conditions and the control ( $F_{3,355}=3.566$ ,  $p = 0.014$ ). The attention score for the colour condition (mean = 5.1, 95%CI 10.0-15.8) was not significantly higher than the control, though when combined with an increase in size the score was greater than the increase in size alone (mean = 5.2, 95%CI 0.1-0.2). The second part of Pham et al.'s (2018) study using an eye tracking approach, revealed that 81% of participants looked at the warning in the colour and size condition compared to 59% in control condition. However, there were no significant differences in number of fixations, time to first fixation and the duration of fixation across the three conditions and the control.

A number of non-experimental studies also identified colour as an issue related to attention. Hall & Partners (2018) used a qualitative approach with focus groups in the city and suburbs of Sydney and in Newcastle. The focus groups were single sex, and covered women who were pregnant or trying to conceive; male partners of women who were pregnant or trying to conceive; and women who had one or more pregnant friends or who had children under 3 years. The focus groups were further stratified across age and education levels. Stimuli used in the focus groups were the standard pictogram and the voluntary warning statement and a series of alternative pictograms and statements<sup>11</sup>. Four of the alternative pictograms used a red circle and diagonal strikethrough, the fifth used a more complex pictogram with several duller colours. Participants highlighted the red colour as being eye catching and makes the pictogram stand out when compared to the standard pictogram. Participants did not draw the same conclusion for the more complex pictogram with several duller colours.

An earlier study by Laughery et al. (1993) used an experimental design to test the influence of design factors on attention on alcohol products. The four conditions used in the experiment were colour (red, black), pictogram (presence, absence), warning icon (a triangle with exclamation mark) associated with signal word (presence, absence) and border around warning (presence, absence). The control stimuli was a base label across beer, wine and spirits products that included brand information and logos, company addresses and information, and a bar code. The stimuli used the standard US mandated alcohol warning<sup>12</sup> altered with the design features in each condition. Attention was measured by the time it took participants to accurately identify if the stimuli included the warning. Participants more rapidly identified warnings when printed in red (mean = 2354 ms) than when the warning was printed in black (mean = 2527 ms,  $F_{1,67} = 5.79$ ,  $p<0.02$ ). There was a significant interaction between colour and icon such that the inclusion of the icon reduced the time taken to correctly identify a warning, when the warning was in black (from 2668 ms to 2385 ms,  $p<0.05$ ), but there was no further improvement when the warning was red (from 2366 ms to 2342 ms,  $p>0.05$ ).

Some colour combinations produce contrast that is difficult to read (e.g. yellow on white), and legibility is reduced when the contrast between characters and the background is low. Dark lettering on a white background, or vice versa, rather than similar shades of a similar colour has been recommended to enhance legibility (Wogalter & Leonard, 1999).

The literature review by Wilkinson et al. (2009) notes the importance of colour in the context of heuristic cues, that is the use of learned knowledge structures in the form of simple decision rules to make judgements. In this context using a signal word (e.g. Warning ) in the colour red serves as a cue to consumers which is perceived as implying a greater hazard than the equivalent signal word in black text (Zuckerman & Chaiken, 1998). In the literature

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<sup>11</sup> These are described and shown in more detail in Table 2

<sup>12</sup> GOVERNMENT WARNING: (1) According to the Surgeon General, women should not drink alcoholic beverages during pregnancy because of the risk of birth defects. (2) Consumption of alcoholic beverages impairs your ability to drive a car or operate machinery, and may cause health problems.

reviews by Scholes-Balog et al. (2012) and Hassan and Shiu (2018a) colour and contrast as design elements were not discussed.

Colour has been used in warnings to enhance the attention that it receives. In both experimental studies included in this review red and black were the colours tested. They found that using red in a warning can increase the speed in which the warning is identified and also increase the reported level of attention the warning receives. The use of the red pictogram was also considered more noticeable in contrast to the black pictogram.

## Signal word

Signal words are used in warnings to both attract attention and to generally indicate a level of hazard (Laughery & Wogalter, 2016). The literature search did not identify any studies that experimentally tested the impact of varying signal words on alcohol warning labels on level of attention attained. Several qualitative studies used stimuli that incorporated various signal words and reported on the responses of participants. Additionally, hand searching identified several papers that tested warning signal words in other contexts that are generalizable to the alcohol situation. A search was also carried out using the term 'pregnancy warning' and 'pregnancy caution' however no studies were identified that used these as a signal word in warnings.

Thomson, Vandenberg, and Fitzgerald (2012) explored the reaction to three different signal words in their Victorian focus groups of participants aged 16 years and above: 1) warning, 2) health warning and 3) government health warning. The majority of participants found 'health warning' most acceptable while 'government health warning' was criticised as it was perceived as akin to a 'nanny' state or a 'Big Brother' type message. The signal words were included on warnings that covered a range of possible hazards arising from alcohol.

Jones and Gregory (2010) used international stimuli that used signal words of 'warning' 'government warning' and 'government health warning' all in capital letters. While participants considered the stimuli to be ineffective, suggestions for improvement did not include changes to the signals words beyond generic size and location enhancements.

In their study Pettigrew et al. (2014) included two warning statements that began 'Warning: alcohol ...', while others did not include the initial signal word. One of these statements was the best performing statement in terms of believability, convincingness and personal relevance, while the second performed about 7<sup>th</sup> in the set of 12 statements. Importantly the study was not designed to test the presence/absence of the signal word and the statements differed in other characteristics.

Only one stimuli used the signal word 'warning' in Hall & Partners' (2018) focus group study. This was reported to be effective in attracting attention among their sample of Australians aged 18-45 years.

An early study by Wogalter, Jarrard, and Simpson (1992) tested a range of signal words on consumer product for perceived level of ha. They tested the signal words 1) NOTE, 2) CAUTION, 3) WARNING; 4) DANGER; 5) LETHAL. The control condition were no warning text and no signal words, and a second control of no signal word (though the warning message was still present). In general they found that the presence of a signal word raised hazard perceptions compared to when no signal words was present. Level of attention was not significantly different across the tested conditions.

Wogalter, Kalsher, and Rashid (1999) asked participants to rate warnings across alcohol, tobacco and dietary supplement examples with signal words from different sources with respect to credibility and likelihood of compliance. The signal words tested were: 1) control –

no signal word; 2) WARNING; 3) GOVERNMENT WARNING; 4) US GOVERNMENT WARNING; 5) FEDERAL GOVERNMENT WARNING; 6) US FEDERAL GOVERNMENT WARNING. The study found that the use of WARNING had a significantly increase the level of perceived credibility and increased likelihood of compliance over the no signal words condition. This was further enhanced with the addition of the source prefix to the word WARNING, so the longer the and most specific prefix US FEDERAL GOVERNMENT was considered the most credible and also the one that participants were most likely to comply with.

A second study by Wogalter et al. (1999) explored the influence on credibility and likelihood of compliance of prefixes to WARNING from different sources. They tested specific regulatory agencies, scientific and professional agencies and general statements. When WARNING was present participants gave significantly higher ratings for credibility and likelihood to comply than when the signal words was not used. Credibility and likelihood to comply increased with the addition of general prefixes (e.g. HEALTH WARNING; IMPORTANT HEALTH WARNING) and increased again when specific source organisation were used (e.g. AMERICAN MEDICAL ASSOCIATION WARNING). Both general and specific source prefixes were significantly different from the control in ratings, however they were not significantly different from each other.

Laughery and Wogalter (2016) cite research that 'danger' is more likely to attract attention than 'warning' or 'caution' or no signal word. They further note that people generally do not differentiate between 'warning' and 'caution' but consider these terms to connote hazard levels less than 'danger'. In their systematic review of warnings on alcohol, Hassan and Shiu (2018b) note that the specific source of a message (e.g. from medical/health bodies/government source) can lead to increased credibility and increased compliance than less specific signals. Wilkinson et al. (2009) noted that when a signal word is in red, this will trigger heuristic processing based on the learned associated of harm and red and the signal word.

There were no studies that had experimentally tested the influence of signal words on attention identified. However there is broader research literature that has demonstrated signals words are important in drawing attention to a warning. Signal words can also connote different levels of hazard. In some circumstances, the use of authoritative sources can increase the credibility of warnings, but may also result in a level of reactance<sup>13</sup> in response to the message. A search of the literature for uses of 'pregnancy warning' or 'pregnancy caution' did not identify any studies.

## Pictorials

Pictorials have been used in warnings to both draw attention to the warning and to convey information. They may comprise representative drawings, such as the standard pictogram, actual photographs, or more abstract symbols (as often used in road signs). Pictorials have been found to enhance attention (Laughery & Wogalter, 2016). The literature search identified one study that explored the impact of graphic warnings on attention to warnings on alcohol. A number of qualitative studies included various pictorials as part of their stimuli participants responded to.

Monk, Westwood, Heim, and Qureshi (2017) used an eye tracking approach to measure attention to different types of alcohol warning labels. They used a head-mounted eye-tracker

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<sup>13</sup> Reactance is a negative state of arousal that can be triggered when individuals feel some perceived or actual loss of freedom.

that recorded eye-movements and dwell time on different areas of interest on stimuli shown on a computer screen. The stimuli were a series of graphic (e.g. medical images) and neutral images (e.g. cartoon physiology) and associated warning text (e.g. alcohol damages brain functioning). Among a small sample of 22 participants, they found that participants spent significantly longer looking at the image component of the warning than the text (mean dwell time 5243.09 ms versus 2777.05 ms). However, there was no significant difference in the dwell time between graphic and neutral images.

Using a questionnaire one week before the eye-tracking component and then on its completion, Monk et al. (2017) collected data on participants' expectations from consuming alcohol. They found that those whose positive expectancies increased after exposure to the warnings spent longer looking at the image than those whose positive expectancies decreased or stayed the same. While noting the small scale of the study, the alcohol related content of pictures may in some circumstances be enough to cue positive alcohol expectancies.

In an earlier study using an experimental approach Laughery et al. (1993) explored the impact of including a pictorial in a warning on the time taken to correctly identify that a stimuli label of an alcoholic beverage included a warning or not. They found that warnings with a pictorial resulted in significantly faster responses (mean = 2359 ms) than when the pictorial was not present (mean = 2533 ms;  $F_{1,67} = 7.95$   $p < 0.01$ ). They found the same result when an icon<sup>14</sup> was included next to the warning signal word (mean = 2364 ms versus 2517 ms,  $F_{1,67} = 7.73$ ,  $p < 0.01$ ).

Pictorials have been used in warnings to both draw attention to the warning and to convey information. Types of pictorial content include representative drawings, such as the standard pictogram, actual photographs, or more abstract symbols (as often used in road signs). Studies generally find that the addition of a pictorial element to a textual warning enhances the level of attention that the warning receives in comparison with a text only warning. Additionally, pictorial elements can bridge literacy and other educational gaps. No literature was found that explored graphic warnings in the context of FASD.

## Message length

Laughery and Wogalter (2016) note that brevity has been a generally accepted criterion for warnings; warnings should be no longer than necessary to communicate the needed information. They note that it can be assumed that a longer message is less likely to be read but find the literature to be mixed in this regard. No studies that explored message length were identified in the literature search for this review. However a number of studies did report on related aspects of clutter on labels.

## Physical interactivity

Requiring some form of physical interaction with a warning label, such as requiring the removal of a warning label before a product could be consumed has been somewhat successful in enhancing the level of attention given to a warning Laughery and Wogalter (2016). No studies that explored physical interactivity were identified in the literature search for this review.

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<sup>14</sup> Laughery et al. (1993) consider the icon separate to a pictorial in their experiment, however we have considered both to be examples of pictorials in this review.

## Comprehension

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Once noticed a warning label needs to be read and its message understood. Reading and comprehension is the second dimension of effectiveness identified by Argo and Main (2004). If the warning is not read, or read and misunderstood or read and not understood, then the information cannot be acted upon. Consumer comprehension of a warning depends on the characteristics of the message itself, (e.g. how simple or complex the message is) as well as characteristics of the consumer (e.g. level of literacy or motivation to read the message) (Argo & Main, 2004).

Much of the research on reading and comprehension relevant to the Australian and New Zealand context comes from the grey literature that has been commissioned by government agencies (e.g. Rout & Hannan, 2016; Siggins Miller, 2017) or by NGOs (e.g. Quantum Market Research, 2019; Rout & Hannan, 2016). This literature varies in its quality and typically provides limited methodological detail. Generally, this literature is not peer reviewed, and often lacks the detail to undertake normal quality assessments (see Appendix 1). Despite this these studies report on participants' comprehension of warning labels from Australian and New Zealand samples and often use warning labels that currently exist in the Australian and New Zealand markets. This makes this set of literature particularly relevant to the discussion on reading and comprehension.

In a 2016 on-line cross-sectional survey of adult New Zealanders commissioned by New Zealand's Health Promotion Agency (HPA), participants were asked about three warning labels: 1) the standard pictogram; 2) the voluntary warning statement; and 3) an alternative warning statement of 'Don't drink pregnant' (Rout & Hannan, 2016).

A primary message of 'Don't drink if pregnant/possibly pregnant' was conveyed by the standard pictogram and the alternative warning text for 80% and 76% of participants. A lower level of participants, 54% associated this primary meaning with the voluntary warning statement. For young women and women with children, this primary message was conveyed to 90% and 86% respectively for the standard pictogram, to 82% and 74% respectively for the alternative warning statement, and to 61% and 66% respectively for the voluntary warning statement.

A secondary message of 'Alcohol consumption during pregnancy can or will harm an unborn baby/pregnant mother' was conveyed to fewer participants for each warning label tested: 10%, 36% and 31% for the standard pictogram, the voluntary warning statement and the alternative warning statement respectively. Importantly, 8% of all participants, and 14% of young women and 8% of women with children, reported that the voluntary warning statement conveyed the message 'You can drink when pregnant but it is safer not to'. This was not the case for either the standard pictogram nor the alternative warning statement. Twelve percent of participants responded with 'don't know' or 'nothing' for the meaning of the standard pictogram. This response was 1% or less for the two warning statements tested.

Rout and Hannan (2016) also asked participants to assess the degree to which each warning label showed: 1) a link between pregnant women drinking and harm to an unborn child, and 2) that you shouldn't drink any alcohol while pregnant. Across both these assessments, the pictogram performed best, and did so for a greater proportion of participants (total well<sup>15</sup> 67% for pregnancy and alcohol harm link and 84% for you shouldn't drink any alcohol while

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<sup>15</sup> Sum of those indicating

pregnant). The voluntary warning statement performed better than the alternative warning statement in terms of the link between drinking and harm to an unborn child (Total well: 49% versus 41% respectively), while the alternative warning statement performed better than voluntary warning statement in terms of showing that you shouldn't drink any alcohol while pregnant (total well 62% versus 56%). The same pattern was observed across these evaluations for Māori, Pacific and Asian participants, though at consistently higher levels than for New Zealand European participants.

Rout and Hannan (2016) tested the standard pictogram in four colour options: duotone gold (circle and strikethrough in darker tone); duotone grey, monochrome green; and red and black (circle and strikethrough in red). A large majority of the total sample (97%), of young women (97%) and of women with children (98%) considered the red and black version of the pictogram looked most like a warning.

As part of the Australian evaluation of the voluntary labelling initiative to place pregnancy health warnings on alcohol products, Siggins Miller conducted on-line cross-sectional surveys in 2014 and again in 2017 (Siggins Miller, 2014, Siggins Miller, 2017). The studies sought understanding of two warning labels: 1) the standard pictogram; and 2) the DrinkWise Australia warning incorporating their web address under 'get the facts' along with the voluntary warning statement.

Using an unprompted open-ended question that was subsequently coded, 92.5% of participants reported that the standard pictogram conveyed the message 'Don't drink alcohol when pregnant' in 2014. In 2017, this proportion dropped to 80.4%. The authors do not provide any reasons for this decrease, though they note some additional categories for coding were identified in the evaluation in 2017, and that this may contribute to the reduction. A second message of 'alcohol causes harm to mother or unborn child' was conveyed to 2.3% and 2.2% in 2014 and 2017, respectively.

For the DrinkWise Australia warning, 34.9% in 2014 and 51.7% in 2017 reported the warning conveyed a message of 'Don't drink when pregnant', while 30.4% in 2014, and 26.5% in 2017, reported the warning conveyed a message of 'Alcohol causes harm to unborn child or mother'.

DrinkWise Australia commissioned two online surveys that included questions on participants' understanding of the DrinkWise warning messages (GALKAL, n.d.; Quantum Market Research, 2019). These studies have limited detail about their sampling and methodological approach and were reported in brief PowerPoint style slide deck. Four alternate DrinkWise warning messages were included: 1) the standard pictogram; 2) website address and 'get the facts'; 3) website address and voluntary warning statement; and 4) website address, 'get the facts', the voluntary warning statement, and the standard pictogram. A fifth version included both 1) and 2) in the context of a back package wine label including additional labelling information. Seventy-five percent of respondents reported that they understood what the messages and images mean, and this level increased to 82% among those aged 18-40 years (GALKAL, n.d.). Note this was a subjective assessment of comprehension.

Using an open-ended question where responses were subsequently coded, Quantum Market Research (2019) reported that 98% of participants understood the message conveyed by the DrinkWise Australia warning label. This comprised 82% who were coded into a 'Don't drink/safest not to drink while pregnant' category; 7% to 'Alcohol is harmful to the baby'; and 5% to 'Be safe/responsible/don't take risks'. The authors do not provide further detail on the breakdown of the don't drink/safest not to drink while pregnant combined category so that it is unclear if that includes interpretations that include consumption of small amounts of alcohol as being safe.

The Foundation for Alcohol Research and Education (FARE) commissioned Hall & Partners (2018) to investigate consumer understanding and interpretation of DrinkWise Australia’s warning labels, specifically: 1) the standard pictogram and 2) the voluntary warning statement. The study used a qualitative approach with focus groups in the city and suburbs of Sydney and in Newcastle. The focus groups were single sex, and covered women who were pregnant or trying to conceive; male partners of women who were pregnant or trying to conceive; and women who had one or more pregnant friends or who had children under 3 years. The focus groups were further stratified across age and education levels. As noted by Hall & Partners (2018) the approach does not intend to provide any measure of prevalence of comprehension of messages, rather it was designed to provide an ‘in-depth understanding of how consumer information messages are interpreted and the factors that impact on this’ (Hall & Partners, 2018, p. 14).

The message conveyed by the standard pictogram was considered by the participants to be clear and straightforward and often articulated as ‘do not drink alcohol while pregnant’. Participants noted the circle and diagonal strikethrough across the silhouette of the woman drinking, and interpreted this as a ‘stop sign’, a universal sign for prohibition. A smaller minority of mainly male participants considered the pictogram conveyed a softer message: ‘that it is advisable/recommended not to drink alcohol while pregnant’. Some participants in the focus groups also commented on the size of the bump in the pictogram and that it could be interpreted as representing a particular stage of pregnancy, but that was not how they interpreted the pictogram. The authors did not suggest that this interpretation was personally held by any participants. Hall & Partners (2018) report that the voluntary warning statement was considered ‘... ambiguous and weak. It was equated to a polite suggestion to consider not drinking, rather than a clear directive or definitive warning’ (Hall & Partners, 2018, p. 25). They highlighted the word ‘safest’ as leading to this ambiguity.

Hall & Partners (2018) also tested a range of alternate pictograms and warning statements.. A brief summary of the comprehension findings from these is at Table 2.

**Table 2: Comprehension of alternate pictograms and warning statements (Source: Hall & Partners, 2018)**

	<p>Pictogram with the strike through was considered too complex as it was a double negative.</p> <p>Without the strikethrough it removed the double negative, but in doing so lost the easily recognised instant ‘prohibition/do not’ message.</p>
	<p>Conveyed the message of ‘do not drink’ linked to the red strikethrough.</p> <p>Could be interpreted as a specific stage of pregnancy.</p>

	<p>Some considered the message too broad. For example some interpreted it related to purchases or being in the vicinity of alcohol.</p> <p>Conveyed that the message applied to a range of alcohol types.</p>
	<p>Conveyed 'do not drink' but the torso distracted from the primary message.</p> <p>Conveyed to some participants that it applied to red wine.</p>
<p>During pregnancy, no amount of alcohol is safe</p>	<p>Conveyed that small amounts of alcohol are not safe.</p> <p>Some questioned whether this definitive statement was factually correct.</p>
<p>Do not drink alcohol when pregnant</p>	<p>Conveys a clear instruction that was same as the pictogram.</p> <p>No reason for not drinking conveyed.</p>
<p>Alcohol causes birth defects, do not drink when pregnant.</p> <p>Do not use if pregnant: alcohol causes birth defects.</p>	<p>Definitive language implied to some that alcohol always causes birth defects, rather than using 'can' or 'may'.</p> <p>This was challenged by some at low levels of alcohol consumption</p>
<p>Drinking any alcohol can harm your unborn baby.</p> <p>Even small amounts of alcohol can harm unborn babies.</p>	<p>Mainly understood as conveying that small amounts have the potential to cause harm.</p> <p>Didn't have the same pushback as 'causes birth defects' by using 'can harm'; seen as less definitive.</p> <p>'Harm' was considered vague by some participants.</p>
<p>This product should not be used when pregnant or breastfeeding</p>	<p>Meaning was considered straightforward, and the extension to breastfeeding was understood.</p>
<p>Warning: Do not use if pregnant or breastfeeding.</p>	<p>Meaning considered straightforward.</p>

	'Warning' implied it was a potentially serious cause or concern.
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The circle and strikethrough used in several of the pictograms appears to be an important element. This readily conveys a message of prohibition or do not use, and is readily associated with warnings. The more detailed aspects of the various pictograms tested produced a range of interpretations, some which may limit the effectiveness of a warning – such that it only applied to a certain stage of pregnancy.

Earlier we noted the impact that colour can have on consumers' attention to a warning, and in the case of the pictogram the colour red further enhanced the interpretation of the pictogram as a warning. Hall & Partners (2018) conclude that the standard DrinkWise pictogram was the 'strongest option' among those tested.

Participants' responses to the alternative statements highlighted that more definitive language, (e.g. 'alcohol causes birth defects') may be problematic compared to when there is some qualification in the statements (e.g. alcohol can cause birth defects'). Such definitive language led some participants to question the scientific veracity of the statement.

Hall & Partners (2018) further found that personalising the message (e.g. 'your baby' rather than 'babies in general'; and 'unborn baby' instead of 'fetus') increased relevance and emotional resonance.. Based on a set of design principles developed from their research, Hall & Partners (2018) suggest: 'Any amount of alcohol may harm your unborn baby' as an example of a warning statement. They did not test this option in their study.

Dossou et al. (2017) report on a French study using in-depth interviews with a small sample of youth and young adults (aged 15-29 years). Since 2007, alcohol sold in France and French territories have displayed a mandatory pictogram which is comparable in design to the standard pictogram. Participants generally understood the meaning of the pictogram, i.e. not to drink while pregnant but the lack of explicit information was lamented (e.g. how dangerous is alcohol to the fetus?).

The review by Wilkinson et al. (2009) noted that none of the research papers they reviewed examined whether or not participants were able to understand the information in the warning label. They drew on research broader than packaged alcohol and pregnancy warning labels and reported that English language skills were important, and noted that some more complex tobacco health warnings required higher levels of education for understanding.

Most of the relevant information on the comprehension of pregnancy warning labels in Australia and New Zealand has been conducted on behalf of government and NGOs. The research on the standard pictogram suggests it is well understood by participants across target populations of women of childbearing age and young women, as well as the general population. When the pictogram is red and black it is seen more like a warning than with other colour combinations.

Comprehension of the voluntary warning statement of 'It's safest not to drink while pregnant' has been explored in cross-sectional surveys with varying degrees of comprehension. While some studies found very high levels of comprehension, others have identified a significant, but small proportion of key target populations who interpret the statement as meaning 'you can drink when pregnant but it is safer not to'. A degree of ambiguity was also identified in focus groups where the word 'safest' gave rise to the varying interpretations.

Few other statements have been tested in Australia and New Zealand populations. However, research findings suggest it is important to personalise the message to make it more relevant, and to avoid using definitive language (will cause) about causal connections.

## Judgement

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Judgement is the fourth dimension of effectiveness in Argo and Main's (2004) framework. Warning labels can influence consumers by providing additional product information that can influence consumers' perceptions of risk associated with that particular product. Pregnancy warning labels can provide information that can alter or challenge consumers' held beliefs and judgements about the risks of consuming alcohol when pregnant.

Argo and Main's (2004) conceptualisation of judgement was focussed on risk and harm perception. In this literature review we have also included other judgements that may not be directly related to risk or harm, but are still important in the effectiveness of a warning. For example consumers' evaluation of a warning's credibility and believability will influence its effectiveness. If a warning is seen as not credible it will not be taken seriously (Beltramini, 1998; Pettigrew et al., 2014). There were studies that report on judgements about harm or risk, as well as studies that explored other evaluations of warnings. Both topics of judgements are discussed in this section.

Pettigrew et al. (2014) tested a series of differently constructed cancer warnings on a sample of Australian drinkers through an online survey. The warnings tested comprised 11 cancer warnings and one general health warning. They varied by message frame (positive versus negative), cancer reference (general versus specific) and manner in which cancer risk was communicated (increases risk versus can cause cancer). Three outcomes were measured: believability, convincingness and personal relevance through 5-point scales. Across the cancer statements younger respondents and those with a tertiary education found the statements more believable than those older and less educated. Similar results were found for convincingness, though females and beer and wine drinkers found the statements more convincing than males and spirits drinkers. High risk drinkers were more likely to find the statements more personally relevant than lower risk drinkers, though there were no significant differences for convincingness and believability.

Analysing by message characteristic Pettigrew et al. (2014) found warning statements that were characterised by positive frame (e.g. Reduce your drinking to reduce your risk of cancer) were considered more believable than those that used fear appeals (e.g. Alcohol can cause breast cancer) or numerical evidence (e.g. Alcohol causes 1 in 20 cancer deaths). This result was generally repeated for convincingness and personal relevance, with some findings only significant for males. Exploring the manner in which cancer was communicated, Pettigrew et al. (2014) found statements that used terms 'increases risk' were more believable than those that used 'can cause'. The same pattern held for convincingness, however there were no significant differences in levels of personal relevance. General cancer statements (e.g. Warning: alcohol increases your risk of cancer) were found to be more believable, convincing and personally relevant than specific cancer warnings (e.g. Alcohol increases your risk of bowel cancer).

Another study by the same research team (Pettigrew et al., 2016) exposed participants to one of six cancer warning statements across a range of situational contexts (warning on a product, newspaper advertisement, comments from child following health class, bus-stop billboard, and a doctor). This approach sought to simulate how alcohol warnings could be disseminated through a comprehensive, public health campaign. Believability, convincingness and personal relevance were measured after exposure to the series of warning situations.

All statements were considered believable, convincing and personally relevant. The only score lower than the mid-point of the scale across the three measures and six statements

was for a statement relating to breast cancer and personal relevance. This may be explained by the mixed sample and perceived lack of relevance of breast cancer for men. There were some significant differences between men and women, and for education and age, for a number of the individual statements and the three measures, however generally there were few differences in responses to the statements across socio-demographic factors.

Al-hamdani and Smith (2015) designed an experiment of warning label options on participants' judgements across beer, wine and spirits. Four warning conditions were used:

- 1) control: standard alcohol bottle without warning
- 2) text warning: text warning about liver cancer occupying 25% of the front label area on a standard bottle
- 3) text and image warning: text warning as for condition 2 and an image of liver cancer occupying 50% of the front label area (text and image occupying 25% each)
- 4) warning and plain packaging: same as condition 3 but on a bottle that had been stripped of all branding and promotional information

The study incorporated a within subjects design for alcohol type and a between subjects design for warning. The sample was a convenience sample from two medium-sized Canadian universities and a large hospital; the sample was not limited to students. Measures included product-based perception measured by participants' response to the product and a consumer-based perception measured by participants' associations with desirable personal attributes of those they associate with the product (e.g. confidence, young, masculine). These were measured through a 5-point Likert scale. Using a multiple choice question, participants indicated which warning condition they had been exposed to. Only one message was used across all conditions and alcohol types so this question assessed correct or incorrect warning recognition.

The study found that warning type had a significant effect on both product-based and consumer-based perceptions. The text and image warning condition and the text and image on plain packaged alcohol condition produced significantly lower product-based evaluations across beer (C<sup>16</sup> mean = 3.61; T+I mean = 2.96, T+I+PP mean = 2.54), wine (C mean = 3.60; T+I mean = 2.48; T+I+PP mean = 2.48) and spirits (C mean = 3.88; T+I mean = 1.98; T+I+PP mean = 2.08). The text warning only produced a significantly lower product evaluation for the spirit condition (C mean = 3.88; T mean = 3.19). There were no significant impacts on the beer and wine conditions.

Similar to product-based perceptions, participants who were exposed to text and image warnings on a plain packaged gave significantly lower consumer-evaluations than those without warnings across beer (C mean = 3.62; T+I+PP mean = 2.37), wine (C mean = 3.12; T+I+PP mean = 2.57) and spirits (C mean = 3.38; T+I+PP mean = 2.47). Text and image warning was significant across wine (C mean = 3.12; T+I mean = 2.45) and spirits (C mean = 3.38; T+I mean = 2.39), but not for the beer product. Participants exposed to the text only warning did not significantly differ in their consumer-evaluation across any of the alcohol types, beer, wine and spirits. These results were consistent regardless of the age and sex of the participant.

These results indicate that text and image warnings and text and image warnings on plain packaging were generally effective in reducing product-based and consumer-based

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<sup>16</sup> C = control; T = text warning; T+I = text and image warning, T+I+PP = text and image warning on plain packaging.

judgements of alcohol products. In contrast, the text only warning condition was not as effective in reducing perceptions, with the only significant effect when displayed on spirits.

In this study, the text warning occupied 25% of the front package label while the text and image condition and text and image on plain packaging both occupied 50% of the front package label. While the only difference between text only and text and image condition is the addition of the image, the result also suggests that increasing the size of the warning label from 25% to 50% of the front label package contributes to the significant effect.

In a subsequent study, Al-hamdani and Smith (2017b) explored the impact of graphic warning size on branded and plain packaged bottles on product-based and consumer-based evaluations across beer, wine and spirits. The warning used was a text statement about liver cancer and a corresponding image and the size of the warning conditions were 50% (25% text +25% image), 75% (25% text + 50% image), and 90% (40% text + 50% image) of the front bottle area, excluding neck and shoulder. In the plain packaged conditions branding information, logos, artwork and other distinguishing features were removed and replaced with size 12 font of the brand name and descriptor.

Product-based perceptions, consumer-based perceptions and product boringness were measured in the study. There were no main effects of warning size on the three evaluations. Importantly the study involved three conditions of size which were tested – there was no control of no warning in this study design. A significant interaction between warning size and alcohol type for product-based rating was observed. Wines and spirits with warning size of 90% had significantly lower product evaluations than their 50% sized warning counterparts (wine: mean 90% =1.86, mean 50% = 2.24; spirits: mean 90% 1.78, mean 50% 2.11). This did not hold for beer. This study shows only modest gains in increasing front warning size beyond 50%, with significant effect only for wine and spirits in one measure when increased from 50% to 90%. Drawing on this result and their earlier study (Al-hamdani & Smith, 2015), and the broader experience from the tobacco warning literature Al-hamdani and Smith (2017b) suggest a threshold effect of warning sized around 50% of the front label in reducing product-based and consumer-based perceptions.

Wigg and Stafford (2016) used an experimental approach to measure the impact of text and pictorial warnings on participants' fear arousal, perceptions of health risk and intention to reduce and quit alcohol consumption. Participants were exposed to one of three warning label conditions: 1) control – no warning; 2) text-only – with the statement 'Alcohol causes fatal liver cancer'; and 3) pictorial plus text? – the text warning as in condition 2 with an image of a diseased liver. The warnings were on placed on realistic images of beer and wine bottles that otherwise included normal branding, marketing and business information. The warnings used in conditions 2 and 3 were the same size and were featured on the front of the wine/beer bottle. The sample was a small, predominantly female sample recruited from a university (n=60, 72% female).

There was a significant difference in the participants' perceived risks of alcohol across the three warning conditions ( $F_{2,54}=6.45$   $p=0.003$ ). Those who were exposed to the pictorial plus text warning perceived higher risks with consuming alcohol than those who were exposed to the control warning. The difference between the text only warning and the control were not significant. There was a significant difference in participants' fear arousal across the three warning conditions ( $F_{2,54}=8.97$   $p<0.001$ ). Those who were exposed to the pictorial plus text condition reported significantly higher levels of fear arousal than those exposed to the text-only condition and the control condition. There was no significant difference in fear arousal between those in the text-only or control conditions. These results show that the pictorial plus text warning is the more effective in increasing perceptions of health risk and heightening fear of alcohol than the text-only condition and when there was no warning.

Jongenelis et al. (2018) found warning statements significantly increased the extent participants believed in alcohol as a risk factor for various chronic diseases (diabetes, cancer, heart disease and mental illness). The study measured beliefs pre- and post-exposure to a warning statement in a simulation, and only included participants who were considered at risk for long term harm from alcohol. Participants were exposed to a single warning statement five times from five different sources (e.g. billboard, on TV, on alcohol) in three simulated on-line locations (doctor office, at home, at a bus stop).

The study found the largest increases in the extent of belief in alcohol as a risk factor for the particular chronic disease that aligned with the warning. However there was a more general effect of increasing the extent of belief in alcohol as a risk factor for the other diseases suggesting a halo type effect occurring. Notably the change in the extent in the belief in alcohol as a risk factor for liver damage between pre- and post-exposure to the warning was not significant. This was attributed to the high baseline level for the belief in alcohol being a risk factor for liver damage.

In a small study of Italian university students, Annunziata, Vecchio, and Mariani (2017) identified three clusters of young students based on their responses to the perceived utility and degree of attention to warnings. Warnings that were focussed on drink driving and not to take drink while taking medicine were perceived as having more utility than longer term health risks including impacts on fetal health and brain health. The study highlights the need for warning messages to be targeted to particular groups, rather than relying on generic messages.

Krischler and Glock (2015) undertook a small study in Germany and Luxembourg (n=122) (tested warning labels posed as questions (e.g. Do you really want alcohol to help you loosen your inhibitions?), and as statements (e.g. Yes, alcohol helps you loosen your inhibitions) and a control with no warning on outcome expectancies (both positive and negative) of drinking alcohol among young people. The warning included the question/statement and a photograph of the expectancy (e.g. vomiting in a toilet for the inhibition warnings). They found a significant increase in negative outcome expectancies among those who were allocated to the question group. However, there were significant decreases in positive outcome expectancies, and the statement condition did not significantly impact either positive or negative expectancies.

In a multi-country correlational study that took advantage of the existence of different alcohol harm reduction policies across the European Union, Boluarte, Mossialos, and Rudisill (2011) looked at the impact of policies on risk perceptions of alcohol among youth. Using existing EU survey data on young people and drugs, they found that of eight policies included, only the presence of blood alcohol limits and requiring warnings on alcohol containers/advertisements were predictive of the level of risk perceptions in youth. The study found that requiring warnings on containers or advertisements almost doubled the probability of individuals indicating a high risk perception towards alcohol compared to where no warnings were required.

Wilkinson et al. (2009) concluded that the impact of warning messages on judgements was equivocal highlighting results that both increased risk perceptions in some populations, and others highlighting decreases. The studies identified in this update showed that warnings can influence judgements participants have about the products. In particular, combinations of graphic warnings with text enhance risk perceptions of products over risk perceptions from text only warnings and those without warnings at all. Multiple exposures to the same warning across different situations can lead to stronger beliefs in alcohol as a risk factor in some chronic illnesses. The size of warnings also appeared to impact product evaluations such that larger warnings are more likely to reduce product-based evaluations. However there

appears to be a ceiling effect above which further reductions in product evaluations are not apparent.

When considering warning message believability, readability and relevance, some types of warnings are more effective than others. Positive framed warnings were rated more positively than those that used fear appeals and those that used numerical evidence. Language such as 'increases risk' was also considered more believable than language like 'can cause'.

## Behaviour

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The fifth dimension of effectiveness identified by Argo and Main (2004) was behavioural compliance. In the context of pregnancy warning labels, the aim for pregnant women and those seeking to become pregnant is to follow current advice not to drink alcohol while they are pregnant. While abstinence is the advice, reducing alcohol consumption or shifting to lower alcohol drink (while maintaining levels of consumption) are also positive behavioural outcomes on the way to cessation. This section summarises the studies that report behavioural changes that arise from warning labels.

Several types of behaviours were reported in the literature reviewed. These include changes in alcohol consumption (reduction in amount consumed, changes in type of alcohol consumed, stopping the consumption of alcohol), discussions with others about the risks associated with alcohol consumption, interventions by third parties acting on warning information, and seeking further information on risks.

In their survey of New Zealanders, Rout and Hannan (2016) reported that the standard pictogram prompted 70% of young women to consider the risks of drinking alcohol while pregnant, 68% considered the pictogram encouraged them not to drink while pregnant and 37% to talk with a friend or family member about the risks of drinking alcohol while pregnant.

Forty-one percent of those who recalled one of the DrinkWise warnings reported that they 'did something different' as a result GALKAL (n.d.). The majority of these reported they 'shared information with other' (20%) followed by 'reduced alcohol intake' (16%) and then changed type of alcohol (2%). One percent reported they had 'stopped drinking alcohol' as a result of seeing the DrinkWise messaging and pictogram.

The survey by Quantum Market Research (2019) for DrinkWise reported that 26% of Australians have taken some action as a consequence of seeing one of the DrinkWise warnings. Ten percent reported talking to others about the information, 6% stopped drinking alcohol, 5% reduced alcohol consumption, and 2% reported they changed the type of alcohol drunk<sup>17</sup>. Among women aged 18-44 years, 28% reported actions comprising: talking to others – 11%, stopped drinking alcohol – 10%, reduced alcohol intake – 4%, and no women (18-44) reported changing types of alcohol<sup>18</sup>. Among women who were pregnant, breastfeeding or planning a pregnancy, 37% reported changing behaviour as a result of seeing one of the DrinkWise warnings. These were: stopped drinking alcohol – 12%, reduced alcohol consumption – 11%, talking with others – 9%, changed type of alcohol – 4%<sup>19</sup>.

Coomber et al. (2015) reported use of the DrinkWise website in response to awareness of the 'Get the facts' logo and web address. While none of the participants recalled the logo unprompted, 25.3% of participants recognised the logo once prompted. Approximately 5.9% of the participants reported visiting the website in response to seeing the logo. Those who were aware of the logo were more than 7-times more likely to visit the website than those who did not (OR 7.25;  $p < 0.001$ ), while females were significantly less likely to visit the website than males (OR 0.23;  $p 0.004$ ). More frequent binge drinkers (OR 1.56;  $p 0.022$ ), those who consumed directly from the can or bottle (OR 3.5  $p 0.032$ ), and those who

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<sup>17</sup> 2% were coded as doing something 'other'.

<sup>18</sup> 2% were coded as doing something 'other'

<sup>19</sup> 1% were coded as doing something 'other'.

supported health warning labels (OR 4.27; p 0.038) were all more likely to visit the website than those who did not.

Jarvis and Pettigrew (2013) used a discrete choice experiment to explore the contribution a text warning made to consumption decisions for pre-mixed drinks. The experiment manipulated three attributes (brand, alcohol content, warning text) with four levels in each attribute. The warnings chosen were all text based and related to brain health and driving. The participants were presented with the scenario of heading out to a social occasion with friends and asked to select one of four possible pre-mixed drinks. Each participant completed the task 16 times. The attributes and choice task context were identified through an initial qualitative phase as being relevant to the study population of young Australian adults (18-25 years).

Jarvis and Pettigrew (2013) reported that brand gave the highest level of utility for participants choices, followed by alcohol content and then the warning, with all attributes being significant in influencing choice. Two of the warning levels were significant (a negative framed message about brain damage had negative utility, while a drink driving message had positive utility). The sample was not homogenous in how the attributes impacted their choices and subsequent latent class modelling revealed five classes of participants. The analysis indicated that these different classes respond differently to warning messages. They found that a negative framed message had a negative impact on choice for several of the classes identified, and a positive framed message had a positive impact for one of the classes. This suggests that for some people a positive framed message may increase the probability of choosing that product. The importance of this research is that the choice experiment has been more reflective of purchase situations than other self-report approaches to data collection.

Miller, Ramsey, Baratiny, and Olver (2016) used a survey of Australian adults to explore the response to four cancer warnings across a range of possible behaviours (drink less often, encourage friends to drink less often, discuss risks, discuss risks with family/friends, educate children about risk). About 50% or less of the participants agreed that the warning labels would influence their drinking behaviour, but larger proportions of participants agreed the warnings would prompt them to educate their children about cancer risks associated with alcohol. There were higher levels of agreement with specific behavioural intents for warnings that were related to specific cancers than a more general cancer warning. Miller et al. (2016) found that females, those who read labels, and those who reassess behaviour on reading warnings were more likely to agree they would prompt discussions, drink less and educate children, than those who were male, who didn't read labels, and who wouldn't reassess behaviour after reading warnings. Miller et al. (2016) concluded that although warning labels may raise awareness and prompt discussions, they are more limited in impacting drinking behaviour.

Pettigrew et al. (2016) explored responses to warning statements across situations (described above). The study measured participants' intention to reduce alcohol consumption; the extent to which participants' thought they actually would reduce alcohol consumption, and participants' intention to consume five or more drinks in a single sitting within the next two weeks. These measures were taken before exposure to the warning and again after exposure to the warning. Participants were significantly more likely to report a perceived need to reduce alcohol consumption and an intention to do so after observing the warning statement than they were prior to their exposure of the warning statements. This was the case for all warning statements, and they were all equally effective. Participants who found the statement more believable and more personally relevant reported larger pre-to post-exposure change in their intentions.

Wigg and Stafford (2016) found significant effects of warning conditions on the behavioural intentions they measured: significantly increased intention to reduce alcohol consumption ( $F_{2,54}=3.48$   $p=0.038$ ); and increased intention to quit alcohol consumption ( $F_{2,54} = 3.93$   $p=0.025$ ). Participants exposed to the pictorial warning reported significantly higher scores on the intention to reduce alcohol consumption and intention to quit alcohol consumption scales. The difference between the text-only warning and the control were not significant, nor was the difference between the text-only and the pictorial warning.

Jongenelis et al. (2018) (described above) found that warning statements significantly decreased participants intention to consume alcohol following exposure to a warning stating that alcohol increases your risk of one of three chronic diseases (diabetes, cancer, and mental illness). Greatest change was observed for the warning statement '*Alcohol increases your risk of diabetes*'. There were no significant effects for warnings about heart disease and liver damage. This lack of effect was attributed to the higher baseline knowledge of the relationship between alcohol consumption and these conditions.

Annunziata, Agnoli, Vecchio, Charters, and Mariani (2019) used a discrete choice experiment to simulate the selection of wine from three options with varying formats of warning labels. The attributes tested were the message, the position of the warning, the size of the warning and the level of alcohol of the wine. The task scenario was to select a bottle of wine to take to dinner with friends. Both front and back labels were shown and the brand, varietal and cost were held constant. The study found that Generation Y (born between 1978-2000) wine drinkers preferred a wine without a warning with the majority of the choice being driven by negative influence of a long-term health outcome and positive influence of the absence of the warning label. The decision was effected to a lesser extent but still negatively by a front label warning and then a large warning. The study concluded that small, back label warning for long-term health effects, or no warning labels are preferred by the participants. The study highlights the capacity for warnings to impact behaviour. However, other product and consumer attributes may ultimately influence wine choice.

Behaviour was also discussed in the qualitative studies identified. Coomber, Hayley, Giorgi, & Miller (2017) whose focus group participants were exposed to pictorial and graphic warnings reported that the warnings would not make them stop drinking, stating it was an activity they did not want to give up. However, participants reported the warnings would make them 'think twice' about drinking too much or 'slow down' or reduce their consumption. They reported that conversations about the warnings were more likely to be 'banter' and 'light-hearted' than serious conversations. Women were less likely to report this approach, but discussion would still be minimal. In this study only two warnings (one graphic and one pictorial) were focussed on pregnancy and the rest focussed on other health consequences of alcohol consumption (cancer, death, brain damage, injury).

In Dossou et al. (2017) study on the mandated French pictogram, the majority of participants reported that the warnings were not effective in changing behaviour. Participants reported overexposure to warnings generally and the lack of noticeability (size, location, marketing environment) as reasons why they considered the pictogram ineffective.

Using text warnings available on international products, Jones and Gregory (2010) reported that in their focus groups these warnings were unlikely to influence participants in reducing alcohol consumption. Participants highlighted the warnings were not relevant to their personal situations, or that they contained information they already knew (noted, though not universally accepted in the case of pregnancy warning).

In their literature review Wilkinson et al. (2009) draw attention to the following behaviours related to the introduction of mandatory warning labels in the US:

- reported increase in the likelihood of respondents having a conversation about the risks of alcohol (Kaskutas & Greenfield, 1992)
- prompted pregnant women to discuss the topic (Kaskutas, Greenfield, Lee, & Cote, 1998)
- the greater number of warning types that respondents were exposed to the more likely they were to discuss alcohol associated risks (Kaskutas & Graves, 1994).

In their meta-analysis Argo and Main (2004) found that warnings moderately influence behavioural compliance. They found that familiarity moderated behavioural compliance the more familiar an individual was with the product the higher the probability of behavioural compliance<sup>20</sup>.

The literature on the effectiveness of pregnancy warning labels on behaviour is limited. The experimental studies reviewed indicated that warning labels have an impact on self-reported intentions to reduce alcohol consumption, and behaviours seeking further information. However, there were no high quality studies identified that demonstrated a decrease in alcohol consumption. Stockwell notes that both alcohol industry researchers and independent researchers 'agree fairly closely that impacts on drinking behaviour are either non-existent or minimal'. Wilkinson et al. (2009) highlight the deficiencies in the implementation of most warning labels such that they are unlikely to be noticed.

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<sup>20</sup> They also found that the higher the cost of complying with the warning, in terms of effort and time, the less likely that consumers would comply with the warning. However this is in primarily in the context of protective and safety equipment and has limited relevance to alcohol warning labels.

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## Appendix A: Method

The literature for this review was initially identified through a search of online electronic databases. FSANZ has access to, and searched the following databases:

- SocINDEX with full text
- EconLit with Full Text
- Food Science Source
- Food Science and Technology Abstracts
- Medline with full text

The search string used across all databases was : AB ( warning OR advisory OR caution OR label ) AND AB (alcohol)

The search was limited to studies that were:

- from peer-reviewed sources
- in English language
- published since November 2008

The search was conducted on 1 August 2019 and delivered 339 papers. Duplicates were identified using EppiReveiwier software and removed. Hand searching of reference lists from studies identified additional studies. The studies were first screened by title and abstract leaving 48 studies that were obtained and their full text reviewed. Sixteen studies were excluded during full text review leaving 32 studies empirical peer-reviewed studies (Table D).

Nine additional studies that reported on systematic or narrative reviews were included in this review.

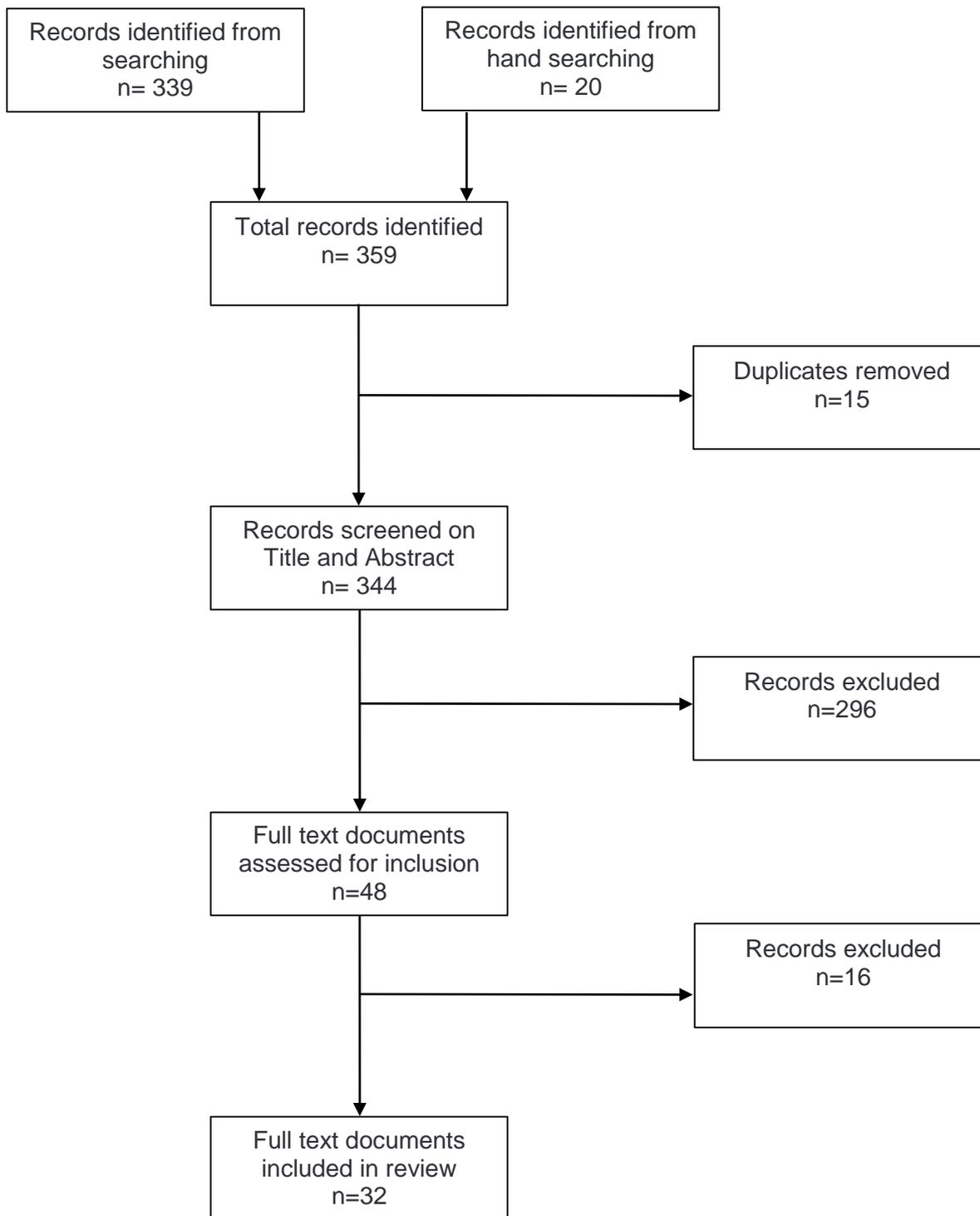
There also exists a set of studies and reports that are not published in the peer review literature. These include reports commissioned by government agencies (e.g. (Rout & Hannan, 2016; Siggins Miller, 2017), and both public health and industry advocacy groups (Hall & Partners, 2018; GALKAL, n.d.; Quantum Market Research, 2019). It is acknowledged that some of this grey literature may be lacking the methodological rigour and reporting standards of the peer-reviewed literature. However this literature also represents some of the few studies undertaken with Australian and/or New Zealand populations exploring alcohol warning labels in the context of pregnancy. These studies have also been included in the literature review. Five studies from the grey literature were included in this review.

In total 32 empirical peer-reviewed studies (Table A), 9 studies reporting on systematic or narrative reviews (Table B) and 5 studies from the grey literature (Table C) were included in this summary of evidence.

The quality of each study was assessed against the following criteria to deliver a rating of low, medium or high.

- Theory/Aims/Justification: the study is appropriately justified with clear aims; the study is located in the body of existing theory
- Population/sampling: population being sampled is relevant to the aims of the study; sampling techniques appropriate and clearly detailed
- Methods: methods used are appropriate to the sample and the aims of the study; measures, tools, questionnaires and guides used described

- Analysis: analysis is appropriate to the data collected, details of statistical testing included, qualitative analysis explained, coding frames explained
- Reporting: results reported with appropriate discussion, limitations identified and discussed
- Peer review: studies that were not peer-reviewed were penalised
- Conflict of interests: studies that were commissioned by NGO's with identifiable activity in lobbying regarding alcohol and warning labels were penalised



**Figure A1: Literature search flowchart**

**Table A1: Peer-reviewed empirical studies included in the review**

Authors	Country, study population and, sampling	Study aim	Design	Key findings	Study quality
Al-hamdani & Smith (2015)	Canada University/hospital adult n=92	Test the impact of warning types and size on consumer and product-based evaluations across beer, wine and spirits.	Quantitative – between subjects  4 levels of warnings: none, text only, combined text and image, combined text and image on plain packaged.  Use real life stimuli cancer warning  Text only was 25% of front package area, combined text and graphic was 50%.	Combined warning and combined warning on plain packaged significantly reduced product and consumer evaluations for all alcohol types except consumer based evaluation on beer.  Text only warning only had significant reduction in product based reductions for spirits – no other significant effects.	Medium  small sample convenience sample subject to bias
Al-hamdani & Smith (2017b)	Canada adults consumed alcohol in previous 12 months convenience sample n=440	Test the impact of warning types, size and plain packaging on consumer and product-based evaluations across beer, wine and spirits.	Quantitative – between subjects  Warning size: medium (50% of front label); large (75%); extra-large (90%)  Across branded and plain packed stimuli of beer, wine and spirits  Warning was always text and graphic image	No significant main effect with warning size across product, consumer evaluations and product boringness.  Significant interaction with alcohol type for product based evaluation – larger warnings on spirits and wines had lower product based ratings than smaller warnings on wines and spirits. No significant effect for beer.  As no control (i.e. a no warning product) the base is the 50% sized warning. Authors conclude that	Medium  convenience sample; subject to bias

Authors	Country, study population and, sampling	Study aim	Design	Key findings	Study quality
			about alcohol and liver cancer	there is a ceiling effect, after which the gains from increases in size are marginal.	
Annunziata et al (2017)	Italy University students 18-30 years old n=385	Analyse the interest and attitude of Italian university students to health warnings on alcohol and identify segments among consumers.	Quantitative – survey  5 different warnings included (driving, medicine, underage, pregnancy and brain)	Three groups of young consumers with varying degrees of attention to and perceived utility of warning labels. Moderate drinkers view warning labels positively, but less so among riskier drinker.  Higher utility attached to warnings about avoiding drinking if taking medicine and not to drink and drive, with less utility attached to warnings concerned with long terms effects of alcohol such as brain damage and fetal risk.  More emotional impact attached to negative framed warning (wrecked car with fatal message) versus a more generic stylised warning (don't drink and drive and a car logo with strike though).	Medium  small sample, stated preferences for utility and attention – no experimental manipulation.
Annunziata et al (2019)	Italy & France wine consumers Generation Y (born 1978-2000) n=500	Analyse generation Y preferences for and interest in different formats of health warnings.	Quantitative: discrete choice experiment  Attributes in choice set: 1) alcohol content; 2) warning framing; 3)	The warning is the most important element driving utility (61.4%), however it is the presence of the brain warning that negatively influences choice.  Second in contribution to utility (19.3%) is the position of the	Medium  Small sample, obtained sample through social media and word of

Authors	Country, study population and, sampling	Study aim	Design	Key findings	Study quality
			<p>warning size; 4) warning location.</p> <p>Warning framing levels: 1) long-term effect (brain damage); 2) short term effect (car crash); 3) no warning.</p> <p>Choice task buying a bottle of wine for dinner with friends. Selecting 1 bottle from a choice of three all costing the same price, all same varietal, both front and back labels of the three bottles shown. Participants to complete 4 choices.</p>	<p>warning where being placed on the front of the label negatively influences choice.</p> <p>Then message with a preference against negatively framed and finally size, with a preference against large warnings. (When analysed by country this second and third swap for Italian sample)</p> <p>Preference for no logo warning option, short term warning and a small logo placed on the back of the product.</p>	<p>mouth potential for bias.</p>
<p>Boluarte et al (2011)</p>	<p>EU-27 Youth 15-24 n=12312</p>	<p>Explore the association between state level policies in the EY-27 and risk perceptions of youth</p>	<p>Quantitative – modelling</p> <p>Secondary data analysis</p>	<p>Significant association between increased alcohol risk perception and two policies: 1) blood alcohol limit for driving; and 2) health warnings on advertisements and/or alcoholic beverage containers</p>	<p>Medium</p>
<p>Coomber et al (2018)</p>	<p>Australia Young adult drinkers 18-25 n=40 in 6 focus groups</p>	<p>Understand young adult drinkers’ perceptions of current voluntary Australian</p>	<p>Qualitative – focus group</p>	<p>Low salience of current voluntary warnings, small size and location on back panel suggest not serious about warning consumers.</p>	<p>Medium</p>

Authors	Country, study population and, sampling	Study aim	Design	Key findings	Study quality
		alcohol product warnings.		Current warnings unlikely to influence consumption behaviour, nor encourage them to seek further information from the DrinkWise website, nor encourage discussions with peers or colleagues	
Coomber et al (2017)	Australia University students 18-15 years old n=26	Explore young adult drinkers perceptions of pictorial and graphic warnings	Qualitative – focus group  Using stimuli (pictorial: simplified drawn; graphic: colour photographs) to assess perceptions of emotional, cognitive and intended behavioural responses	Pictorial and graphic warnings stand out to young adult drinkers and convey new information. They elicit a negative emotional response, and may be prompted to reduce the amount they drank, but unlikely to deter them from risky drinking.  Large size and front of pack placement increased noticeability, though there was a preference for back of pack position of warnings.  Images increase salience. Photos and images led to quick understanding of message without need to read warning text. Photos elicited stronger response than pictorial.  Level of unease and discomfort with some warnings – negative emotional response to some graphic warnings Some talk of avoidance through using a glass or	High

Authors	Country, study population and, sampling	Study aim	Design	Key findings	Study quality
				<p>turning bottle around to avoid looking at the image</p> <p>Not stop them drinking but make them think about level of drinking and encourage discussion about drinking with others</p>	
Coomber et al (2017)	Australia Adult drinkers 18-45 n=1061	Investigate awareness of short-term and long-term consequences of alcohol use.	Quantitative – cross sectional survey  Online survey	<p>52.7% aware of warning labels.</p> <p>Participants aware of any alcohol warning label were significantly more likely than participants not aware of warning labels to respond <i>definitely true</i> to harm to unborn babies and cirrhosis of the liver</p>	Medium
Coomber et al (2015)	Australia Adult 18-45 n=561	Evaluate the awareness of the 'Get the Facts' logo and alcohol warning labels, and evaluate use of the website	Quantitative – cross sectional survey  Online survey	<p>Significant predictors of recalling voluntary warning message were being younger, binge drinker, drink from can/bottle, support warning labels Sex, education, drink type were not significant predictors</p> <p>similar patterns for other two warnings (is drinking harming yourself or others, kids and alcohol don't mix)</p>	Medium
Critchlow et al (2019)	UK youth and young adult 11-19 years old n=3399	Assess awareness and recall of alcohol health warning information among	Quantitative – cross-sectional survey	13% recalled pregnancy health message which was the second most recalled message (Highest was drink responsibly)	Moderate

Authors	Country, study population and, sampling	Study aim	Design	Key findings	Study quality
		youth and young adults	Online survey, weighted to national rep sample	Awareness was significantly higher for those who were of legal drink age, had ever had alcohol, current drinker, high risk drinkers – however some difference may be driven by sociodemographic differences in prevalence of alcohol consumption.	Generalisability limited given youth sample.
Dossou et al (2017)	France Youth 15-29 years old n=26	Assess effectiveness of warning labels across recall, noticeability, credibility, comprehension, responsiveness, impact on behaviour and contrast standard and more embellished packaging.	Qualitative - in-depth interview  Existing products on market with pictogram and print advertisements with mandatory French statement.  Standard and special (celebratory) examples.	Warnings suffered lack of visibility and noticeability due to size and location limitations.  Pictogram generally understood but lacked explicitness.  Source of warning – industry or government a potential credibility risk.  Not likely to encourage behaviour change	Medium  Brief description of methodology and analysis – double coded transcripts.
Dumas et al (2018)	France pregnant or post-partum women n=3603	Assess awareness of the warning and risk perceptions about pregnant and postpartum women	Quantitative – cross sectional	66.1% of women noticed warning label  Drinkers and more educated more likely to be aware of warning.	Medium
Jarvis & Pettigrew (2013)	Australia Young drinkers	Assess four warning statements for influence on choice behaviour relative to	Quantitative – choice experiment	Brand had the brand highest utility, followed by alcohol content then warning in choice.	Medium  Youth sample – generalisability

Authors	Country, study population and, sampling	Study aim	Design	Key findings	Study quality
	18-25 n=300	brand and alcohol content among a youth sample	Qualitative – focus groups  Used realistic brands of RTD beverages varying Brand, alcohol level and warning statement  Warning statement was text, and covered brain health and drink driving. These were identified as most salient in the initial focus groups to test.	5 class latent class model statistically significant  Small influence on some classes - negatively framed messages had higher impact on higher consumers (at risk consumers) positively framed message on driving lead to a positive impact (i.e. increasing utility)	limited to specific populations
Jones & Gregory (2010)	Australia University students 18+ years n=44 in 6 focus groups	Examine the attitudes and opinions of students to warning messages on alcohol and the likelihood of impacts on behaviours	Qualitative – focus groups  Used international products with text based warning statements – including pregnancy warnings.	Some participants had seen warnings before, but thought likely to be ignored.  Not considered effective, not relevant to demographic, or perceived to be targeted to other groups  Limitations in believability	Medium
Jongenelis et al (2018)	Australia Drinkers at long term risk from alcohol 18-65 years n=365	Examine the risk beliefs and impacts of warning statements on those risk beliefs of drinkers who drink at	Quantitative – within subjects experiment  Online survey – simulation of trip from doctor to home via bus stop or vice versa –	Warning labels led to significant increase in the extent to which participants considered alcohol was a risk factor in a related risk (e.g. diabetes, cancer, heart disease and mental illness). There was no significant increase for the liver	Medium  No control group with no warning – but within subjects design offsets this.

Authors	Country, study population and, sampling	Study aim	Design	Key findings	Study quality
		long-term risk levels term.	warnings displayed 5 times from 5 different sources in three scenes.  5 warnings tested across various outcomes (mental health, cancer, diabetes liver damage, heart disease)	warning though already the highest and about the level others reached following exposure. No moderating effects of age, sex, education or SES.  Similar results occurred for drinking intention where the warning reduce intention to drink significantly for all warnings except liver and heart disease warnings. No moderating effects of age, sex, education or SES.	
Kersbergen & Field (2017)	UK University staff and students Study 1 n=60 Study 2 n=120	To explore the attention that warning labels receive.	Quantitative – cross-sectional/eye tracking Quantitative – between subjects design  Study 1 was a cross-sectional eye ting study that explore the attention to warnings  Study 2 was an between subjects experiment to explore the impact of a motivation intervention on attention to warning labels.	Spent less time looking at health information than brand information, but noted roughly proportional to the sizes of areas.  Alcohol warning labels were attended to when they were larger in size and less complex.  Manipulation that encouraged participants to focus attention on warning labels did not affect their drinking intentions.	Medium  Small sample with potential for bias.

Authors	Country, study population and, sampling	Study aim	Design	Key findings	Study quality
Krischler & Glock (2015)	Luxemburg & Germany university students and their colleagues n=122	Investigate the effectiveness of warning labels tailored toward young adults' positive outcome expectancies.	Quantitative - between subjects' design  3X2 mixed design with warning labels (questions vs statements vs control) as a between subjects factor and expectancy category (positive vs negative) as within subjects factor  3 outcome expectancies presented as warnings with a photographic image: loosen inhibitions (being sick in the toilet); meet new people (police officer); tests your limits (car crash)  Presented bottles with the warnings across three bottle of wine and three of beer	Warnings as questions were able to increase individual negative-alcohol related expectancies  No impact on individual positive expectancies or general expectancies and drinking behaviour  Statement wording warnings had no significant impact on expectancies above control.  Authors suggest that the pictures may attract attention and reduce impact of text.	Medium  Small sample with potential for bias
Laughery et al (1993)	US Adults Study 1 n=75 Study 2 n=72 Study 3 n=24	Assess the noticeability of warning labels on alcoholic beverages, and testing the influence of various design	Quantitative  Study 1 used a set of existing warnings on alcohol that were characterised by their design features and	When container labels were filled with non-warning information locating the warning took longer  Pictorials, signal icons and colour (red) can significantly improve	Medium  Sample size limit generalisations.

Authors	Country, study population and, sampling	Study aim	Design	Key findings	Study quality
		features on noticeability.	<p>recorded the time taken for the participants to correctly identify the warning.</p> <p>Study2 manipulated the presence and absence of 4 design features (colour, pictorial, signal icon and borders) to test the noticeability of the warning</p> <p>Study 3 used eye-tracking to measure time taken to identify warning location.</p>	<p>noticeability. Borders may not have much effect.</p> <p>Presence of a pictorial was the only design feature that significantly lowered response times when tested by eye tracking.</p>	
Miller et al (2016)	Australia Adults n=1547	To test 4 alcohol warning labels about cancer on a variety of impacts (awareness, conversations, drink less often etc)	<p>Quantitative – cross sectional survey</p> <p>Online survey</p>	<p>Females, reading labels and reassessing behaviour based on general product warnings independently predicted agreement that warnings would raise awareness and prompt conversations about cancer risk associated with alcohol consumption, prompt to drink less and prompt to educate children about alcohol-cancer link.</p> <p>Cancer-related warning labels generally perceived as neutral to positive.</p>	Medium

Authors	Country, study population and, sampling	Study aim	Design	Key findings	Study quality
				More detailed messages were received more positively.	
Monk et al (2017)	UK University students n=22	Examine attention levels to different types of warnings using eye tracking	Quantitative – between subjects  text and graphic images on white card as stimuli	Participants spent longer looking at graphical images than the text  This was regardless of pictorial content - explicit or not explicit  Pictorial content may cue positive expectancies – caution advised in using graphic imagery	Medium  Very small sample, exploratory only
Parackal et al. (2010)	New Zealand teenage and non-pregnant women 16-40 years n=1129	Report the preference of warnings on alcohol as a source of information on risks of alcohol consumption while pregnant.	Quantitative – cross-sectional survey  WATI survey using RDD	Majority of women gave a high rating for preference of warning label as source of information (High 53%; medium 17%; low 30%).  Maori, Pacific and Asian women were more likely to prefer warnings as a source of information than European	High
Pettigrew et al (2016)	Australia Adults consumed alcohol on two days in preceding week 18-65 n=1680	Test the effectiveness of cancer warning statements delivered through a simulation of various situations	Quantitative – within subjects experiment  Participants were exposed to 1 of 6 possible cancer warning statements 3 were general cancer statements and 3 were	Participants were significantly more likely to report a perceived need to reduce alcohol consumption and intention to do so after exposure to the warning.  Generally specific cancer warnings had more enhanced attitudinal outcomes than general cancer warnings.	Medium

Authors	Country, study population and, sampling	Study aim	Design	Key findings	Study quality
			<p>specific cancer statements.</p> <p>Warnings were presented on alcohol beverages containers as well as advertisements, from a child via a health class in school, billboard.</p> <p>In total they saw the same warning in five different situations. Pre and post exposure intentions to drink were recorded.</p>	<p>Participants who found the statement more believable and more personally relevant, reported greater pre – to post-exposure changes.</p> <p>Warning effectiveness was not significantly influenced by participant characteristics.</p>	
Pettigrew et al (2014)	Australia Adult drinkers 18-65 years n=48 in 6 focus groups n=2168 (R)	Develop and test a series of cancer warning statements.	<p>Mixed methods – focus group followed by between subjects survey</p> <p>Developed 12 cancer warning statements varying by message frame (positive/negative), form of cancer (specific/general), fear appeal (fear/no fear) and use of numerical information (yes/no).</p>	<p>Females, younger respondents and those with higher education generally found statements to be more believable, convincing and relevant.</p> <p>Positive framed messages more believable than those with fear appeals and numerical evidence. Similar trend for convincingness and relevance – but some differences by sex</p> <p>Use of 'increase risk' type statements found more believable</p>	High

Authors	Country, study population and, sampling	Study aim	Design	Key findings	Study quality
				<p>and convincing than 'can cause' among females</p> <p>More general statements were more believable, convincing and personally relevant than specific statements</p>	
Pham et al (2018)	<p>Australia Adults Study 1 n=559 Convenience sample through advertising and snowballing Study 2 n=87 university students</p>	<p>Assess the impact of changes to size and colour of standard pictogram on attention</p>	<p>Quantitative – between groups experiment Quantitative – eye-tracking</p> <p>Study 1 used an online survey to allocate participants to 1 of four experimental groups 1) control, 2) increased pictogram by 50%; 3) change pictogram from black/grey to black and red and 4) increased size and colour manipulations.</p> <p>Study 2 used eye-tracking to record the time and fixations of participants on the same stimuli as in study 1</p>	<p>Attention was highest for colour and size combination, then size, then colour over control, however effect sizes were small</p> <p>Not all participants looked at warning logo - 65.5% of sample 59% looked at control and 81% looked at increased size and colour warning (a 37% increase with colour and size) However no significant differences in number of fixations, time to first fixation, nor fixation duration average</p>	<p>Medium</p> <p>Small sample size</p>

Authors	Country, study population and, sampling	Study aim	Design	Key findings	Study quality
Sillero-Rejon et al (2018)	UK Adult consumed excess alcohol (UK guidelines) in preceding week recruited from university (staff, students and public) 18+ n=128	Study used eye tracking to measure visual attention, with a between-subjects factor of self-affirmation and within subject factor of warning severity to assess defensive and positive reactions to pictorial health warnings.	Quantitative – experiment  On-line large cans of beer - 6 moderately-severe and 6 highly severe occupying bottom 1/3rd of front of branded cans	Self-affirmation did not have any effect on degree of attention  No evidence of effect of warning severity on visual attention	Medium  Small sample size
Thomson et al 2012	Australia teenage and adult drinkers Aged 16 and above n=45 in 6 focus groups	Test the response to a range of warning labels.	Qualitative - focus groups  (Note paper also includes cross-sectional survey but not relevant to this review)	Signal word of 'warning' most acceptable while 'government health warning' was criticised as being akin to 'Nanny' state/Big Brother.  Participants generally indicated a preference for new health information in warnings rather than already known information.  Graphic images important to increase attention participants linked to experience with tobacco warnings.  Simple, clear, unambiguous language in statements was best understood by the greatest breadth of participants. Educate and inform not be authoritarian or prescriptive of behaviour. Serious tone was	Medium

Authors	Country, study population and, sampling	Study aim	Design	Key findings	Study quality
				<p>more acceptable than a humorous tone.</p> <p>Messages needed to resonate with relevant population – the pregnancy warnings did not resonate with males and some young women.</p>	
<p>Vallance et al (2018)</p>	<p>Canada Yukon residents (rural/regional population) 19+ years n=45 across 5 focus groups</p>	<p>Explore consumer perception and acceptability of enhanced alcohol labels.</p>	<p>Qualitative – focus group</p> <p>Used pictorial stimuli of enhanced alcohol labels that included warning message as well as information on low risk drinking guidelines.</p>	<p>Strong support for enhanced alcohol labelling</p> <p>Participants though warning about increased risk of cancer were important – considered new information for some participants and linked to a ‘right to know’.</p> <p>Pregnancy pictogram could be enhanced with additional text about the risk of FASD. Some noted it could aid in discussion with friends and family.</p>	<p>Medium</p>
<p>Wogalter et al (1992)</p>	<p>US Youth and young adults (high school and college) n=90</p>	<p>Test impact of different signal words on hazard perceptions</p>	<p>Quantitative – between subjects</p> <p>Five signal words NOTE, CAUTION, WARNING, DANGER, LETHAL were used on mock products with two controls: 1) warning and no signal word 2) no warning and no</p>	<p>Significant main effect for signal word where all signal words except NOTE were associated with significantly higher hazard perceptions scores.</p>	<p>Medium</p> <p>Small sample with potential for bias.</p>

Authors	Country, study population and, sampling	Study aim	Design	Key findings	Study quality
			signal word. Additional test conditions combined an icon (exclamation mark in triangle) next to DANGER and LETHAL		
Wogalter et al (1999)	US University students Study 1 n=66 Study 2 n=57	Testing the effects of presence of signal words and source denoting prefixes on credibility and behavioural compliance	Quantitative – between groups  Study 1 tested 6 conditions 1) control no signal word, 2) WARNING, 3) GOVERNMENT WARNING, 4) US GOVERNMENT WARNING 5) FEDERAL GOVERNMENT WARNING 6) US FEDAERAL GOVERNMENT WARNING  Study 2 tested three groups of sources: specific regulatory agencies (US SURGEON GENERAL’s WARNING), professional	Higher ratings were produced with the signal words presence than its absence and adding more specificity and length.  Inclusion of specific sources produced higher ratings compared to signal word alone.	Medium  Small sample with potential for bias

Authors	Country, study population and, sampling	Study aim	Design	Key findings	Study quality
			organisations (e.g. AMERICAN MEDICAL ASSOCIATION WARNING), general (e.g. HEALTH WARNING)		
Wogalter & Rashid (1998)	US University staff and students n=1200+	Test effectiveness of different borders on the attention a warning receives in a field setting	Quantitative – observational study  Warning with different borders (red thick, yellow/black alternating stripes, thin red, thin black) and controls of warning without borders and no warning at all.	Thick red and thick yellow/black borders were noticed more often and for longer than the control of no border or thin borders.	Low  Abstract only.
Wigg & Stafford (2016)	UK University students 18-35 years old n=60	Test effectiveness of alcohol warning types on risk perceptions and behavioural intentions	Quantitative – between subjects experiment  Pictorial, text-only and no warning on wine and beer bottles.	Pictorial warnings were associated with significantly higher risk perceptions of alcohol and fear arousal compared to control and text-only warnings.  Pictorial warnings were associated with significantly more favourable intention to reduce and quit alcohol consumption.	Medium  Small sample with potential for bias
Zahra et al (2015)	UK University students	Investigate the cognitive processing of emotive pictorial	Quantitative – between subjects	No difference in reasoning accuracy between positive and negative warning messages.	Medium

Authors	Country, study population and, sampling	Study aim	Design	Key findings	Study quality
	Study 1 n=153 Study 2 n=58	warnings intended to curb alcohol misuse	Study 1 used Wasson section tasks to test effectiveness of negatively valenced graphic warnings.  Study 2 using visual conditionals (if ...then..) based on real word warnings to explore reasoning	Accuracy was enhanced when consequences of alcohol were considered from negative framed warnings.	Small sample with potential for bias

**Table A2: Systematic and narrative reviews included in the review**

<b>Authors</b>	<b>Review type</b>	<b>Content</b>
Argo & Main (2004)	Systematic review	Quantitative studies that reported effect sizes for attention, reading and comprehension, recall, judgement or behavioural compliance across consumer products.
Hassan & Shiu (2018)	Systematic review	Empirical quantitative and qualitative studies on alcohol warning effectiveness
Laughery & Wogalter (2016)	Narrative review	Review of warning studies across consumer products.
Scholes-Balog et al (2012)	Systematic review	Quantitative and qualitative studies on impacts of alcohol warnings with adolescent sample (11-18)
Stockwell (2006)	Narrative review	Quantitative studies on the impact of alcohol warning labels on attitudes and behaviour.
Wogalter & Leonard (1999)	Narrative review	Quantitative studies on warning attention capture and maintenance on consumer products and work place situations
Wogalter (2006)	Narrative review	Detailing a theoretical model and how empirical studies link across consumer product warnings
Wilkinson & Room (2009)	Narrative review	Quantitative and qualitative studies on effectiveness of alcohol warning labelling
Wilkinson et al. (2009)	Narrative review	Quantitative and qualitative studies of on effectiveness of alcohol warning labelling

**Table A3: Grey literature included in the review**

Authors	Country, study population and, sampling	Study aim & Commissioning agency	Design	Key findings	Study quality
GALKAL. (n.d.)	Australia adults 18+ years purchased packaged alcohol in previous 12 months n=301	Measures awareness, understanding and behaviours responding to DrinkWise suite of warnings  Commissioned by DrinkWise Australia	Quantitative: Cross sectional online survey  Stimuli used complete set of DrinkWise warnings	Moderate levels of awareness, high levels of self-reported understanding and some self-reported behaviour change in response to warnings.	Low  Limited detail provided on methodology and sampling. 2+4 slide ppt report.
Hall & Partners. (2018)	Australia adults from Sydney city, suburbs and Newcastle infrequent alcohol consumers screened out  18-45 years n=6-8 in each of 8 focus groups	Investigate consumer understanding and interpretation of the two most commonly used warnings and explore whether there might be potential to enhance effectiveness  Commissioned by Foundation for Alcohol Research and Education.	Qualitative: Focus groups  4 focus groups with women who are pregnant or trying to conceive 2 with female peers 2 with male partners of those trying to conceive  Focus groups were further segmented across age and SES  Used existing warning on products as stimuli as well as new alternative versions of pictograms and warning statements.	Standard pictogram found to be well understood and conveyed message not to drink alcohol while pregnant.  Voluntary warning text seen as ambiguous and weak due to term 'safest'. Reinforces belief that risk from small amounts of alcohol while pregnant is negligible.  Size and location on products of standard pictogram and warning text not attention grabbing due to size.  Other pictograms tested highlighted that: pictogram plus text was more attention grabbing than text alone; red strikethrough seen as universal prohibition symbol and instantly recognisable; size of bump could infer stage of pregnancy; 'harm' is	Medium  No detail on management of moderator and coder bias in data analysis  No coding frame

Authors	Country, study population and, sampling	Study aim & Commissioning agency	Design	Key findings	Study quality
				vague while 'birth defects' was confronting.  Use of personalised language and avoiding definitive statements enhances relevance and credibility.	
Quantum Market Research. (2019)	Australia Adults 18+ female boost sample of 18-44 n=660 (gen pop) n=515 (female boost)	Assess general and target audience awareness and attitudes towards pregnancy labels on alcohol products.  Commissioned by DrinkWise Australia	Quantitative: cross sectional online survey  Stimuli warning with DrinkWise website, pictogram and voluntary warning text.	40% recall in adults (56-59% targets groups) 98% understood message (97-98%) 98% message important and influential 26% took action (28-37%)  Decreasing awareness with age.	Medium  Limited description of methodology and sampling, coding for open ended questions unclear. 3+7 slide ppt report.
Rout & Hannan (2016)	New Zealand Adults booster sample women 18-34 and women with children under 15 n=1,488 (total) n=387 (women 18-34) n=388 (women with children under 15)	Assess the effectiveness of the current warning labels focus on recall, awareness, and reading and comprehension.  Commissioned by Health Promotion Agency	Quantitative: cross sectional online survey  Used standard pictogram, voluntary text and alternate text of 'Don't drink pregnant' as separate stimuli	25% aware of pictogram (30-46% in target populations) 29% aware of voluntary text (36-49%) 19% aware of alternate text (29-20)  22%-62% pictogram prompted various behaviours 38-72% voluntary text prompted various behaviours 23-64% alternative text prompted various behaviours	High  Included discussion of sampling, weighting, quotas used. Coding frames for open ended questions and questionnaire included.
Siggins Miller. (2017)	Australia Adult comprising 6 target groups: 1) pregnant women; 2)	Evaluation of awareness and understanding of	Quantitative cross sectional online survey	38.9% awareness of pictogram among target women 32.5% awareness of text among target women	Medium  Coding frame for open ended

Authors	Country, study population and, sampling	Study aim & Commissioning agency	Design	Key findings	Study quality
Consumer survey in section 4 and Appendix 4	women planning pregnancy; 3) women with child under 18 months; 4) men who is partner of 1, 2 or 3; 5) parent of adult child in 1, 2, or 3; 6) adults over 18 n=5622	warning labels on alcohol  Commissioned by the Australian Department of Health		83.2% understand pictogram as don't drink alcohol when pregnant among target women 1.9% understand pictogram as alcohol causes harm among target women 52.5% understand voluntary statement as don't drink alcohol when pregnant among target women 30.0% understand voluntary statements as alcohol causes harm among target women	questions not provided. Sample boosted by self-enrolment through online banner advertising.

**Table 4: Studies excluded during full text review**

Study	Reason for exclusion	Comment
Al-hamdani (2014)	Commentary	Extended commentary on lessons from tobacco warnings
Al-hamdani and Smith (2017a)	Editorial	Editorial for an edition of <i>Journal of Public Health</i>
Annunziata et al (2016)	Enhanced nutrition label	Primary focus on enhanced nutrition labels on alcohol, limited reference to warnings
Bazzo et al. (2012)	Advertising	Evaluation of an image used in an alcohol and pregnancy advertisement
Brennan et al. (2017)	Off topic	Survey of awareness and attitudes held towards DrinkWise
Brown et al. (2016)	Advertising	Experiment to explore impacts of alcohol promoting and alcohol warning advertising
Cil (2017)	Warning signs	Ecological study on warning signs
Hassan and Shiu (2018b)	Editorial	Editorial for an edition of <i>Alcohol and Alcoholism</i>
Jones et al. (2017)	Off topic	Focus of paper was the interpretation of alcohol industry responsible drinking initiatives
Kukla (2010)	Off topic	Theoretical argument on the ethics and cultural politics of reproductive risk warnings
Martin-Moreno et al. (2013)	Enhanced nutrition label	Primary focus on enhanced nutrition labels on alcohol, limited reference to warnings
O'Brien et al (2018)	Editorial	Response to a commentary
Robertson et al. (2017)	Off topic	Study of negative alcohol related expectancies among a NZ sample
Subbaraman et al. (2018)	Warning signs	Ecological study on warning signs
Stautz and Marteau (2016)	Advertising	On-line experiment on impact of viewing alcohol advertisements
Warren (2015)	Off topic	Historical review of the attitudes toward drinking in pregnancy

