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Effectiveness of numeric energy menu labelling and potential alternative formats and/or content:

An evidence review

Debra Hector PhD MPH

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Prevention Research Collaboration

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1 EXECUTIVE SUMMARY

1.1 Background

This review was conducted between January and March 2016 to inform ongoing implementation of the NSW Fast Choices Menu Labelling legislation. This legislation was passed by NSW Parliament in November 2010 requiring certain food outlets particularly in the Quick Service Restaurant (QSR) setting to display nutrition information in the form of numeric kilojoule (kJ) amounts for food and beverage items at the point-of-sale, on menu boards. Requirements came into effect on 1 February 2011, with a 12-month period for QSRs to comply before 1 February 2012.

The primary audience for this review is the Working Group of the Fast Choices Labelling Reference Group within NSW. Research questions and primary outcomes, inclusion and exclusion criteria were determined by the author of this review in consultation with the Working Group. The findings of this review will be triangulated with those from a broad stakeholder consultation (online survey) to inform potential future steps in menu labelling.

1.2 Methods

This review was a comprehensive, rapid review. It was highly inclusive in terms of study quality and study type and setting in order to fully inform this very specific policy question. Quality of individual studies (internal validity) or reviews was not explicitly graded however specific consideration was given to the external validity (generalisability) of the study setting, study design and findings. Appropriate search terms and databases were used, in addition to snowballing methods, to identify the full gamut of peer-reviewed relevant literature. A limited search of the grey literature was also undertaken. Studies were identified during the period January 16th to March 31st 2016. Studies published prior to 1990 were not included.

1.3 Findings

1.3.1 Description of the evidence base

Four systematic reviews and meta-analyses were identified which were published 2012-2015. Inclusions and exclusion criteria of these four reviews, which were all focused on the effectiveness of NEML (with or without a daily reference value) and with outcomes related to energy, were varied. Consequently the included studies varied across these reviews/meta-analyses and the quantitative (meta-analysis results) and qualitative (narrative) summaries of findings for each review were vastly different.

The literature is optimally categorised not on study quality per se, but on setting:

- Survey (purchase intentions of hypothetical choice)
- Simulation (actual food purchased or consumed under laboratory conditions)
- Field experiments conducted in cafeteria (workplace, hospital, school) settings

- Real-world implementation of numeric energy menu labelling (NEML) legislation or regulation in the fast food (menu boards) and sit-down (printed menu) restaurant settings.

Very little research has examined the real 'use' of ML and the impact of ML on energy consumed in the context of the whole diet. No studies were identified which indicated the sustainability of impact, i.e. whether kJ labelling is 'used' over the longer term.

1.3.2 Limitations of the evidence base

Overall the evidence base is limited by the external validity of many of the studies, that is, the generalisability of the findings to the specific setting of menu boards. A large proportion of choice experimental studies have been conducted under artificial conditions, often purportedly simulating the real world setting but not able to account for the many contextual factors acting on food choice in the real world. The other large body of experimental study has been conducted in sit-down restaurants and in University (and therefore among students, a particular group) and workplace cafeterias, where the presentation of the ML has not been relevant to QSR menu boards. Natural experiments, i.e. observational evaluation of real world implementation, have the disadvantage that they do not have a randomised control (thus internal validity is low); however pre- post-study designs and matched comparison groups successfully inform this evidence base.

1.3.3 RQ1 — What is the effectiveness of menu labelling (numeric energy content +/- daily reference value)?

There is very mixed evidence from a large variety of studies (four recent systematic reviews and meta-analyses, 15 natural experimental studies evaluating real world implementation of numeric energy menu labelling (NEML) in fast food and coffee chain QSRs, 13 field experiments (predominantly in cafeterias and full-service restaurants), and 10 studies conducted under artificial, controlled conditions) of the impact of NEML on energy selected or ordered/purchased. Findings overall are inconclusive. However, there is moderately convincing evidence from self-reported surveillance data that NEML leads to a decrease in energy purchased among those consumers who see and use NEML; these consumers are most likely to be female, diet-conscious and on higher-incomes; although research evidence is less discerning regarding the impact across population sub-groups than for broad outcomes.

Consumer literacy with respect to NEML and the importance of the contextual information (daily reference value statement) and how and when ML information is used, especially in the context of overall daily diet, has been very minimally researched. These are crucial gaps in the evidence. Nevertheless there is very limited, emerging evidence that NEML may impact on weight gain.

Revenue does not seem to be affected by NEML. There is some limited evidence that reformulation has occurred in response to NEML, although a stronger indication that product innovation for healthier, lower energy items has occurred.

1.3.4 RQ2 — Are there alternative formats for menu labelling with energy alone, which have been shown to be effective (and which also support the policy

objective of providing consistent, standardised and clear nutrition information)?

There is insufficient evidence for the effectiveness of alternative formats for menu labelling for energy alone to recommend making changes to the current presentation. There has been no real world policy implementation of alternative formats.

There is mixed evidence from field experiments and experiments conducted under controlled conditions as to the effectiveness of the addition of traffic light colour-coding to the numeric values for energy (i.e. use of a single traffic light symbol for energy alone), with evidence tending towards no additional efficacy.

Similarly there are contrasting findings for studies – which have only been conducted under artificial conditions – examining energy organised into groups and/or rank ordering of energy content. Efficacy may be affected by perceptions regarding restaurant and nutrition information credibility.

There is an indication from six studies conducted under artificial conditions that the addition of physical activity equivalents (PAE) to energy labels is effective at reducing energy selected, but not significantly more than NEML alone. There is minor evidence to suggest PAE may be more effective than NEML at promoting healthy eating and prompting exercise.

1.3.5 RQ3 — Are there menu labelling approaches which have been shown to be effective that have included (a) other nutrients and/or (b) overall healthiness (and which also support the policy objective of providing consistent, standardised and clear nutrition information)?

(a) Nine experimental studies conducted in field environments (predominantly cafeteria settings) and 12 studies conducted under artificial, controlled conditions, inform this RQ. Many of the labels and/or presentations, particularly those used in the field setting, are not applicable to the QSR setting (Appendix 2).

Among a number of studies examining the provision of numeric energy plus numeric fat information, the majority did not prove efficacious compared to no labels. Under artificial conditions multiple traffic lights (MTL) labelling does not appear to lead to the selection of less energy beyond that measured due to NEML. Impact on the selection of overall healthier foods (not necessarily lower in energy) has not been reported.

The use of multiple nutrient numeric labels (MNNL) on printed menus in the real world, full-service restaurant setting has been shown to be effective in reducing energy, sodium and saturated fat purchased, and a field experiment showed greater efficacy for this format than for labelling with a health logo.

Evidence from two studies indicates that the addition of numeric sodium information to numeric energy information might reduce the amount of sodium selected, although this may be only among hypertensive adults.

(b) Fifteen field experimental studies and two controlled environment experimental studies examined the efficacy of an 'overall healthiness' symbol in encouraging consumers to choose healthier options. A single traffic light colour-coding labelling system in the cafeteria setting appears efficacious in increasing consumer choice of healthier items.

However, there is mixed evidence for the use of a 'healthy icon' in encouraging healthier choices.

There is some evidence from a mixture of a small number of interventions that verbal or textual prompting to switch to healthier options or smaller portion sizes may be efficacious.

1.4 Conclusions and policy implications

The evidence with regard to the impact of the provision of nutrition information at the point of sale in quick service restaurants (QSRs), i.e. 'menu labelling', is extremely mixed. As indicated in several recent meta-analyses, there is large heterogeneity across studies in terms of research design, setting, and the presentation of nutrition information. The higher 'quality' studies in terms of research design have been mainly conducted under artificial conditions or in the cafeteria/canteen setting with low applicability to the QSR environment, where many contextual factors act. Thus any conclusions are tentative.

Regarding menu labelling for energy alone:

- The predominant measure of effectiveness has been 'energy selected' or 'energy purchased' and there is moderate evidence that those consumers who report seeing and 'using' NEML purchase less energy. Effectiveness may vary across outlet type. Consumers using NEML are more likely to be female, diet-conscious and on higher incomes.
- There is a lack of evidence regarding the impact of these purchases [of reduced energy within the QSR setting] on overall dietary energy intake.
- There is some limited, emerging evidence that NEML reduces weight gain.
- There is some mixed evidence regarding reformulation in response to NEML, with stronger evidence indicating that product innovation has occurred.
- There has been no real world policy implementation of alternative formats in QSRs for energy alone and there is insufficient, mixed, evidence from research in other settings to recommend making changes to the current presentation.

Regarding menu labelling for other nutrients/overall healthiness:

- No evidence is available regarding the implementation of multiple nutrient menu labelling (MNML), either numeric or interpretive, in QSRs.
- There is moderate to good evidence to support the use of numeric MNML in the sit-down restaurant setting however the feasibility of putting numeric sodium, saturated fat and energy labels in the QSR setting, although not specifically examined in this review, is likely to be low.
- There is mixed evidence, predominantly from the cafeteria setting, regarding the use of interpretive symbols or icons to denote 'overall healthiness' in encouraging healthier choices.
- As such, there is insufficient evidence to support adding additional nutrients to menu boards in QSRs; although the use of interpretive symbols for specific nutrients, such as a salt shaker for high salt items, could be investigated as there is evidence to support the use of sodium labelling by hypertensive adults.

2 BACKGROUND

Kilojoule menu labelling legislation and the accompanying 8700 campaign have been in place in NSW since 2012. The legislation mandated a review of the initiative to determine whether: (1) The policy objectives of the requirements remain valid; (2) The requirements remain appropriate for securing those objectives; and (3) If the requirements should be amended so that the nutrition information to be displayed includes information relating to fat and salt.

A literature review on the efficacy of nutrition labelling on menu boards was conducted in 2012 to inform the Review of Fast Food Labelling Requirements (published in November 2012). The review assessed information on the ability of menu labelling to influence the purchase and consumption of lower energy content meal items and the awareness and use of menu labelling. Overall, the review found that while there was some evidence to show menu labelling affects purchasing behaviour, the effect appears to be limited. Further, there was insufficient evidence to show that menu labelling had an impact on consumers' total energy intake. While consumers were aware of the nutrition information on the menu, it appeared not to influence behaviour change. The review highlighted the need for more research to fully understand the effectiveness of menu labelling initiatives and their potential impact on public health outcomes.

Since the launch of menu labelling in NSW, there has been a considerable amount of research published on menu labelling initiatives around the world. The proposed scope for menu labelling in the next three years requires consideration of this literature to ensure that the policy objectives of the initiative continue to be met and are informed by contemporary evidence.

The broader strategic context for this work is the NSW Healthy Eating and Active Living (HEAL) Strategy[1] – a five year, whole of government plan linked to achievement of a number of goals within the state plan NSW2021. This work relates to Strategic Direction 1 '*Environments to support healthy eating and active living*' and to two of the six behavioural objectives of the HEAL Strategy, namely to: (i) reduce the intake of energy-dense, nutrient-poor foods and drinks, and (ii) to increase the intake of water in preference to sugar-sweetened drinks.

Related nationally-led initiatives include the Health Star Rating front-of-pack labelling for packaged foods in supermarkets and the recently-resumed Food and Health Dialogue which had started to address reformulation of foods and beverages sold in the quick service sector.

The suggestion to include fat and salt information has been proffered by some public health and nutrition groups. However it is recognised that simply adding fat and salt to the menu boards along with kilojoules may not be the most suitable mechanism to address these nutrients for a number of reasons, including the feasibility of including additional nutrition information on menu boards (e.g. space constraints on menu boards), securing funding for supporting consumer education campaigns and that further work is required to improve consumer knowledge regarding kilojoules.

[1] http://www.health.nsw.gov.au/heal/Publications/nsw-healthy-eating-strategy.pdf

3 PURPOSE AND AUDIENCE

The aim of this review is to inform the Working Group on the latest evidence for the effectiveness of menu labelling initiatives so that current initiatives remain contemporary, to determine whether there is sufficient evidence to suggest that changes to nutrition labelling should be considered, and if so, the recommended way to do this.

The primary audience for this review is the Fast Choices and Menu Labelling Reference Group but it is anticipated that the review will be published in the public domain.

In addition, the Working Group will consult with stakeholders from industry, public health, academia, non-government organisations, government and consumer groups to explore what menu labelling initiatives exist. Findings from this rapid review will be triangulated with the findings from the stakeholder consultation to inform potential future steps in menu labelling.

4 RESEARCH QUESTIONS

RQ1: What is the effectiveness of menu labelling (numeric energy content +/- daily reference value) in terms of consumer awareness and understanding of labelling, purchase intent and purchase and/or consumption behaviour?

RQ2: Are there alternative formats for menu labelling with energy alone, which have been shown to be effective (and which also support the policy objective of providing consistent, standardised and clear nutrition information)?

RQ3: Are there menu labelling approaches which have been shown to be effective that have included other nutrients and/or overall healthiness (and which also support the policy objective of providing consistent, standardised and clear nutrition information)?

5 METHODS

This review is a rapid but comprehensive review of the evidence. A rapid review aims to provide a concise summary of evidence that answers specific policy questions in a policy-friendly format. This review was highly inclusive in its search methods to try and identify the full gamut of evidence in relation to the research questions. This review places greater emphasis on higher quality evidence reviews (meta-analyses and systematic reviews of evaluations of real world implementation, randomised trials or of longitudinal studies). Individual studies published since the most recent reviews and meta-analyses, as well as individual studies excluded from these reviews but which provide insight into the review questions were identified.

An initial scoping of the literature showed that the evidence stems from research and evaluation conducted under real world quick service restaurant and sit-down restaurant settings, from field experiments conducted in cafeteria environments and a substantial number of experimental studies conducted under controlled (simulated/virtual) conditions either in the laboratory or as web-based surveys. The latter were initially excluded from the search as external validity is low for such studies. However as much of the evidence particularly in relation to possible alternatives to kJ menu labelling as currently practiced in

NSW was conducted under these controlled or simulated conditions, the inclusion criteria were expanded to include such studies.

A range of suitable search terms and MESH terms were used to ensure that the full extent of the published literature was identified within the inclusion/exclusion criteria of the search. Primary databases were SCOPUS, PubMed and Google Scholar. A limited search of grey literature (reviews, reports, case studies, industry data and surveys) was also undertaken using Google search engine.

Snowballing methods including forward and backward citation tracking and hand searching were conducted where necessary to identify evidence particularly in relation to potential alternative formats and the potential for inclusion of additional nutrients to the current NSW scheme.

5.1 Main outcomes considered

- Consumer awareness (of kJ labels and of daily reference amount)
- Consumer improved understanding of energy and/or kJ alone and/or in context of daily reference amount
- Consumer reported use of kJ when making purchase choices
- Energy/ nutrient(s)/item selected (survey/laboratory/simulated setting)
- Energy/nutrient(s)/item ordered (real world setting – subjective measure)
- Energy /nutrient(s)/item purchased (real world setting – objective measure)
- Energy/nutrient(s)/item consumed later in the day/24 hours/overall diet
- Energy/healthy meals sold
- Revenue/transactions per month
- Reformulation – reduced energy content of pre-existing menu items (by item size or nutrient content)
- Product innovation – introduction of (new) lower-energy menu options

5.2 Inclusion criteria

- Publication details:
    - English Language
    - Reviews published 2012 onwards
    - Individual studies published 1990 onwards
- Study types:
    - Qualitative
    - Cross-sectional
    - Randomised controlled experiments (artificial setting)
    - Pre-test/post-test
    - Natural experiments with or without control (quasi-experimental)
    - RCT (in real world setting)
- Settings
    - Quick service restaurants
    - Sit-down restaurants (including fine dining)
    - Cafeterias (e.g. workplaces, hospitals, universities)
    - Survey
    - Simulated QSR/restaurant

- Interventions
  - Menu board labelling (numeric or interpretive) for individual nutrients (including energy +/- daily reference value) and/or overall healthiness of menu items
  - Printed menu labelling (numeric or interpretive) for individual nutrients (including energy +/- daily reference value) and/or overall healthiness of menu items
- Populations (at least but not restricted to the following):
  - Whole of population
  - Age
  - Gender
  - Socioeconomic status
  - Ethnicity
  - Individual or group menu item ordering
  - Diet-consciousness

5.3 Exclusion criteria

Evidence relating to:

- Restaurant certification schemes
- Labelling on packaged foods (Back/side-of packet Nutrition Information Panel (NIP), Front of Pack Labelling, nutrient claims) – including consumer preferences for display of particular nutrients on FOPL and misleading claims – or choice labelling experiments where there is no apparent link to menu boards/menus
- Multi-component schemes (e.g. menu labelling combined with increased availability and promotion – including choice architecture; particularly in retail setting) unless impact of menu labelling component specifically measured
- Shelf-labels
- Vending machines
- Non-restaurant retail setting
- Correct understanding of 'energy' by consumers generally (i.e. not in relation to energy menu labelling or contextual guidance (daily reference value))
- Nutrition education and literacy more generally, except in relation to adult daily reference values for energy and kJ/energy with respect to adult daily reference values (i.e. salt labelling on packaged foods and general understanding of salt/sodium excluded)
- Consumer attitudes/preferences (only)
- Consumer intention to use menu labelling (only)
- Ethics of menu labelling

6 FINDINGS

6.1 Description of the evidence base

- Essentially the literature can be separated based primarily on setting:
  - survey (purchase intentions of hypothetical choice)
  - simulation (actual food purchased or consumed under laboratory conditions)
  - field experiments conducted in cafeteria (workplace, hospital, school) settings
  - real-world implementation of menu labelling legislation or regulation in the fast food (menu boards) and sit-down (printed menu) restaurant settings.

- A vast majority of the research, particularly regarding alternative formats for menu labelling, has been conducted under simulated or survey conditions and in field experiments conducted predominantly in University cafeteria (sit-down restaurant) environments; not evaluations of real world implementation in QSRs. In addition, some of the real-world evaluation in the US relates to sit-down restaurants as these are part of the regulation in some states/counties; as is multiple nutrient numeric labelling.
- Very little research has examined the real 'use' of ML and the impact of ML on energy consumed in the context of the whole diet. No studies were identified which indicated the sustainability of impact, i.e. whether kJ labelling is 'used' over the longer term.
- Four systematic reviews (SR) and meta-analyses (MA) have been published in the peer-reviewed literature since 2012 [70, 75, 82, 99]. These are summarised in Table 1. All four were concerned with only 'energy labelling' as the intervention and with outcomes related to energy. A mapping of the included studies showed considerable differences in the studies included in these systematic reviews and in the meta-analyses, due to differences in the inclusion and exclusion criteria; and therefore the findings, quantitative and qualitative, differ significantly across them.
  - The review by Nikolaou et al (2015)[82] was restricted to good quality studies of calorie labelling in real life settings (real world implementation); hence only included seven studies (six for the MA) published between 1990 and 2014.
  - The review by Long et al (2015) [75] included 19 experimental and quasi-experimental studies across restaurant and non-restaurant settings, up to October 2013.
  - Similarly, Sinclair et al (2014) [99] included experimental and quasi-experimental studies but excluded studies without a control group, published between 1990 and March 2013. Seventeen studies were identified in their review; however the majority of studies included in the meta-analyses are those conducted under controlled conditions in a survey or laboratory environment.
  - The review by Littlewood et al (2015)[70] is the peer-reviewed version of a review conducted for the Danish Cancer Society, and only included studies published between 2012 and 2014, as it was an update of an earlier review published in the grey literature [71] which included much earlier studies. The inclusion of only later studies in the SR and MA was considered to reflect evidence gained during an era of increasing implementation of menu labelling.

- An earlier SR and MA [104] was reported as an update of a previous review [53] and included 7 studies published since 2008 but did not include any further studies to those included in the four more recent SR and MAs.
- Two systematic reviews were identified in the grey literature [112] [24] but these were excluded as they were restricted to RCTs conducted mainly under controlled, laboratory or survey conditions and did not include studies that were not included in the SR and MAs published in the peer-reviewed literature.
- Several narrative reviews were identified in the grey literature published since 2012:
  - Littlewood & Olsen (2014): Published also as SR and MA [70]. '*New evidence more consistently and robustly supports that Menu Labelling is an effective intervention of informing consumers of the energy content of their food and beverage choices while demonstrating it has a positive effective in reducing energy ordered and consumed*'. Menu Labelling is found to be effective in various settings and compared to the previous review it is now considered an 'equitable' initiative between the genders and across socio-economic status. [72]
  - Kiszko et al (2014): Examined 31 studies published from 2007 to July 2013 examining the effectiveness of calorie labelling at the point-of-purchase. They found that, while there are some positive results reported from studies examining the effect of calorie labelling, *overall the best designed studies (real world studies, with a comparison group) show that calorie labels do not have the desired effect in reducing calories ordered at the population level.* [61]
  - Kitchlu et al (2013): *Findings were inconclusive* relating to a change in calorie consumption following the introduction of calorie labelled menus. [62]
  - Krieger & Saelens (2013): A 2008-2012 update: *High degree of public support for providing nutrition information at the point of purchase, and menu labelling in cafeterias and restaurants increases consumers' awareness of nutritional information*. [63]

6.2 Limitations of the evidence base

- The majority of studies, especially the randomised trials, were conducted in an artificial setting (laboratory, online survey, intercept survey) which don't control for potentially biased estimates of how ML would have an impact on consumer behaviour in realistic restaurant settings; in other words they lack external validity. In the real world setting customers will be influenced by price and peer-influence, for example. In addition, most of these studies were not designed to evaluate the relevant construct of how ML would have an impact on a purchased meal intended for consumption, and the menus were not always presented as they would be in the real world. Further, few of these studies reported concealing allocation or the method of randomisation used to allocate participants to treatment groups (i.e. internal validity was low).
- Experimental studies in the field setting were generally conducted in cafeterias or sit-down restaurants and therefore also lack generalisability to the QSR setting. It was not often stated in these studies exactly how the information was presented POP, and in many studies it appeared to be not on menu boards per se. In sit-down restaurants it was generally on printed menus.

- In addition, many of the experimental studies in artificial and field settings tended to recruit from young and relatively well-educated population sub-groups, often undergraduate students; hence generalisability to the general population is uncertain.
- Quasi-experimental studies that were conducted with comparison or control groups in the real world restaurant, including QSR, setting eliminates some of the concerns indicated above, but lack of randomisation introduces the risk of confounding as most of the comparison groups were from different source populations and confounding variables were not always controlled for in the analyses.

6.3 Summary of the evidence

6.3.1 RQ1: Is numeric energy menu labelling effective?

6.3.1.1 Outcome: Weight

- An empirical study published in the grey literature in the US [89] compared counties in New York State with/without calorie labelling and using surveillance data (data from the 2004-2012 waves of the Behavioural Risk Factor Surveillance System; BRFSS) indicated that the provision of calorie information on point-of-purchase chain restaurant menus causes economically important and statistically significant reductions in BMI and the probability of obesity. The analysis estimated that on average calorie labelling reduces body weight by -1.22 kg [-2.16, -0.30]. This reduction in body weight was explained by a persistent average daily energy imbalance gap between intake and expenditure of about 45 calories per day for a year.

  Quantile regression results in this study indicate that calorie labelling has similar impacts across the BMI distribution. An analysis of heterogeneity suggests that calorie labelling has a larger impact on the body weight of lower-income individuals, especially lower-income minorities. The estimated impacts of calorie labelling on physical activity and the consumption of alcoholic beverages, fruits, and vegetables are small in magnitude, which suggests that other margins of adjustment drive the body-weight impacts estimated here.
- The only other study which included weight as an outcome was conducted over a two-year period (pragmatic interrupted time-series design)[80]. The weight change of 120 young adults (undergraduate students), similar in age, gender and ethnicity, for each of the two years, was measured over 36 weeks with no labelling (apart from a 5-week pilot) in a University residential dining hall and over a 36 week period where calorie-labelling was present prominently and consistently at main meals for 30 of the 36 weeks. Weight changes were significantly different between years for males and females. Mean weight changes over 36 weeks, per protocol, were +3.5 kg (95% CI = 2.8-4.1 kg) (n = 64) in Year 1 and -0.15 kg (95% CI = -0.7-0.3 kg) (n = 87) in Year 2. Intention-to-treat analysis showed similar results. Relative risk for weight gain in Year 2 (calorie labelling) compared to Year 1 (no labelling) was 0.5 (mean difference 3.7 kg, $p<0.0001$).

6.3.1.2 Outcome: Ordering/Purchasing

Systematic reviews and meta-analyses

- Overall energy consumed was reduced by a mean of 419·5 kJ (100·2 kcal) and energy ordered in real-world settings decreased by a mean of 325·7 kJ (77·8 kcal) (15 peer-reviewed articles)[70]
- Three studies reported significant changes, all reductions in calories purchased (-38.1 to -12.4 kcal). Meta-analysis of 6 studies showed no overall effect, -5.8 kcal (95% confidence interval =-19.4 to 7.8 kcal) but a reduction of -124.5 kcal (95% CI=-150.7 to 113.8 kcal) among those who noticed the calorie-labelling (30-60% of customers).[82]
- Among 19 studies, menu calorie labelling was associated with a -18.13 kcal reduction ordered per meal with significant heterogeneity across studies (95% confidence interval = -33.56, -2.70; P = .021). However, among 6 controlled studies in restaurant settings, labelling was associated with a non-significant -7.63 kcal reduction (95% confidence interval = -21.02, 5.76; P = .264).[75]
- Menu labelling with calories alone did not have the intended effect of decreasing calories selected or consumed (-31 kcal [P=0.35] and -13 kcal [P=0.61], respectively). The addition of contextual or interpretive nutrition information on menus appeared to assist consumers in the selection and consumption of fewer calories (-67 kcal [P=0.008] and -81 kcal [P=0.007], respectively).[99]

Real World Policy Implementation in Chain Restaurants

- King County, Washington
  - Three studies were identified; and each of these were included in at least one of the four recent SRs/MAs:

  The largest study [64] examined 50 locations and 10 chain QSRs (FF and coffee chains) pre- and 6 months post-implementation difference of -35.5 kcal FF chains (95% CI = -75.5, 4.4; p=0.06) and -26.3 kcal (-40.0, -12.7; p=0.002) in coffee chains. This study showed a decrease in taco and coffee chains but not in burger and sandwich chains. Food chain customers using information purchased on average fewer calories compared to those seeing but not using (difference=143.2 kcal, p<0.001) and those not seeing (difference=135.5 kcal, p<0.001). Two much smaller studies; one in Taco Time using a comparison study post-implementation [42] showed no impact of ML on purchasing behaviour, and the findings in the other study [105] which involved an unspecified FF restaurant and a small cohort of children and their parents pre- and post-implementation were not clear.

- New York City/State:
  - 6 studies were identified, and each of these was included in at least one of the four recent SRs/MAs:

  One study found no effect of ML in a chain coffee shop, nor was there any effect in a Manhattan McDonald's store. However there was a significant effect in a Brooklyn McDonald's store (-77 kcal). Overall labelling resulted in 17.7 fewer kcal, labelling with a daily anchor reduced calories ordered by 61.4 and the combined effect resulted in a reduction of 79.2 kcal. [30]. A very robust study involving very large numbers of transaction data pre- and 10 months post-implementation in Starbucks outlets across NYC, showed that average calories per transaction fell by 5.8% (14.4 kcal, p<0.01), mainly resulting from customers decisions to order only coffee and skip food items altogether. [15] A study across 31 burger restaurants in NY State, involving comparison restaurants post-implementation, showed fewer calories ordered in restaurants with ML, compared to those without menu labelling, a difference of 59.6 kcal; and among those reporting using ML, 84.4 fewer calories were ordered per person. Across 168 randomly

selected locations of the top 11 FF chains in NYC during lunchtime hours, Dumanovsky et al (2011) found that mean calories purchased did not change from before to after regulation (there was a non-significant increase of 19 kcal; 828 v 846 kcal, P = 0.22) for the full sample, although the significance of the findings varied depending on the chain. [32] Three major chains showed significant reductions in mean energy per purchase (McDonald's (829 vs. 785 kcal, p=0.02), Au Bon Pain (555 vs. 475 kcal, p<0.001), and KFC (927 vs. 868 kcal, p<0.01)); whereas mean energy content increased for Subway (749 vs. 882 kcal, p<0.001). Survey findings indicated that customers who reported using the calorie information (15%) purchased 106 fewer calories than those who did not see or use the information (757 vs. 863 kcal, P<0.001). [32] Two studies by Elbel and co-workers (2009, 2011) in McDonald's/Burger King/Wendy's/KFC; pre- and post- implementation, among 57% of adolescents who noticed calorie labelling, 9% said they considered the information when ordering; and among adults 27.7% who saw calorie labelling said it influenced their choices however no change was detected in calories purchased among either population group (Difference in difference b=19 kcal (SE = 58)).[33, 34]

- Two studies were not included in any of the SR/MAs and one more recent study has been published since the SRs/MAs:

In the most recently published evaluation, Cantor Torres et al (2015) examined nearly 8000 cash register receipts and survey responses of consumers of four FF chains. Repeated measures immediately post-implementation and at several time points 5-6 years post-implementation showed no statistically significant changes over time in levels of calories or other nutrients purchased or in the frequency of visits to FF restaurants. [22] A study by Vadiveloo et al (2011) not included in any of the systematic reviews (although it was included in a narrative review [61]) surveyed nearly 1200 adults of four FF chains pre- and post- ML in NYC and in the comparison district of Newark. A difference-in-difference analysis revealed no significant favourable differences and some unfavourable differences in food purchasing patterns and frequency of fast food consumption. Adults in NYC who reported noticing and using the calorie labels consumed FF less frequently compared to adults who did not notice the labels (4.9 vs. 6.6 meals per week, p <0.05). The study by Bassett et al (2008) was also not included in any of the SRs/MAs but was included in the narrative reviews [9]. This study was pre-legislation at a time when Subway had voluntarily posted calorie information. Of those seeing ML at Subway (implemented) vs. other FF outlets (32% vs. 4%), 37% reported using and these consumers purchased 99 kcal fewer than those seeing and not using (p<0.001). Among Subway consumers who reported seeing calorie information purchased 52 kcal fewer than those not seeing (p<0.001) and fewer meals ≥ 1000 kcal (17% vs. 23%, p<0.01). This latter study, though, has been criticised as having a high propensity for selection bias. [94]

- Philadelphia
  - Two studies were identified; of which both were included in at least one of the four recent SRs/MAs:

An evaluation involving data collected from consumers before and after ML in QSRs in Philadelphia compared to the matched comparison city of Baltimore showed that, although ML was noticed by 38% of consumers in Philadelphia, calories purchased and number of fast food visits did not change in either city over time. [35] In contrast, numeric multiple nutrient menu labelling (NMNML) – for calories, sodium, fat and

carbohydrate – on printed menus in full service restaurants in Philadelphia led to customers purchasing 151 fewer calories, 224 mg less sodium, and 3.7 g less saturated fat compared to customers at restaurants in the same chain but with no ML. Those consumers who indicated that the NI affected their order purchased 400 fewer calories, 370 mg less sodium and 10 g less saturated fat (SFA).[7]

- Phoenix, AZ

  In a cross-sectional study using customer intercept surveys (n=329) outside 29 McDonald's restaurants in Phoenix, Arizona, Green Brown et al (2015) showed that noticing ML was not associated with purchasing fewer calories; however those who reported using ML purchased 146 fewer calories (p=0.001) than those who did not. [50]

- NSW, Australia

  The evaluation study measuring purchases in QSRs before and two times after ML in NSW (from May 2011 to January 2013) showed a reduction in the median number of kilojoules purchased[2], from 3355 to 2836, resulting in a reduction of 519 kJ purchased. The trend towards a reduced mean kJ purchased was not significant. [111]

Field Experiments

- The vast majority of studies conducted in school, worksite and university cafeteria settings indicate a positive impact (i.e. fewer calories purchased) of numeric calorie labelling on the calorie content of items purchased.

Thirteen studies were identified that were conducted under field experimental conditions in the cafeteria setting (school[57, 121], university[52, 81], hospital[117]), one in an online catering setting for employees[115], one in two full-service restaurants [38], one in a fine dining restaurant[43], and two in the fast food setting[76, 123].

Among four of the five studies conducted in school, university or hospital cafeterias point-of-purchase numeric calorie labelling was shown to be effective in reducing the amount of energy purchased: by 47 calories/day (fat intake reduced by 2.1 g/day) among middle school children[57]; by 89 calories (by 95 calories consumed) among university students[51]; by 94 kcal among university students[81] (fat, saturated fat contents also reduced without compromising micronutrient consumption); and, significant increases in purchases of lower calorie side dishes and snacks in hospital cafeterias with labelling compared to those with no labelling[117]. In the fifth study, in a school setting, an additional educational strategy involving assembly-style, hip-hop themed multimedia classes resulted in a mean decline of 20% in calories purchased, however the impact was only evaluated for 12 days post-intervention[121].

In the study in an online catering company setting for employees energy labelling reduced lunch calories by about 10%, as did single traffic light (STL) labels and numeric calories plus STL[115].

Evidence from two field experiments with different experimental designs in the full-service restaurant setting indicated no significant impact of numeric calorie labelling on total caloric intake [38]. However, calorie labelling in a fine dining setting resulted in a reduction of 227 calories consumed per client[43].

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[2] http://www.foodauthority.nsw.gov.au/_Documents/science/fastchoices_evaluation_report.pdf

In a study involving calorie labelling on survey menus for a FF restaurant and then subsequent ordering in the FF restaurant with no labelling, a moderate effect of labelling on reducing calories selected (by an average of 3%) under survey conditions was not replicated under subsequent ordering in the restaurant [76]; while a study by Wisdom Downs & Lowenstein (2010; included in two of the four systematic reviews[75, 99])[123] involved intercepting customers before they entered a Subway outlet and randomising them to order from a printed paper menu containing calories only, calories + daily 'anchor', or no label. Findings showed that the addition of a daily anchor increased the effectiveness of calorie labelling (see below).

Virtual Setting (Surveys or Laboratory)

- Eleven studies were identified conducted as online surveys or laboratory choice experiments [31, 46, 47, 53-55, 76, 91, 94, 101, 118].

The most recently published identified study conducted under artificial conditions (n=245 adults) examined the interaction between calorie information and pricing and found that, in a scenario about imagining going out for dinner at a casual, full-service restaurant, NEML was effective only when linear pricing was used [54]. In this study the decrease in calories occurred (with linear pricing) as people switched from unhealthy full-sized portions to healthy full-sized portions rather than unhealthy half-sized portions. In a convenience sample of 178 college students, from menus viewed on a computer screen, fewer calories were selected when NEML was provided and when a tax was applied to high calorie foods, with a significant tax by NI interaction, where a tax reduced percentage of calories selected for lunch but only among those with no labelling among high-restraint eaters [47]. The 'laboratory' experimental study by Harnack et al (2008) among 594 adolescents and adults who regularly ate at FF restaurants showed no significant effect of NEML and/or value pricing on meals selected [53]. In South Korea, a random sample of 245 FF consumers were more likely to choose a healthier burger option (among a choice of 6) in a survey when NEML and multiple nutrient numeric labelling (MNNL) was present than when it was not, although there was no difference between labelling treatments (see below) [55]. In this study BMI and gender modified the response to ML.

In a lunchtime experiment with 232 college students, NEML led to the highest calorie, but also fibre reduction, compared to a complete Nutrition Facts Panel (NFP) or health-related claims [101]. The NFP resulted in most sizable decreases in problematic nutrient content such as empty calories and calories from fat and added sugar while the health-related claims treatment led to a reduction in carbohydrates and calories from fat. Among 90 college students assigned to either NEML of no NI on mock FF menu boards complying with the New York Health Code, the 33 calories reduction due to NEML was not statistically significant[94]. Of note in this study, 61.5% of females vs. 26.3% of males agreed with the statement '*I am aware of the calorie content of foods that I eat*'; and similar percentages indicated that they '*Choose meals low in calories when available*'. Women chose lower calorie meals/items (146 fewer kcal), and lower priced meals from a hypothetical FF menu when NEML was provided in a study among 288 pyschology students; however men's selection was unaffected by ML (with non-significant higher amount of kcal chosen) [46].

Perceived healthfulness of a restaurant interacted with the effect of NEML in an online survey of 178 adults using hypothetical FF menus. In a perceived 'healthful' restaurant NEML led to food choices of about 100 calories fewer [118]. In another study, provision of NEML in the simulated FF restaurant context using a survey led to 3% fewer calories being selected, however subsequent purchases in the real world FF setting were not different in energy

content [76]. In a street intercept survey of 302 adults, Roseman et al (2013) found no effect of NEML on calories selected, with nutritionally-motivated participants more likely to make healthier menu selections regardless of NEML or no NI [91]. Dowray et al (2013) found no significant effect of NEML on calories selected among 820 adults randomised to various labelling conditions including physical activity equivalents (see below)[31].

6.3.1.3 Outcome: Self-reported awareness and use (real world implementation)

- A substantial number of studies involving surveillance data and research evaluations of real world ML implementation indicate the percentage of self-reported awareness as between around 25% to 60% in the US, with reported use of the labels to make healthful selections shown to be around 10% in research studies compared to surveillance surveys where reported use is much higher. Self-reported use of NEML in the US has been found consistently to be more likely among females, those who are obese or trying to lose weight, and those who use FF outlets/chain restaurants less frequently.

In King County, Chen et al (2015) indicated that, from 2008 to 2010, the proportion of consumers who saw and used calorie information tripled, from 8.1% to 24.8% [23]. Women, higher income groups, and those eating at a FF versus sit-down chain restaurant were more likely to use this information. In the evaluation study in McDonald's outlets in Phoenix, Arizona, Green Brown et al (2015) showed that although approximately 60% of participants noticed NEML, only 16% reported using the information [50]. Higher-income individuals had twice the odds of noticing calorie labels and three times the odds of using them. Significant positive associations were found between individuals with a bachelor's degree or higher and use of NEML.

In Philadelphia, several weeks post-legislation, 35.1% of respondents surveyed POP at FF restaurant and 65.7% of telephone survey respondents reported seeing posted calorie information [18]. 11.8% and 41.7%, respectively, reported that the labels influenced their purchasing decisions, and 8.4% and 17% reported they were influenced in a healthful direction. BMI, education, income, gender, consumer preferences, restaurant chain, and frequency of visiting fast food restaurants were associated with heterogeneity in the likelihood of reporting seeing and reporting seeing and using calorie label**s.**

Five studies using data from national surveillance surveys in the US variously showed that:

- Those trying to lose weight were most likely to report using fast food ML. [13]
- Across 17 states, approximately 97% of respondents noticed ML information, and estimated overall proportion of ML users was 57.3 % (48.7% in Montana to 61.3% in New York). [65]
- 52% indicated that they used ML. People who used ML were more likely to be female (odds ratio [OR], 2.29; 95% CI, 2.04-2.58), overweight (OR, 1.13; 1.00-1.29) or obese (OR, 1.29; 1.12-1.50), obtain adequate weekly aerobic exercise (OR, 1.18; 1.06-1.32), eat fruits (OR, 1.20; 1.12-1.29) and vegetables (OR, 1.12; 1.05-1.20), and drink less soda (OR, 0.76; 0.69-0.83). [17]
- Among those who reported eating at FF/chain restaurants, 36.4% reported reading NEML when available. Reading calorie information was not related to race/ethnicity, income or education. Compared with men, women had higher odds [adjusted OR = 1.8; 1.5-2.1] of reading calorie information when available while those who frequented FF/chain restaurants ≥3 times/week had lower odds (aOR = 0.6; 0.4-0.8) compared with those going <4 times/month. Of those who reported reading calorie information when available, 95.4% reported using calorie information at least sometimes.[119]

- Among 721 youth aged 9-18 years who visited FF restaurants, 42.4% reported using NEML at least sometimes. Girls were more likely than boys to report using NEML (aOR 1.8, 1.2-2.5), youth who were obese were more likely to report using NEML than healthy weight youth (aOR 1.7, 1.0-2.9), and youth eating at a FF/chain restaurant twice a week or more versus once a week or less were half as likely to report using NEML.

6.3.1.4 Inclusion of Daily Reference Value Statement (various outcomes)

- Inclusion of a daily reference value (DRV), otherwise termed 'contextual information' or 'anchor' in several studies, or 'Health Statement' in one, was specifically investigated in 4 field experiments [30, 81, 85, 123] and 2 laboratory studies [48, 90].

The meta-analysis by Sinclair et al (2014) [99] included three of these contextual studies [48, 90, 123] and concluded that "*the addition of contextual or interpretive nutrition information on menus appears to assist consumers in the selection and consumption of fewer calories*", by -67 kcal and -81 kcal, respectively, compared to no labelling; however the effect of contextual information wasn't summarised independently of interpretive information (e.g. logo or TL). One of the two included studies that were conducted in the laboratory setting showed that for a choice of two meals, a salad or pasta dish containing the same calories but labelled as either high or low in different treatments, participants who chose high-calorie foods over low-calorie foods did not eat less in response to calorie information, although non-dieters reduced their intake somewhat when calorie labels were put in the content of recommended daily calories [48]. One of only a few studies to examine intake outside of the immediate eating situation, Roberto et al (2010) [90] showed that when calories consumed during a study dinner (measured) and in the subsequent 24 hours (24-hour dietary recall) were combined, participants (n=303 overall) in the NEML+DRV group consumed an average of 250 fewer calories than those in the other groups which either had no ML or NEML only.

In the field experiment that was included in the meta-analysis [123], 632 individuals were intercepted before they entered a Subway outlet and randomised to order their meal from a paper menu printed with no ML, NEML only, or NEML+DRV. NEML alone resulted in the ordering of 61 fewer calories, and the addition of the DRV reduced the calories ordered by a further 38, resulting in 98.5 fewer calories purchased compared to no ML. A more recent field experiment, by the same research group, in McDonald's among 1094 adults indicated no impact of a daily anchor (calorie benchmarks)[30].

In a study among undergraduate students in a controlled setting, a variety of ML formats, including NEML and a 'health statement' – 'The recommended daily energy intake for adults is 2000 calories' – were examined[85]. The study showed that participants who selected from menus with no ML selected snacks with higher calorie amounts than participants in the NEML and the NEML+DRV condition, although there was no difference compared to the physical activity statement condition. However there was no significant difference between ML conditions. The NEML+DRV menu was perceived to be most understandable.

In a field experiment in a university dining hall, the calorie content of each meal component meals was displayed in bold text on large laminated cards at POS for ten weeks [81]. The cards were removed for ten weeks and then cards containing the calorie content plus estimated daily energy requirement were displayed POS. There was a significant increase in the energy content of meals from period 1 (NEML only) to Period 2 (no labels) and a significant decrease between Period 2 and Period 3 (NEML+DRV); mean

number of calories chosen was 658, 722, and 578 respectively. However there was no statistically significant difference between Periods 1 and 3, i.e. the addition of the DRV did not 'add value' to the NEML in this study, at least not significantly so.

6.3.1.5 Outcome: Understanding of kJ

- No studies have examined the effect of NEML, with or without the daily reference value, on consumer understanding of kJ or energy. The NSW evaluation examined this to some extent but not independently from the associated social marketing 8700 campaign.

Three articles were identified which examined the impact of NEML on estimation of the energy content of meals. In one study involving participants intercepted as they were exiting a Chipotle (Burrito) restaurant, some participants were randomised to exposure to calorie content information of burritos with some treatments further indicating an energy range with end points – which were a description of the burrito types that contained the extreme kcal, e.g. *410 calories: Tortilla, black beans vs. 1185 calories: tortilla, chicken, black beans, cilantro-lime rice, corn salsa, cheese, sour cream, guacamole, lettuce* [74]. Energy range information improved energy estimation accuracy and defining the meaning of the end points further improved accuracy. In an earlier study by the same senior author of this previous study, participants in an online survey randomised to different ML conditions including no labels, NEML only, NEML and rank-ordered by calorie content from low to high, and TL coloured-calorie labelling, showed that participants in each calorie label condition were significantly more accurate in estimating calories ordered compared to the no labels group [73]. Those in the coloured-calories group perceived the restaurant as healthier.

In a study examining consumers' Weblogs and experimentation, it was shown that consumers' calorie estimates tend to fall within a narrow range, and that there are substantial perceived calorie differences between, for example, the salads and chicken sandwich meals [106]. There was a main effect of healthfulness of the tested meal for both percentage accuracy and raw accuracy of calorific content. Consumers overestimated the energy content of low calorie meals and underestimated the energy content of higher calorie meals. Evidence also indicated that consumers underestimate calories more for meals from restaurants where their perceptions of healthfulness and the actual healthfulness of meals are less consistent. Overall there was a significant interaction between (i) perceived general healthfulness of the restaurant, (ii) perceived healthfulness of the category of food item, and, (iii) actual meal healthfulness on consumers' calorie estimates. A further finding was that calorie levels are used to make inferences about the sodium and saturated fat content of items, whereas there is not always a direct link. For example, a large Subway sandwich meal may have an intermediate level of calories (relative to large hamburger-based meals), it exceeded the recommended sodium level for an entire day[3].

In a randomised experiment in a hospital café, text messaging was found to increase knowledge of the government calorie reference value, whereas email messaging had no impact [1].

[3] Conversely the study by Nikolaou et al (2015) in a university dining hall showed that fewer calories selected resulted in reductions also in fat and saturated fat contents of the meals chosen, without compromising micronutrient consumption

6.3.1.6 Outcome: Reformulation (Real World Implementation)

- Four studies were identified which inform this outcome [14, 20, 79, 92].

Two of the studies audited menu items pre- and post- NEML legislation [79, 92] and three of the studies audited items in comparison restaurants without NEML [14, 79, 92]. It is important to note that in at least one of these evaluations [79] different restaurant chains were used as comparison outlets, i.e. these comparison restaurant chains did not have outlets in jurisdictions requiring NEML.

In this latter study, an audit of 3887 items across 5 FF restaurants requiring NEML and 4 FF restaurants with no labelling requirements before and after regulation in 2008, showed that the prevalence of healthier food options increased from 13% to 20% at case locations while remaining static at 8% in control locations[79]. There were, however, no clear systematic differences in the trend between chain restaurants in case versus control areas for calorie content.

The most recent data from evaluation in the US [14] was from an audit of 66 of the largest restaurant chains across a 3-year period (2012-2014) and compared the calorific content of items in restaurants with NEML versus those without NEML. Mean per item calorie content was lower in all years for restaurants with NEML (-139 calories in 2012, -136 calories in 2013, and -139 calories in 2014). New menu items introduced in 2013 and 2014 showed a similar pattern.

Two studies examined the effect of regulation for NEML, including a DRV, in King County, Washington. Bruemmer et al (2012) examined nutrient content of menu items at 6 months and 18 months post-regulation and noted modest improvements in energy, saturated fat, and sodium content of chain restaurants over the 12-month period [20]. Energy contents were significantly lower for all chains by 41 kcal, in sit down restaurants by 73 kcal, and in QSRs by 19 kcal, for entrees that were on the menu at both time periods. As this study did not compare outlets with no ML then the changes could have been secular. The other study compared the menu items available at the same restaurant chains in King County before ML legislation and at 6 and 8 months post-implementation, and compared these to menu items available in the same restaurant chains in an adjacent county (Multnomah County) where there was no ML regulation. This study found no evidence of changes in the availability of healthy options and facilitation of healthy eating, other than ML itself. King County restaurants demonstrated modest increases in signage that promoted healthy eating, although overall prevalence was low, and the availability of reduced portions decreased in these restaurants. There was a secular, modest increase in the healthfulness of children's menus over time, i.e. this improvement was observed in both counties.

6.3.2 RQ2: Is there any evidence that alternative formats for energy might be more effective than the numeric format?

- Studies examining alternative presentation of energy content of items in restaurants have been conducted as:
  - Field experiments (5 studies included; 4 by same researchers)
  - Experiments in virtual settings (9 studies).
- All five field experiments were in a sit-down restaurant/cafeteria setting (one was online catering company[115]) examined the effectiveness of a single traffic light label (STL)

for energy content; several studies conducted in university cafeterias were by the same research group [36-39].

In a study[115] involving employees of a large corporation who ordered lunch through an online catering company, numeric calorie labels, TL labels, or both labels together, were equally effective in reducing calories ordered (by about 10%).

Several field studies in full-service restaurants by Ellison Lusk & Davis [36, 38] showed mixed findings, but overall indicated that numeric calorie labelling had no impact on calories ordered, whereas the addition of a symbolic TL label caused patrons to order lower-calorie items (a 67.8 kcal reduction in average calories ordered in one of the studies[39] although a non-significant difference of 121 fewer calories through the addition of a STL in the other study[36]), particularly main meal items in one of the studies[36], and an additional modelling study [39]using the field experimental data showed that the TL symbol enhanced the effect of numeric calorie labelling to a level exceeding that of a 10% tax on high-calorie items and a 10% subsidy on low-calorie items. The additional study by Ellison (2014)[37] suggests that the effects of any labelling are diminished by peer effects when dining with others.

- A variety of studies conducted under virtual conditions (simulated menu environment/ +/- online survey) have shown[4]:
    - efficacy (fewer calories selected) for:
        - *green symbols signifying 'lower than 600 calories'[110]*
        - *salient calorie information in larger, red font and/or a 'mere-reminder'[49]*
        - *colour-coded specific menu categories(McDonald's Drive Thru menu)[27, 125]*
    - no efficacy (in calories selected) for:
        - *single TL + graphic summary (total calories chosen as % of average daily calorie requirement)[126]*
        - *single TL energy (several studies)[28, 51]*
        - *grouping low-calorie items into single 'low calorie' category (calorie organising)* – diminished the positive effects of calorie posting*[86]*
    - uncertain efficacy (in calories selected) for:
        - *rank-ordered calories (calorific sequence low-to-high) (increased accuracy of estimating calorie content)[73]*
        - *rank-ordered + red/green circles indicating lower/higher calorie content (perceived healthiness of restaurant)[73]*

The evidence does not support the inclusion of a STL for energy – although this is often the preferred option by consumers – although green symbol indicating low calories may be useful. (cf. Healthier symbol). Mixed findings for studies looking at calorie organising into groups or rank order – with the addition of part-TL colour-coding added to McDonald's drive-thru menu impacting more strongly than numeric calories alone. However, one study showed that grouping low-calorie items together meant that they were 'overlooked' and inadvertently led to higher calorie options being selected. One rejected study in snack food choice and using choice architecture suggests putting items in rank order is likely to be successful in the physical setting. There was an indication from a study in South Korea that numeric values lends consumers to see restaurant perceived as more credible among

[4] Note that some formats have shown differing efficacy across studies

those that don't perceive NI generally to be credible, whereas addition of green symbols preferred by those who generally perceive NI as credible. One study indicated that salient information of any kind, including heuristic cues (such as TL) and %DRA act as 'reminders', prompting consumers to consider the NI.

One study in a simulated environment in South Korea[66] showed that parents who did not trust NI in general reacted more positively to the frame containing numeric values (multiple) only; however parents who do perceive NI as being highly credible perceive restaurants as more healthful and trustworthy when both numeric values and low-calorie symbols are presented, and have more positive perceptions overall.

Findings from a recent study [49] suggest that salient-information of any kind, including potentially MTL (typically seen as a very different intervention to numeric calories), and including reminding people to think about the calorie content of food, such as reference daily amount, may serve as a reminder, prompting people to consider nutrition, rather than providing 'new' information.

- [5]Eight studies [3, 31, 49, 56, 59, 85, 87, 116] were identified which examined the efficacy of Physical Activity Equivalents (PAE) [for energy/calorie content], usually minutes walking or running, and sometimes distance (miles) walking or running – all were conducted under artificial, controlled conditions:

Five studies involved internet surveys and choice experiments from hypothetical fast food menus [3, 31, 49, 56, 116]. In a study reported separately for parents[3] and then parents ordering for their children[116], there was a preference for PAE format compared to NEML alone and respondents perceived that PAE labels would be more likely to influence their level of PA and encourage their children to engage in PA[3, 116]; however there were no differences between calories selected across labelling conditions – although all labelling conditions (NEML, NEML + PAE miles, NEML + PAE minutes) resulted in fewer calories selected compared to no labelling. In the other internet study [31] among 820 adults, total energy selected was lower for all ML conditions (NEML, NEML + PAE (minutes), NEML+PAE (distance)) than no labelling, however the difference was only significant between NEML + PAE (distance) and no labels.

A choice experimental study published in the grey literature among 545 subjects and involving choice between six different chicken burgers showed that calorie labelling shifts choices regardless of whether the information is framed in terms of numeric calories (NEML)

[5] Three additional studies (11, 12, 60) were identified which evaluated the effectiveness of PAE on reducing purchases of sugar-sweetened beverages in the retail setting. Two of these studies, by the same research group, examined the effect of posted signs with calorie labelling in corner stores among black adolescents and showed that the provision of any calorific information (NEML only, number of teaspoons of sugar, PAE time and PAE distance) significantly reduced the odds of SSB purchase relative to baseline, which persisted in one of the studies after the signs were removed. In the earlier study the effect was only significant compared to no labelling for the PAE label. However a multi-site field study also involving PAE, failed to demonstrate a consistent effect of labelling:

11. Bleich, S.N., et al., *Reduction in purchases of sugar-sweetened beverages among low-income Black adolescents after exposure to caloric information.* Am J Public Health, 2012. **102**(2): p. 329-35,
12. Bleich, S.N., et al., *Reducing sugar-sweetened beverage consumption by providing caloric information: How black adolescents alter their purchases and whether the effects persist.* American Journal of Public Health, 2014. **104**(12): p. 2417-2424..
60. Jue, J.J.S., et al., *The impact of price discounts and calorie messaging on beverage consumption: A multi-site field study.* Preventive Medicine, 2012. **55**(6): p. 629-633.

or PAE (minutes of running) but only if it is sufficiently salient [49]. The authors of this study considered that visual salience is crucial and acts as a 'mere reminder' prompting people to consider nutrition rather than merely providing new information. This was the only study identified which explicitly looked at the importance of the salience of the ML information.

A study in Israel among 511 respondents recruited from a variety of settings located nearby McDonald's restaurants, while females increased consumption of salad in the desired direction after exposure to NEML only, males responded positively to NEML + PAE (burn time) [56]. Estimation of energy content of food items was improved when 'burn time' was added to the labels (see above).

Three laboratory experimental studies also involved hypothetical FF menus, two conducted among university students [59] [85] and one among a small number of female young adults[87]. This latter study using hypothetical FF menus and repeated measures found no difference between calories 'ordered' for the NEML and NEML + PAE, although participants in the two labelling conditions ordered substantially fewer calories (about 15%) than those in the no labelling condition. In the most recent study by James et al (2015)[59] among 300 undergraduate students in dining areas of a research kitchen and a campus residence, the PAE (mins brisk walking) labelled group ordered and consumed significantly less energy than the no labels group, but not compared to the NEML group. This study was one of only two studies identified in the review which have measured energy consumed over the whole of day, and found that there was no difference in post-lunch energy intake by menu type. A Canadian study among 213 undergraduates[85] compared NEML to NEML + DRV statement, to NEML + PAE (mins running) and NEML + PAE (distance running). The NEML and NEML + Health Statement condition (DRV) led to fewer calories being selected than among menus with no calorie information. The DRV statement in addition to the calories was perceived as most understandable, and the NEML + PAE menu was perceived as most effective in helping to promote healthy eating.

6.3.3 RQ3: Is there any evidence to suggest that additional nutrients should be added in a numeric or alternative format?

A particular point to note with respect to this RQ is that the intended outcome relates more generally to reducing the intake of specific negative nutrients and/or improving the overall healthiness of food choices, as opposed to reducing only the energy content of food choices.

6.3.3.1 Individual nutrients

- Nine studies [4, 7, 8, 25, 26, 44, 77, 88, 114] were identified which examined menu labelling with nutrients additional to energy content under field conditions in the cafeteria (University, hospitals, workplaces) setting (one was in full-service restaurants under mandated law in Philadelphia[7] requiring full-service restaurants to display calories, sodium, fat and carbohydrates on printed menus). The labelling formats used were:
  - Nutrition Facts Panel *on poster next to food displays vs. complex 2D graphical format for menu items[88] – University cafeteria*
  - Nutrition Facts Panel *information (total kcal, serving size, fat, protein, carbohydrates) University cafeteria/dining hall[25]*
  - *Nutrition Facts Label on laminated cards near food items – University café[26]*

- Calories+sodium+fat *on digital menu boards vs.* health logo – *hospital cafeteria[114]*
- Calories+sodium+ fat+carbohydrates *on printed menus – Mandated law in Philadelphia in sit-down restaurants[7]*
- *Pictures of different portion sizes with corresponding* calories, fat and % calories from fat- *student dining hall (french fries and salad dressing only)[44]*
- 4-colour code + calories, fat, cholesterol, protein and energy density – *hospital cafeteria with no control[77]*
- *Energy, satfat, added sugars, carobhydrate content displayed graphically as bar charts in proportion to the dietary reference values – on a computer screen at entrance to workplace canteen[8]*
- *Energy+fat content – student cafeteria* [4]

Several of these labels are not applicable to the QSR setting; for example a very complex 2D graphical format trialled in a University cafeteria [88], and the energy, SFA, added sugars, carbohydrate content of a meal presented as a bar chart in proportion to the dietary references values on a computer screen as employees entered a workplace canteen [8]. Social desirability bias was likely particularly in this latter study which was effective at making 16% of patrons change their initial food selection, to a healthiness level of those patrons that chose not to change their first selection.

The study by Pratt et al (2016) [88] and an earlier study by Chu et al (2009)[25], the latter of which was included in the meta-analysis by Nikolaou et al (2015)[82], examined the effect of posting of the Nutrition Facts Panel (NFP), which is mandatory on the back or side of packaged foods in the US, on food choices in University dining halls. Signposting using NFP did not affect total calories purchased compared to no labels in the more recent study [88], however the average kcal content of entrées purchased dropped immediately by 12.4 kcal/day after NFP labelling in the earlier study, and calorific content increased gradually when labelling was removed[25]. The NFP label was used on laminated cards near food items in a University café for 2 weeks in one study [26]. There was a trend towards an increase in the sales of lower fat, lower calorie entrees and a decrease in the sales of higher fat, higher calorie entrees. Notably sales of vegetables and side orders of salads and fruit increased, and side orders of fries and baked goods decreased. This form of labelling, i.e. on laminated cards, is, of course, quite different to menu boards in the QSR environment.

The study by Auchincloss et al (2013)[7] under real world policy sit-down restaurant conditions (but printed menus) showed that full-service restaurant chains listing values for calories, sodium, fat and carbohydrates for each item purchased fewer kcal (151 kcal), less sodium (224 mg), and less saturated fat (3.7 g) than customers at unlabelled restaurants[6].

[6] In the study by Nikolaou et al (2015) the calorie content of the foods was strongly correlated with the fat, satfat, and sodium content in foods hence the selection of fewer calories resulted in reductions in also in fat and satfat content of the meals (cafeteria conditions). Further, the study by Tangari et al (2010) – conducted under virtual conditions – showed that calorie levels were used to make inferences about the sodium and satfat content of items. In this study it was indicated that, among items from Burger King and Subway menus this inference was not valid. For example, while the large Subway sandwich meal may have an intermediate levels of calories (relative to large hamburger-based meals), it exceeded the recommended sodium level for an entire day.

A study in hospital cafeterias showed that the provision of calories+sodium+fat on digital menu boards led to, among those patrons at the intervention site who noticed ML, consumption of significantly less energy (77 kcal), sodium (159 mg), satfat (1.5 g), and total fat (-37%) than consumers at the control site which used a health logo to indicate healthier options[114].

Another, longitudinal, study in hospital cafeterias with 96 participants compared labelling of food items with a STL for energy density (ED) plus MNNL for calories+fat+carbohydrate+protein (one hospital cafeteria) with the same labelling in addition to education and discounts on low-ED foods (comparison hospital cafeteria)[77]. This 3 month-long intervention did not result in any differences across groups or over time with respect to kcal purchased or consumed in a 24-hour period. A reduction in percentage of fat in lunches consumed was associated with an increase in carbohydrate intake. Total energy intake from cafeteria-purchased foods and percentage of energy from fat declined over the 6-month post-intervention period among overweight and obese participants.

An oft-quoted study by Freedman et al (2001), in a University Dining Hall, found that pictures of portion-sizes with corresponding numeric information for calories, fat and % calories from fat resulted in a decrease of 20% of students (among 1675) choosing the larger of two portions of French fries (63% pre- vs. 43% post). There was no effect on salad dressing choices, possibly due to negative taste perceptions for the healthier options.

A very small study involving 65 students in a cafeteria showed no effect of the provision of energy+fat information on food choices, and for some sub-groups, labelling had a negative impact.

- Twelve studies relating to this RQ conducted under controlled conditions are included in this review [2, 29, 51, 58, 78, 101, 103, 124]:
  - *calories+ fat vs. no labelling – mothers children 3-6 years [29]*
  - *calories+fat vs. heart icon – FF menus online [16]*
  - *calories+fat vs. heart symbol vs. no label– parents children 6-11 years [102]*
  - *calories+satfat+sodium vs. calories only vs. no labels [21]*
  - *calorie+fat vs. no labels – 106 adolescents; 3 real FF menus [124]*
  - *Calories+satfat+sodium+sugar+protein – popular FF items (parents children 2-12 years who normally choose low or high calorie items) [2]*
  - *Nutrition Facts Panel vs. Calorie content vs. Health-related claims – students [101]*
  - *MTL (calories, fat, sodium, sugar) vs. STL (calories) vs. NEML vs. no NI– Canadian adults [51]*
  - *Calories, fat %, protein %, carbohydrate % vs. descriptive NI (full factorial = four menus)– Taiwanese college students [103]*
  - *kJ vs. kJ + %DI (RDA) vs. kJ + MTL (fat, sodium, sugar) vs. kJ+MTL+%DI vs. no label– Australian adult FF diners [78]*
  - *calories vs. high or low for fat, satfat, cholesterol, sodium, carbohydrates, protein [termed 'evaluative disclosures'] – actual FF items [58]*

A study examining numeric calories+fat found that significantly fewer mothers chose a higher-calorie meal (entrée) when there was ML for calories+fat versus no NI [29]. Conversely, no effect of calories+fat information was found two other studies which compared calories+fat to heart icons, as well as no labels [16] [102]. Similarly, in the study among 106 adolescents using 3 real FF menus, 31 adolescents made some changes to their

orders when exposed subsequently to menus containing calories+fat information after viewing the same menu with no information[124]; however although 43 items were of lower calorific value, 11 were increased calories, i.e. the calorie+fat information led to only calorie decreases by a small proportion of adolescents. This study was also subject to high social desirability bias.

In a simulation study of FF menus in South Korea [2] the low-calorie group (those who normally chose lower calorie items) were more likely to use the multiple NI provided (calories, sugar, protein, satfat, sodium) than the high-calorie group; and the higher-calorie group had more difficulty understanding the NI provided. The study by Hwang (2013) didn't measure calories chosen but indicated that the evaluative disclosures of high or low levels of multiple nutrients led to less favourable evaluations of the FF menu items than when calories only were displayed, particularly among those with a healthy BMI[58]. A study in Taiwan[103] using mock FF menus showed that quantitative NI (calories, % fat, % protein, % carbohydrate) did not have a significant impact on calories chosen, whereas descriptive nutrition information (e.g. "*This dish contains carrots, broccoli, and tomatoes, which are high in vitamins A and C*") did produce a significant impact towards healthier choices.

Multiple traffic light labelling for calories, fat, sodium and sugar, did not lead to fewer calories selected for a free meal among 635 Canadian adults compared to calories only, or STL for calories; however calorie consumption was significantly lower among participants in the calorie-only condition compared to the no information condition[51].

In a lunchtime experiment with 232 students[101], NEML versus NFP versus health-related claims led to the highest calorie reduction and was associated with a significant reduction in the fibre content of the meal. The NFP resulted in largest reductions for empty calories and calories from fat and added sugar, while the health-related claims treatment led to a reduction in carbohydrates and calories from fat.

An Australian study involving online menu boards among 1294 FF diners (adults) showed that the addition of MTL labelling to kJ labelling did not lead to further reductions in calories selected, although both these labelling conditions resulted in significantly lower mean orders compared to the no labelling condition. Differences between the other labelling conditions (kJ+%DI and kJ+MTL+%DI) compared to the control (no label) were not significant.

Two articles were identified that specifically examined the effect of numeric sodium disclosure on sodium content of foods selected. One of these studies involved 4 sub-studies, and showed that disclosure of sodium levels for popular FF items, in addition to calorie information and satfat information, influences purchase intentions and choices of consumers with high health risk levels (hypertension), but has little effect on other consumers[21]. When exposed to the extended NI, 78% of hypertensive adults chose a lower sodium product compared to 42% in calories only or control condition. A much larger study, in Canada, specifically sought to examine the addition of sodium to ML, and across 3 ML treatments [NEML; NEML+sodium; sodium+serving size] and four mock menus, the online survey study showed that in 3 of the 4 restaurant types, consumers who saw NEML+sodium information ordered meals with significantly less sodium than consumers who saw only calorie information[96]. Consumers who saw sodium labelling decreased the sodium level of their meal by an average of 171-384 mg, depending on the restaurant. In the subset of consumers who saw sodium information and chose to change their order, sodium levels decreased by an average of 681-1,360 mg, depending on the restaurant.

6.3.3.2 Overall Healthiness Symbol

- Fifteen studies conducted under field experimental conditions – school, workplace and university cafeterias, full-service restaurants, and QSRs – examined the efficacy of an 'overall healthiness' symbol in encouraging consumers to choose healthier options. Intervention formats were primarily healthy option logos or icons, but included single traffic light labels (STL)in four studies:
  - *green smiley face emoticon (school cafeteria)[98]*
  - *STL label (4 studies: low-income Workplace[68] ; Sport & rec setting[84]; Hospital[108, 109]; 'Go for Green' military dining facilities[5])*
  - *'¡Por Vida! Item' as part of a voluntary restaurant menu designation initiative in the US[100]*
  - *healthy symbol vs. calories only vs. nutrient list – Table service restaurant university campus [69]*
  - *health logo vs. calories+sodium+fat – digital menu boards hospital cafeterias [114]*
  - *healthy and non-healthy nutrient icons; non healthy = numeric + MTL (calories, sodium, sugar, total fat, carbs) – University cafeteria [41]*
  - *'Healthy Picks' label vs. no label – Hospital cafeteria [93]*
  - *'Healthy Choice® label vs. no label – Full service a la carte restaurant [45]*
  - *McDonald's Heart Foundation Tick approved range and Subway's 'Six grams of fat or less' range – FF outlets Australia [6]*
  - *Heart shaped label (and 'Look for the Heart (symbol) for your low-fat entrée selection' sign) – Workplace cafeteria [67]*
  - *'Star Struck' positive marketing scheme(high in fibre and/or low in fat items) – Workplace cafeteria [120]*

Green smiley-face emoticons had a positive impact on white milk versus chocolate sales (without affecting overall milk sales) and vegetable sales in a primary school canteen, although this symbol had no significant effect on entrées or fruits purchased[98]. A single traffic light symbol to denote overall healthiness (STL) has been trialled in the sports & recreation eating environments (overall increase in sales of green items and reduction in sales of red items)[84]; in military dining facilities a 'Go for Green' scheme resulted in reduced percentage energy intake from fat among users compared to non-users, and were more likely to be used by those following a special diet or taking multivitamin or protein supplements; nearly half of all soldiers said they used the labelling at some point[5]; in a cafeteria intervention in a workplace, a TL colour-coded labelling system of green (healthier items) and red (unhealthy items) led to a reduction in purchases of red items (red beverages purchases decreased most) and increased green purchases [68]. A subsequent treatment involving making green items more and red items less accessible (choice architecture) further decreased red purchases; there were no differences according to socio-demographic factors. Further, a similar study among the same research group in a hospital cafeteria environment [61, 62] showed that sales of red items decreased and sales of green items decreased from baseline over a 24 months period, with changes being most obvious for red beverages, i.e. the intervention sustained healthier choices, albeit modest ones, over two years.

Eight different schemes involving 'healthy pick' logos or icons have been trialled under field conditions. The factors '*Patrons' age between 18 and 35 years*' and '*patrons seeing the logo*', were the strongest predictors of purchasing a '*¡Por Vida! Item*' in a voluntary

restaurant menu scheme in Bexar County, US [100]. In the Voluntary McDonald's Heart Foundation Tick approved range (subsequently removed) and Subway's 'Six grams of fat or less' range [6], only a very small proportion of lunchtime diners chose the nutritionally-promoted item; older females and those involved in a health-related profession were more likely to order the foods with the promotions. An (unknown) healthy symbol and favourable attitudes towards healthy eating were both significantly associated with healthier entrée selections in a study among 173 participants at a table service restaurant at a University campus [69]. However the healthy symbol was the least effect format (although most preferred by respondents) compared to calorie only information format which was most effective in reducing calories in the entrees sold, and the nutrient list which was most effective in reducing fat and saturated fat content of the entrees sold[69]. Similarly healthy icons did not affect item selections in another study in a University setting [41]. A very modest increase in sales of 'Healthy Picks' entrees and concurrent modest decrease in sales of regular menu items was observed among 32 menu items in a hospital cafeteria in Northern California [93]. In an intervention study in two hospital cafeterias, a 'health logo' was the control condition compared to calorie+sodium+fat on digital menu boards [114]. The nutrient labelling was significantly more effective than the health logo in reducing energy, fat and sodium purchased. In a full-service a la carte restaurant, 54% of restaurant customers chose the healthy choice menu item, confirming that people who desire NI also use this information in their menu choice [45]. Two older studies in the workplace cafeteria setting [67, 120] showed that (i) a heart symbol was perceived by nearly 50% of customers as influencing their choices, and led to sustained changes in purchase of healthier items, although purchases did not continue to increase in the longer term follow-up [67]; and the 'Star Struck' positive marking scheme for items high in fibre and/or low in fat produced encouraging results.

- Five studies are included which were conducted in a controlled environment or survey setting. Formats were:
  - *Heart symbol vs. calorie+fat vs. no NI [102]*
  - *Heart icon vs. calories+fat [16]*
  - *Boxes around healthy items +/- nutrition labels [40]*
  - *Asterisk next to unhealthy item – explanation at bottom of menu that item marked as unhealthy for exceeding values for fat and/or sugar content [97]*
  - *STL label [107]*

Two studies conducted using online surveys showed that a heart icon trialled among children aged 6-11 years [16] and a heart symbol among adults at a University [102] led to healthier item selections compared to no nutrition information and compared to calories+fat information, the latter format of which had no impact on foods selected in both studies (see above). In the latter study, participants exposed to the heart icon were more than twice as likely to select a healthy meal rather than an unhealthy one. Placing boxes around healthy items led to a significant effect on encouraging healthy menu selections in a laboratory study among undergraduates at a New Jersey University, however this positive effect was mitigated when nutrient labels were added [40]. A single traffic light label – with an indication that this was related to calories, added sugar and fat content – in a convenience sample of 47 adults at a University, was only effective in reducing calories consumed as part of a buffet lunch among lean women [107].

6.3.3.3 Prompting

- Four articles are included which involved nutritional promotion through prompting and were conducted under field experimental conditions:
  - *'Nutricate Receipt; personalised recommendations to switch from unhealthy to healthier items at a restaurant chain [10]*
  - *Verbal prompting by cashiers in self-service restaurant (for low calorie side dishes) [113]*
  - *Table signs listing changes customers might consider (non-chain restaurants) [83]*
  - *Verbal prompt to downsize portions of 3 starchy side dishes (Chinese FF restaurant)[95]*

The 'Nutricate receipt' was effective in shifting the mix of items purchased toward the healthier alternatives, such as increased requests for 'no sauce' with adult main meals, increased share of children's meals with apples instead of fries, and in the share of breakfast sandwiches without sausages [10]. Verbal prompts for healthy side dishes led to increased purchases of these items – particularly orange juice but also fruit salad and pancakes – at breakfast time in a self-service restaurant [113], although there is no indication of impact on overall calorie intake. Table signs listing changes customers might consider such as asking for meat broiled instead of fried, or requesting smaller portions, did not show significant changes in terms of order slips – although these data were found to be an inadequate measure; table signs were noticed by approximately 70% of customers and of those, about one-third said that the signs influenced their order [83]. Three field experiments as part of the same study involved asking customers if they wanted to downsize portions of three starchy side dishes at a Chinese FF restaurant [95]. Up to one-third of customers accepted the downsizing offer reducing total calories served to them by more than 200. A study that was not included as it was not menu board labelling involved a 'Pick me! I'm low calorie' sign on low-fat milk in a university kitchen [122]; the sign was not efficacious.

7 CONCLUSIONS

7.1 Overall summary of evidence by research question

7.1.1 RQ1: Is numeric energy ML (NEML) effective?

- Four recent systematic reviews and meta-analyses, 15 natural experimental studies evaluating real world implementation of NEML in fast food and coffee chain restaurants (QSR – Quick Service Restaurants), 13 field experiments (predominantly in cafeterias and full-service restaurants), and ten studies conducted under artificial, controlled conditions; investigated the impact of NEML on energy ordered/purchased or selected.
- There is mixed evidence regarding the effectiveness of numeric energy labelling, particularly in the specific setting of the QSR, in terms of energy ordered/purchased. Four recent systematic reviews and meta-analyses arrived at different conclusions regarding the effectiveness of NEML with regard to this outcome, with the majority of studies conducted in the real world setting showing no overall increase in calories ordered/purchased as a result of NEML. Study heterogeneity was found to be large in all systematic reviews and meta-analyses limiting the ability to make firm conclusions regarding the evidence.
- There is, however, moderately convincing evidence that NEML leads to a decrease in energy purchased among those consumers who see and use NEML. Meta-analyses indicate that this reduction may be as high as 124.5 kcal (521 kJ) per purchase. Differential effects have been noted in different types of outlets, e.g. burger versus sandwich versus coffee chains, but these findings are not consistent across real world implementation studies (in King County, Washington; in New York City and New York State; in Philadelphia; and in NSW). One of the systematic reviews and meta-analyses indicated that NEML had a greater impact where the level of awareness is higher. Awareness does not, however, necessarily lead to use.
- Very few, weak, studies have examined the effectiveness of NEML with respect to overall daily energy intake. Later, compensatory, effects from 'indulging' at lunchtime, for example, have not been researched.
- Nevertheless there is emerging, although limited, evidence (from one field experiment among students and empirical data in the US) that NEML may impact on weight gain, possibly with a larger impact on lower-income individuals.
- There is mixed evidence for the efficacy of the use of posting of contextual information, i.e. a daily reference value (e.g. 8700 kJ), and this element of NEML has not been independently evaluated for effectiveness in real world implementation studies. Menu board posting of the daily reference value has not been evaluated independently of associated campaign messaging with respect to knowledge of this value.
- There is no consistent evidence to suggest whether NEML is used differentially across population sub-groups, with inconsistent findings across BMI category, race/ethnicity, gender, age, and neighbourhood socio-economic status from research studies. A recent systematic review of NEML by socio-economic position concluded that the evidence was currently limited in quantity and quality. Surveillance studies in the US consistently indicate that women, those who are dieting or obese, and those who are on higher incomes, self-report using NEML more to make food choices.
- No evidence was identified specifically around consumers' literacy with respect to NEML, i.e. accessing, understanding, appraisal and application of NEML to make food

choices. A small number of studies, including real world implementation, showed mixed findings with respect to the effect of NEML on estimation of energy content of foods/items selected or purchased. It has been suggested that future research should consider the personal and situational/contextual factors that affect a person's knowledge, competence and motivation to access, understand, and use health and nutrition information to make a food-related behaviour change.

- There is very limited evidence that reformulation has occurred in response to energy ML, although there is some indication that product innovation (for lower energy content/healthier products) has occurred.
- Revenue does not seem to be affected by NEML.

7.1.2 RQ2: Are there alternative formats for menu labelling with energy alone, which have been shown to be effective (and which also support the policy objective of providing consistent, standardised and clear nutrition information)?

- There has been no real world implementation of alternative formats to numeric labelling of energy content on menu boards.
- There is mixed evidence from field experiments and experiments conducted under controlled conditions as to the effectiveness of the addition of traffic light colour-coding to the numeric values for energy (i.e. use of a single traffic light symbol for energy alone), with evidence tending towards no additional efficacy.
- Similarly there are contrasting findings for studies – which have only been conducted under artificial conditions – examining energy organising into groups and/or rank ordering of energy content. Efficacy may be affected by perceptions regarding restaurant and nutrition information credibility.
- There is an indication from six studies conducted under artificial conditions, that the addition of physical activity equivalents (PAE) to energy labels is effective at reducing energy selected, but not significantly more than NEML alone. There is minor evidence to suggest PAE may be more effective than NEML at promoting healthy eating and prompting exercise.

7.1.3 RQ3: Are there menu labelling approaches which have been shown to be effective that have included (a) other nutrients and/or (b) overall healthiness (and which also support the policy objective of providing consistent, standardised and clear nutrition information)?

- Nine experimental studies conducted in field environments (predominantly cafeteria settings) and 12 studies conducted under artificial, controlled conditions, inform this research question.
- Many of the labels and/or presentations, particularly those used in the field setting, are not applicable to the QSR setting.
- Among a number of studies examining the provision of numeric energy plus numeric fat information, the majority did not prove efficacious compared to no labels. Multiple traffic lights (MTL) labelling does not appear to lead to the selection of less energy beyond that measured due to NEML.
- The use of multiple nutrient numeric labels (MNNL) on printed menus in the real world, full-service restaurant setting has been shown to be effective in reducing energy, sodium and saturated fat purchased, and a field experiment showed greater efficacy for this format than for labelling with a health logo. Evidence from two studies indicates

that the addition of numeric sodium information to numeric energy information might reduce the amount of sodium selected, although this may be only among hypertensive adults.

- Fifteen field experimental studies and two controlled environment experimental studies examined the efficacy of an 'overall healthiness' symbol in encouraging consumers to choose healthier options. A single traffic light colour-coding labelling system in the cafeteria setting appears efficacious in increasing consumer choice of healthier items. However, there is mixed evidence for the use of a 'healthy icon' in encouraging healthier choices.
- There is some evidence from a mixture of interventions that verbal or textual prompting to switch to healthier options or smaller portion sizes may be efficacious.

7.2 Research Gaps and Policy Implications

The 'logic model' of how numeric energy menu labelling is suggested to impact on weight (e.g. Kuo et al 2009[7]) supposes that consumers see the labelling, understand the labelling, and 'use' the labelling to make 'healthier' food choices in the context of the daily diet – i.e. compensatory changes are not made during the remainder of the day which negates the effect of the labelling. Consumers may also choose not to visit such restaurants if they consider the food items on offer to be too unhealthy and/or too high in energy (kilojoules). Very minor sections of the overall logic model have been researched. In particular a large number of personal and situational factors affect a person's ability and motivation to use NEML. Consumer literacy in Australia with respect to kilojoules remains an area for further research. Saliency of the current presentation of NEML has not been explicitly evaluated. Nevertheless there is emerging evidence that NEML may reduce weight gain and thus continuation of the current scheme is recommended.

The lack of good evidence around alternative presentations for ML of energy alone suggests that a more strategic, in-depth body of research is required before considering changes to the current format/presentation. It is likely that no single format will appeal to all consumers.

While energy content is often related to the saturated fat, sugar, and sodium content of fast food items, this is not always the case; and the addition of other nutrients to the ML scheme would attempt to address concerns, beyond weight status, that less healthy fast food items might have on population health. How different consumers might use the various elements of a multiple nutrient ML (MNML) to make food choices is not known; although evidence from implementation under different settings suggests that numeric sodium and possibly numeric fat, although the latter has been less studied, could be considered. Nonetheless, the low feasibility of MNML in the QSR setting, where food choices are made very quickly, renders the need to research alternative, more interpretive formats which might prove more helpful to motivated consumers, such as hypertensive adults, in identifying items to avoid in this specific setting.

[7] Kuo T, et al (2009) Menu labeling as a potential strategy for combating the obesity epidemic: a health impact assessment. American Journal of Public Health 99(9): 1680-1686

8 ABBREVIATIONS

FF	Fast Food
FOPL	Front of pack labelling
HEAL	Healthy Eating Active Living
KC	King County
MA	Meta-analysis
ML	Menu labelling
NMNML	Numeric multiple nutrient menu labelling
NEML	Numeric energy menu labelling
NI	Nutrition information
NFP	Nutrition Facts Panel (US)
NSW	New South Wales
NYC	New York City
POP/POS	Point of purchase/ Point of service
QSR	Quick service restaurant
RCT	Randomised controlled trial
RQ	Research question
SR	Systematic review
UK	United Kingdom
US	United States

9 REFERENCES

1. Abel ML, et al., *Consumer understanding of calorie labeling: A healthy monday email and text message intervention.* Health Promotion Practice, 2015. 16(2): p. 236-243.
2. Ahn, J.-Y., et al., *The effect of providing nutritional information about fast-food restaurant menus on parents' meal choices for their children.* Nutr Res Pract, 2015. 9(6): p. 667-672.
3. Antonelli, R. and A.J. Viera, *Potential effect of physical activity calorie equivalent (PACE) labeling on adult fast food ordering and exercise.* PLoS ONE, 2015. 10(7): p. e0134289.
4. Aron, J.I., R.E. Evans, and D.J. Mela, *Paradoxical effect of a nutrition labelling scheme in a student cafeteria.* Nutrition Research, 1995. 15(9): p. 1251-1261.
5. Arsenault, J.E., M.C. Singleton, and L.K. Funderburk, *Use of the Go-for-Green nutrition labeling system in military dining facilities is associated with lower fat intake.* J Acad Nutr Diet, 2014. 114(7): p. 1067-1071.
6. Atkinson, L.F. and M.A. Palmer, *Purchase rates and energy content of nutritionally promoted and traditional fast foods purchased at lunchtime in Australia-a pilot study.* Public Health Nutrition, 2012. 15(3): p. 495-502.
7. Auchincloss, A.H., et al., *Customer responses to mandatory menu labeling at full-service restaurants.* American Journal of Preventive Medicine, 2013. 45(6): p. 710-719.
8. Balfour, D., et al., *Food choice in response to computer-generated nutrition information provided about meal selections in workplace restaurants.* Journal of Human Nutrition and Dietetics, 1996. 9(3): p. 231-237.
9. Bassett, M.T., et al., *Purchasing Behavior and Calorie Information at Fast-Food Chains in New York City, 2007.* American Journal of Public Health, 2008. 98(8): p. 1457-1459.
10. Bedard, K. and P. Kuhn, *Micro-marketing healthier choices: effects of personalized ordering suggestions on restaurant purchases.* J Health Econ, 2015. 39: p. 106-22.
11. Bleich, S.N., et al., *Reduction in purchases of sugar-sweetened beverages among low-income Black adolescents after exposure to caloric information.* Am J Public Health, 2012. 102(2): p. 329-35.
12. Bleich, S.N., et al., *Reducing sugar-sweetened beverage consumption by providing caloric information: How black adolescents alter their purchases and whether the effects persist.* American Journal of Public Health, 2014. 104(12): p. 2417-2424.
13. Bleich, S.N. and J.A. Wolfson, *Differences in consumer use of food labels by weight loss strategies and demographic characteristics.* BMC Public Health, 2015. 15(1): p. 1-8.
14. Bleich, S.N., et al., *Restaurants With Calories Displayed On Menus Had Lower Calorie Counts Compared To Restaurants Without Such Labels.* Health Aff, 2015. 34(11): p. 1877-84.
15. Bollinger, B., P. Leslie, and A. Sorensen, *Calorie Posting in Chain Restaurants.* American Economic Journal: Economic Policy, 2011. 3(1): p. 91-128.
16. Boonme, K., et al., *Visual Information Influences Consumer Fast-Food Choices.* Nutrition & Food Science, 2014. 44(4): p. 3-3.

17. Bowers, K.M. and S. Suzuki, *Menu-labeling usage and its association with diet and exercise: 2011 BRFSS Sugar Sweetened Beverage and Menu Labeling module.* Preventing Chronic Disease, 2014. 11: p. 130231.

18. Breck, A., et al., *Who reports noticing and using calorie information posted on fast food restaurant menus?* Appetite, 2014. 81(0): p. 30-36.

19. Brissette, I., et al., *Predictors of total calories purchased at fast-food restaurants: restaurant characteristics, calorie awareness, and use of calorie information.* J Nutr Educ Behav, 2013. 45(5): p. 404-11.

20. Bruemmer, B., et al., *Energy, saturated fat, and sodium were lower in entrees at chain restaurants at 18 months compared with 6 months following the implementation of mandatory menu labeling regulation in King County, Washington.* J Acad Nutr Diet, 2012. 112(8): p. 1169-76.

21. Burton, S., et al., *How the perceived healthfulness of restaurant menu items influences sodium and calorie misperceptions: Implications for nutrition disclosures in chain restaurants.* Journal of Consumer Affairs, 2014. 48(1): p. 62-95.

22. Cantor, J., et al., *Five Years Later: Awareness Of New York City's Calorie Labels Declined, With No Changes In Calories Purchased.* Health Aff, 2015. 34(11): p. 1893-900.

23. Chen, R., et al., *Changes in awareness and use of calorie information after mandatory menu labeling in restaurants in King County, Washington.* Am J Public Health, 2015. 105(3): p. 546-53.

24. Chu LY, *Effectiveness of energy labelling in restaurant menu in reducing calorie in food selection and consumption: A systematic review*, 2014, University of Hong Kong.

25. Chu, Y.H., et al., *Improving patrons' meal selections through the use of point-of-selection nutrition labels.* Am J Public Health, 2009. 99(11): p. 2001-5.

26. Cranage, D.A., M.T. Conklin, and C.U. Lambert, *Effect of Nutrition Information in Perceptions of Food Quality, Consumption Behavior and Purchase Intentions.* Journal of Foodservice Business Research, 2004. 7(1): p. 43-61.

27. Davis, M., et al., *FDA Ruling and Nutritionally Focused Menus: Alternative Strategies to Comply with the U.S. Federal Guidelines.* Journal of Foodservice Business Research, 2014. 17(4): p. 283-300.

28. Dodds, P., et al., *The effect of energy and traffic light labelling on parent and child fast food selection: a randomised controlled trial.* Appetite, 2014. 73(0): p. 23-30.

29. Domoff, S.E., et al., *Maternal feeding goals and restaurant menu choices for young children.* Childhood Obesity, 2015. 11(4): p. 484-488.

30. Downs, J.S., et al., *Supplementing menu labeling with calorie recommendations to test for facilitation effects.* American Journal of Public Health, 2013. 103(9): p. 1604-1609.

31. Dowray, S., et al., *Potential effect of physical activity based menu labels on the calorie content of selected fast food meals.* Appetite, 2013. 62: p. 173-181.

32. Dumanovsky, T., et al., *Changes in energy content of lunchtime purchases from fast food restaurants after introduction of calorie labelling: cross sectional customer surveys.* Bmj, 2011. 26(343): p. d4464.

33. Elbel, B., et al., *Calorie labeling and food choices: a first look at the effects on low-income people in New York City*. Health Aff (Millwood), 2009. 28(6): p. w1110-21.

34. Elbel, B., J. Gyamfi, and R. Kersh, *Child and adolescent fast-food choice and the influence of calorie labeling: a natural experiment*. Int J Obes (Lond), 2011. 35(4): p. 493-500.

35. Elbel, B., et al., *Calorie labeling, Fast food purchasing and restaurant visits.* Obesity, 2013. 17(10): p. 20550.

36. Ellison, B., J.L. Lusk, and D. Davis, *Looking at the label and beyond: The effects of calorie labels, health consciousness, and demographics on caloric intake in restaurants.* International Journal of Behavioral Nutrition and Physical Activity, 2013. 10.

37. Ellison, B., *"I'll have what he's having": Group ordering behavior in food choice decisions.* Food Quality and Preference, 2014. 37: p. 79-86.

38. Ellison, B., J.L. Lusk, and D. Davis, *The Effect of Calorie Labels on Caloric Intake and Restaurant Revenue: Evidence from Two Full-Service Restaurants.* Journal of Agricultural and Applied Economics, 2014. 46(02): p. 173-191.

39. Ellison, B., J.L. Lusk, and D. Davis, *The impact of restaurant calorie labels on food choice: Results from a field experiment.* Economic Inquiry, 2014. 52(2): p. 666-681.

40. Feldman, C., et al., *Menu Psychology to Encourage Healthy Menu Selections at a New Jersey University.* Journal of Culinary Science and Technology, 2014. 12(1): p. 1-21.

41. Feldman, C.H., et al., *Nutrition information and its influence on menu choice within higher education establishments.* British Food Journal, 2015. 117(4): p. 1399-1410.

42. Finkelstein, E.A., et al., *Mandatory Menu Labeling in One Fast-Food Chain in King County, Washington.* American Journal of Preventive Medicine, 2011. 40(2): p. 122-127.

43. Fotouhinia-Yepes, M., *Menu Calorie Labelling in a Fine Dining Restaurant: Will it Make a Difference?* Journal of Quality Assurance in Hospitality and Tourism, 2013. 14(3): p. 281-293.

44. Freedman, M.R., *Point-of-Selection Nutrition Information Influences Choice of Portion Size in an All-You-Can-Eat University Dining Hall.* Journal of Foodservice Business Research, 2011. 14(1): p. 86-98.

45. Gallicano, R., R.J. Blomme, and A. Van Rheede, *Consumer response to nutrition information menu labeling in full-service restaurants: Making the healthy choice®*, in *Advances in Hospitality and Leisure*2012. p. 109-125.

46. Gerend, M.A., *Does calorie information promote lower calorie fast food choices among college students?* J Adolesc Health, 2009. 44(1): p. 84-6.

47. Giesen, J.C., et al., *Exploring how calorie information and taxes on high-calorie foods influence lunch decisions.* The American Journal of Clinical Nutrition, 2011. 93(4): p. 689-694.

48. Girz, L., et al., *The effects of calorie information on food selection and intake.* International journal of obesity (2005), 2012. 36(10): p. 1340-1345.

49. Goswami I and Urminsky O *The "mere-reminder" effect of salient calorie labelling*. Chicago Booth Research Paper, 2015.

50. Green, J.E., A.G. Brown, and P. Ohri-Vachaspati, *Sociodemographic disparities among fast-food restaurant customers who notice and use calorie menu labels.* J Acad Nutr Diet, 2015. 115(7): p. 1093-101.

51. Hammond, D., et al., *A randomized trial of calorie labeling on menus.* Preventive Medicine, 2013. 57(6): p. 860-866.

52. Hammond, D., et al., *The impact of nutrition labeling on menus: a naturalistic cohort study.* Am J Health Behav, 2015. 39(4): p. 540-8.

53. Harnack, L.J., et al., *Effects of calorie labeling and value size pricing on fast food meal choices: results from an experimental trial.* Int J Behav Nutr Phys Act, 2008. 5: p. 63.

54. Haws, K.L. and P.J. Liu, *Half-size me? How calorie and price information influence ordering on restaurant menus with both half and full entrée portion sizes.* Appetite, 2016. 97: p. 127-137.

55. Hee Park, S. and I.-K. Oh, *The Effect of Nutrition Information on Consumers' Healthy Menu Choices at a Fast Food Restaurant.* International Journal of Tourism Sciences, 2009. 9(3): p. 25-38.

56. Heiman, A. and O. Lowengart, *Calorie information effects on consumers' food choices: Sources of observed gender heterogeneity.* Journal of Business Research, 2014. 67(5): p. 964-973.

57. Hunsberger, M., et al., *Calorie labeling in a rural middle school influences food selection: findings from community-based participatory research.* J Obes, 2015. 531690(10): p. 531690.

58. Hwang, J., *The effects of nutrient ad disclosures of fast food menu items on consumer selection behaviors regarding subjective nutrition knowledge and body mass index.* British Food Journal, 2013. 115(9): p. 1281-1296.

59. James, A., B. Adams-Huet, and M. Shah, *Menu labels displaying the kilocalorie content or the exercise equivalent: effects on energy ordered and consumed in young adults.* Am J Health Promot, 2015. 29(5): p. 294-302.

60. Jue, J.J.S., et al., *The impact of price discounts and calorie messaging on beverage consumption: A multi-site field study.* Preventive Medicine, 2012. 55(6): p. 629-633.

61. Kiszko, K.M., et al., *The influence of calorie labeling on food orders and consumption: a review of the literature.* J Community Health, 2014. 39(6): p. 1248-69.

62. Kitchlu, N., et al., *Assessing the effectiveness of calorie labeling on restaurant menus.* Environmental Health Review, 2013. 56(03): p. 73-82.

63. Krieger J and Saelens BE, *Impact of menu labelling on consumer behaviour: a 2008-2012 update*, in *Healthy Eating Research: Building evidence to prevent childhood obesity*, R.W.J. Foundation, Editor 2013 Robert Wood Johnson Foundation: Princeton, New Jersey. p. 23 pages.

64. Krieger, J.W., et al., *Menu labeling regulations and calories purchased at chain restaurants.* American Journal of Preventive Medicine, 2013. 44(6): p. 595-604.

65. Lee-Kwan, S.H., et al., *Restaurant menu labeling use among adults--17 states, 2012.* MMWR Morb Mortal Wkly Rep, 2014. 63(27): p. 581-4.

66. Lee, K., Y. Lee, and S. Kwon, *How nutrition information frame affects parents' perceptions of restaurants: The moderating role of information credibility.* International Journal of Hospitality Management, 2015. 46: p. 112-119.

67. Levin, S., *Pilot Study of a Cafeteria Program Relying Primarily on Symbols to Promote Healthy Choices.* Journal of Nutrition Education, 1996. 28(5): p. 282-285.

68. Levy, D.E., et al., *Food Choices of Minority and Low-Income Employees: A Cafeteria Intervention.* American Journal of Preventive Medicine, 2012. 43(3): p. 240-248.

69. Li G, Behnke C, and Almanza B, *An evaluation of three nutrition labelling formats for restaurant menus.* FIU Hospitality Review, 2014. 31(3): p. 145-169.

70. Littlewood, J.A., et al., *Menu labelling is effective in reducing energy ordered and consumed: a systematic review and meta-analysis of recent studies.* Public Health Nutr, 2015. 30: p. 1-16.

71. Littlewood JA and Kyrø C *Implementing menu board labelling in Denmark; Expert' perspectives*. Report: The Danish Cancer Society, 2014. 50 pp, + Appendices; www.cancer.dk/rapporter.

72. Littlewood JA and Olsen A *Menu labelling is effective in reducing energy ordered and consumed: An update of the evidence 2012-2014*. Danish Cancer Society, 2014. 47 pp, www.cancer.dk/rapporter.

73. Liu, P.J., et al., *A test of different menu labeling presentations.* Appetite, 2012. 59(3): p. 770-7.

74. Liu, P.J., et al., *'How many calories are in my burrito?' Improving consumers' understanding of energy (calorie) range information.* Public Health Nutrition, 2014. FirstView: p. 1-10.

75. Long, M.W., et al., *Systematic review and meta-analysis of the impact of restaurant menu calorie labeling.* Am J Public Health, 2015. 105(5): p. e11-24.

76. Loureiro ML and Rahmani D, *Calorie labeling and fast food choices in surveys and actual markets: some new behavioural results*, in *Agricultural & Applied Economics Association & CAES Joint Annual Meeting*2013: Washington, DC.

77. Lowe, M.R., et al., *An intervention study targeting energy and nutrient intake in worksite cafeterias.* Eating Behaviors, 2010. 11(3): p. 144-151.

78. Morley, B., et al., *What types of nutrition menu labelling lead consumers to select less energy-dense fast food? An experimental study.* Appetite, 2013. 67: p. 8-15.

79. Namba, A., et al., *Exploratory analysis of fast-food chain restaurant menus before and after implementation of local calorie-labeling policies, 2005-2011.* Prev Chronic Dis, 2013. 20(10): p. E101.

80. Nikolaou, C.K., C.R. Hankey, and M.E. Lean, *Preventing weight gain with calorie-labeling.* Obesity, 2014. 22(11): p. 2277-83.

81. Nikolaou, C.K., C.R. Hankey, and M.E.J. Lean, *Effects of calorie labelling on macro- and micro-nutrients in main-meal choices made by young adults.* European Journal of Clinical Nutrition, 2015: p. 10.1038/ejcn.2015.175.

82. Nikolaou, C.K., C.R. Hankey, and M.E.J. Lean, *Calorie-labelling: Does it impact on calorie purchase in catering outlets and the views of young adults?* International Journal of Obesity, 2015. 39(3): p. 542-545.

83. Nothwehr, F.K., et al., *Promoting healthy choices in non-chain restaurants: effects of a simple cue to customers.* Health Promot Pract, 2013. 14(1): p. 132-8.

84. Olstad, D.L., et al., *Using traffic light labels to improve food selection in recreation and sport facility eating environments.* Appetite, 2015. 91: p. 329-335.

85. Pang J and Hammond D, *Efficacy and consumer preferences for different approaches to calorie labeling on menus.* Journal of Nutrition Education and Behavior, 2013. 45(6): p. 669-675.

86. Parker, J.R. and D.R. Lehmann, *How and When Grouping Low-Calorie Options Reduces the Benefits of Providing Dish-Specific Calorie Information.* Journal of Consumer Research, 2014. 41(1): p. 213-235.

87. Platkin, C., et al., *The effect of menu labeling with calories and exercise equivalents on food selection and consumption.* BMC Obes, 2014. 1: p. 21.

88. Pratt, N.S., et al., *Improvements in recall and food choices using a graphical method to deliver information of select nutrients.* Nutr Res, 2016. 36(1): p. 44-56.

89. Restrepo B *Calorie labelling in chain restaurants and body weight: Evidence from New York*. 2016 February. http://www.mwpweb.eu/1/154/resources/research_245_1.pdf.

90. Roberto, C.A., et al., *Evaluating the impact of menu labeling on food choices and intake.* Am J Public Health, 2010. 100(2): p. 312-8.

91. Roseman, M.G., K. Mathe-Soulek, and J.A. Higgins, *Relationships among grocery nutrition label users and consumers' attitudes and behavior toward restaurant menu labeling.* Appetite, 2013. 71: p. 274-8.

92. Saelens, B.E., et al., *Nutrition-labeling regulation impacts on restaurant environments.* American Journal of Preventive Medicine, 2012. 43(5): p. 505-511.

93. Sato, J.N., et al., *Food Label Effects on Customer Purchases in a Hospital Cafeteria in Northern California.* Journal of Foodservice Business Research, 2013. 16(2): p. 155-168.

94. Schornack B and Rozensher S, *The effects of menu calorie labelling on consumer food choice behavior.* American Journal of Health Sciences, 2014. 5(1): p. 29-36.

95. Schwartz, J., et al., *Inviting consumers to downsize fast-food portions significantly reduces calorie consumption.* Health Aff, 2012. 31(2): p. 399-407.

96. Scourboutakos, M.J., et al., *Restaurant menu labelling: Is it worth adding sodium to the label?* Can J Public Health, 2014. 105(5): p. e354-61.

97. Shah, A.M., et al., *Surcharges plus unhealthy labels reduce demand for unhealthy menu items.* Journal of Marketing Research, 2014. 51(6): p. 773-789.

98. Siegel, R.M., et al., *Emoticon use Increases Plain Milk and Vegetable Purchase in a School Cafeteria without Adversely Affecting Total Milk Purchase.* Clin Ther, 2015. 37(9): p. 1938-43.

99. Sinclair, S.E., M. Cooper, and E.D. Mansfield, *The influence of menu labeling on calories selected or consumed: a systematic review and meta-analysis.* J Acad Nutr Diet, 2014. 114(9): p. 1375-1388.e15.

100. Sosa, E.T., L. Biediger-Friedman, and M. Banda, *Associations Between a Voluntary Restaurant Menu Designation Initiative and Patron Purchasing Behavior.* Health Promotion Practice, 2014. 15(2): p. 281-287.

101. Streletskaya, N.A., et al., *Menu-Labeling Formats and Their Impact on Dietary Quality.* Agribusiness, 2015: p. DOI: 10.1002/agr.21444.

102. Stutts, M.A., et al., *Nutrition Information and Children's Fast Food Menu Choices.* Journal of Consumer Affairs, 2011. 45(1): p. 52-86.

103. Sun, Y.H.C., *Menu Nutrition Labels' Effects on Customers' Attitudes toward Menu and Restaurant Dining Intentions-The Moderating Role of Psychosocial Factors.* Journal of Foodservice Business Research, 2013. 16(2): p. 139-154.

104. Swartz, J.J., D. Braxton, and A.J. Viera, *Calorie menu labeling on quick-service restaurant menus: An updated systematic review of the literature.* International Journal of Behavioral Nutrition and Physical Activity, 2011. 8: p. 135.

105. Tandon, P.S., et al., *The impact of menu labeling on fast-food purchases for children and parents.* Am J Prev Med, 2011. 41(4): p. 434-8.

106. Tangari, A.H., et al., *Weighing in on Fast Food Consumption: The Effects of Meal and Calorie Disclosures on Consumer Fast Food Evaluations.* Journal of Consumer Affairs, 2010. 44(3): p. 431-462.

107. Temple, J.L., et al., *Nutrition labels decrease energy intake in adults consuming lunch in the laboratory.* J Am Diet Assoc, 2011. 111(5 Suppl): p. S52-5.

108. Thorndike, A.N., et al., *A 2-phase labeling and choice architecture intervention to improve healthy food and beverage choices.* American Journal of Public Health, 2012. 102(3): p. 527-533.

109. Thorndike, A.N., et al., *Traffic-light labels and choice architecture: Promoting healthy food choices.* American Journal of Preventive Medicine, 2014. 46(2): p. 143-149.

110. Tian Y, *Impact of menu designs and personal dietary behaviors on young Millenials' restaurant menu choices*, in *Hotel Administration*2015, University of Nevada. p. 143.

111. TNS Social Research, *Fast Choices: An evaluation of energy purchased and consumer information*, 2013.

112. USDA Nutrition Evidence Library, *What is the effect of use of food and menu labels on dietary intake or body weight across US population groups? (2015 DGAC)*, 2015.

113. van Kleef, E., O. van den Broek, and H.C.M. van Trijp, *Exploiting the Spur of the Moment to Enhance Healthy Consumption: Verbal Prompting to Increase Fruit Choices in a Self-Service Restaurant.* Applied Psychology-Health and Well Being, 2015. 7(2): p. 149-166.

114. Vanderlee, L. and D. Hammond, *Does nutrition information on menus impact food choice? Comparisons across two hospital cafeterias.* Public Health Nutr, 2014. 17(6): p. 1393-402.

115. VanEpps EM, Downs JS, and Loewenstein G, *Calorie Label Formats: Using Numbers or Traffic Lights to Reduce Lunch Calories.* Journal of Public Policy & Marketing, 2016: p. http://dx.doi.org/10.1509/jppm.14.112.

116. Viera, A.J. and R. Antonelli, *Potential effect of physical activity calorie equivalent labeling on parent fast food decisions.* Pediatrics, 2015. 135(2): p. e376-e382.

117. Webb, K.L., et al., *Menu Labeling Responsive to Consumer Concerns and Shows Promise for Changing Patron Purchases.* Journal of Hunger & Environmental Nutrition, 2011. 6(2): p. 166-178.

118. Wei, W. and L. Miao, *Effects of calorie information disclosure on consumers' food choices at restaurants.* International Journal of Hospitality Management, 2013. 33(1): p. 106-117.

119. Wethington, H., et al., *Use of calorie information at fast-food and chain restaurants among US adults, 2009.* J Public Health, 2014. 36(3): p. 490-6.

120. Williams, C. and J. Poulter, *Formative evaluation of a workplace menu labelling scheme.* Journal of Human Nutrition and Dietetics, 1991. 4(4): p. 251-262.

121. Williams, O., et al., *Hip Hop HEALS: Pilot Study of a Culturally Targeted Calorie Label Intervention to Improve Food Purchases of Children.* Health Educ Behav, 2016. 43(1): p. 68-75.

122. Wilson, A.L., S. Bogomolova, and J.D. Buckley, *Lack of efficacy of a salience nudge for substituting selection of lower-calorie for higher-calorie milk in the work place.* Nutrients, 2015. 7(6): p. 4336-4344.

123. Wisdom J, Downs JS, and Lowenstein G, *Promoting healthy choices: Information versus convenience.* American Economic Journal: Applied Economics, 2010. 2(2): p. 164-178.

124. Yamamoto, J.A., et al., *Adolescent fast food and restaurant ordering behavior with and without calorie and fat content menu information.* Journal of Adolescent Health, 2005. 37(5): p. 397-402.

125. Yang, W., et al., *FDA Ruling and Nutritionally Focused Menus—Part II: Consumer Effort Versus Nutritional Accuracy in Restaurant Menus.* Journal of Foodservice Business Research, 2015. 18(2): p. 93-110.

126. Yepes, M.F., *Mobile Tablet Menus: Attractiveness and Impact of Nutrition Labeling Formats on Millennials' Food Choices.* Cornell Hospitality Quarterly, 2015. 56(1): p. 58-67.

APPENDIX 1: TABULATED DETAILS OF INCLUDED STUDIES

Table 1 Summary of recent systematic reviews and meta-analyses with regard to the effectiveness of energy menu labelling (ML)

Author/ date	Data limits	Interventions	Outcomes	Included Studies	Exclusions	Critical appraisal	Meta-analyses	Overall findings
Littlewood et al 2015[70]	2012-2014	Menu labelling – prominent display of energy values on menus (or food tags, retail shelf displays, other promotional material)	– Energy consumed – Energy ordered – Energy selected (purchase intentions) – Importance ML format – ML awareness ('noticing')	Real world and experimental settings N = 15	If they assessed only: (i) customer/participant awareness of ML; (ii) self-reported use of ML; (iii) consumer energy-based knowledge; (iv) consumer attitude towards the provision of ML; and/or (v) consumer preference for various labelling formats	Rating scheme inspired by previous reviews. According to: study setting; sample size; extent of displaying ML; ML noticing rate; randomization (for experimental studies) or case-control match (for real-world studies); degree of blinding	– energy consumption (n=3) – energy ordered in RW situations (n=5) – + experimental settings (n=7) – energy selected (n=6)	9/15 studies showed statistically significant reductions in energy consumed, ordered or selected 3 articles reported no effect of menu labelling MA showed sig effects on overall energy consumed 419.5 kJ (100.2 kcal) and energy ordered in real-world settings mean - 325.7 kJ (77.8 kcal)
Long et al 2015[75]	Up to Oct 2013	Menu calorie labelling (with our without daily anchor statement) compared with control condition	– BMI – Calories ordered/ purchased in single meal – Calorie consumed single meal – Total daily energy intake	Experimental and quasi-experimental studies N = 19	menu labelling formats not included in federal labelling laws (e.g. NFL, TL labels, PA labels, menu items ranked by calorie content, %DI) Cross-sectional studies at single time point	Estimates from studies in restaurant settings with control deemed at lowest risk of bias Publication bias assessed through visual inspection of funnel plot and Begg's test	– restaurant vs. non-restaurant – restaurants controlled vs. restaurants no control	Among 19 studies, -18.13 kcal reduction ordered per meal - with significant heterogeneity across studies Among 6 controlled studies in restaurant settings, n.s. -7.63 reduction Among 10 studies in non-restaurant settings n.s. -18.13 reduction
Nikolaou et al 2015[82]	1990 - 2014	Effect of calorie labelling on calories purchased	– Calories purchased	Calorie labelling in real-life settings N = 7 (N = 6 for MA)	– studies on children – low quality studies	Cochrane risk of bias assessment tool	– studies in coffee & FF chains (n=6) [some studies different time points] – subgroups who noticed calorie labels (n=2)	3/7 studies reported reductions in calories (-38.1 to -12.4 kcal) MA showed no overall effect (-5.8 kcal; -19.4 to 7.8) Reduction of -124.5 kcal (-150.7 to 113.8 kcal) among those noticed labelling (30-60% customers)

Sinclair et al 2014[99]	1990 – March 2013	Informative, contextual, or interpretive menu labelling provided in a restaurant or other food service setting	– Calories selected – Calories consumed – Other estimates of caloric intake (e.g. frequency of purchase of calorically-targeted items)	Controlled experimental and quasi-experimental studies N = 17	– No control group – Nature of control condition didn't allow effect of nutrition info to be isolated – Nutrition literacy or awareness of info – Consumers' intentions (e.g. online surveys)	Scottish Intercollegiate Guidelines Network methodology checklists for cohort studies and controlled trials (for quasi-exp/exp trials resp.) All studies initially graded as low quality. Re-examined for items that distinguished studies: relatively more/less likely to deviate from truth	outcome and/or by menu label format/type sensitivity/subgroup analysis – significant results for studies in natural setting and results separately for women; also for contextual or interpretive information on menus	Menu labelling with calories alone did not decrease calories selected or consumed (-31 [30.84]kcal; p=0.35, and -13 kcal; p=0.61) resp. Addition of contextual or interpretive nutrition info = selection and consumption of fewer calories (-67 [67.39]kcal, p=0.008; and -81 kcal p=0.007) respectively Gender effect - women used the info to select and consume fewer calories

Table 2 Summary details for evaluation studies of menu labelling implementation in the real world setting

Author Year Location	Intervention	Setting	Study Design	Sample	Outcomes	Findings	Additional Findings Comments
Atkinson & Palmer 2012 ***QLD, Australia***	Nutritionally-promoted: ▪ McDonald's NHF Tick range ▪ Subway's 'Six grams of fat or less' range	McDonald's and Subway FF restaurants	Post-only 2 months *Customer intercept receipts and survey*	Lunchtime diners 16 years+ N=927 (median age 25 years)	Purchase of healthier (promoted) items	Only 3% (24/910) of respondents who ordered a main option purchased a nutritionally-promoted item These 3% purchased 1.5 fewer MJ and 0.6 more veg serves than purchasers of traditional foods (p<0.05)	Purchasers were 13 years older, predominantly female (79%), and more often reported in health-related profession (29% vs. 11%) (p<0.05)
Auchincloss Mallya et al 2013 ***Philadelphia US***	Mandatory MNML Numeric: ▪Calories ▪Sodium ▪Fat ▪Carbohydrates *Printed menus*	7 full service chain restaurants 2 NMNML 5 control	Post-only with comparison (between city cross-sectional study) *Customer intercept receipts and survey*	N = 648 Mean age = 37yrs	Calories purchased Nutrients purchased Use	Labelled restaurants 151 fewer kcal purchased (95% CI=-270, -33); 224 mg less sodium (-457, +8); and 3.7 g less SFA (-7.4, -0.1) vs. customers at unlabelled restaurants [155 (-284,-27) fewer kcal from food plus beverages] Those reporting NI affected their order purchased 400 fewer food calories, 370 mg less sodium, and 10g less SFA	76% noticed ML at energy label sites 26% reported that it influenced their ordering decisions Rated FAIR by Littlewood
Bassett 2008 ***New York City, US***	Voluntary calorie ML (NEML)	167 FF outlets	Observational, single-time point (baseline data pre-regulation, although already implemented	N= 7318 customers	Awareness Use Calories purchased	Significantly more consumers saw ML at Subway vs. other FF outlets (32% vs. 4%, p<0.001) Of those seeing, 37% reported using, and these purchased 99 kcal fewer than those seeing and not using (p<0.001) Among Subway consumers who	Study not included in meta-analyses Schornack & Rozensher (2014) indicate that self-selection bias would have been high in

			some outlets) *Purchases and survey*			reported seeing ML purchased 52 kcal fewer than those not seeing (p<0.001) and fewer meals ≥ 1000 kcal (17% vs. 23%, p<0.01)	this study
Bollinger Leslie et al **2011** ***New York City, US***	Mandatory calorie ML (NEML)	316 STARBUCKS 222 NYC (ML) 94 Boston & Philadelphia (control)	Pre- / post- with comparison 3 months pre-/11 months post- *Sales data*	2.7 million anonymous Starbucks cardholders	Calories purchased Revenue	Average calories per transaction fell by 5.8% (14.4 kcal, p<0.01) Almost entirely related to changes in consumers' food rather than beverage choices Larger impact among high-calorie purchasers – 26% decrease in calories per transaction	No impact on revenue (store visits, purchases, profits) Females more responsive than males
Brissette Lowenfels et al **2013** ***New York State, US***	Mandatory calorie ML (NEML)	31 FF burger restaurants 17 ML 14 control	Post-only (single-time point) with comparison group (between-group) *Customer intercept receipts and survey*	Adult customers N = 1,094	Customer purchasing patterns Predictors	Calorie use and calorie awareness independently associated with total calories purchased (all P < .05) When 3 purchasing patterns were added to the model, calorie use (P = .005), but not calorie awareness, remained associated with total calories purchased Energy ordered = 947.7 vs. 888.1 (59.6 fewer) kcal (p=0.05); among those reported using = 84.4 fewer kcal (controlling for restaurant characteristics, calorie knowledge, calorie awareness)	Rated FAIR by Littlewood In kJ = energy decreased from 3965 to 3715.8 kcal (p=0.05) in sites with ML vs. sites with no ML

Cantor Torres et al **2015** ***New York City, US***	Mandatory calorie ML (NEML)	4 FF chains	Time series Pre-post- with comparison Immediately after regulation in 2008, then 3 time points 2013-14 *Receipts and survey responses*	Adult consumers N=7699	Awareness Use Calories or other nutrients purchased Frequency visits to FF restaurants	In each successive period of data collection, the % of respondents noticing and using NI declined, while remaining above the pre-baseline level No statistically significant changes over time in levels of calories or other nutrients purchased or in the frequency of visits to FF restaurants	
Downs Wisdom et al **2013** ***New York City (Manhattan & Brooklyn)*** ***US***	Mandatory calorie ML+ (NEML±DRV) Subjects randomised to receive: ▪ Per meal anchor ▪ Daily anchor ▪ No calorie anchor	2 McDonald's	Pre- / post- no comparison 2 months pre- 2 months post- *Customer intercept receipts*	Adult lunchtime customers n=1121 (n=624 pre- n=497 post-)	Calories purchased	No direct impact, nor did it moderate the impact of calorie labels on food purchases Labelling (b=17.74; SE = 28.20)/Daily anchor (b=61.44; 34.22)/combined effect = 79.18; SE=62.42) Appeared to promote a slight increase in calorie intake, attributable to increased purchases of higher-calorie entrees	Daily or per meal calorie recommendations didn't enhance the impact of posted calorie information Also in coffee ship (no effect)
Dumanovsky al 2011 ***New York City*** ***US***	Voluntary then Mandatory calorie ML (NEML)	168 randomly selected FF restaurant locations (3 burger, 2	Pre- / post- no comparison 12 months pre- 9 months post-	Adult customers n=7309 pre- n=8489 post-	Calories purchased (lunchtime) Use	Mean calories purchased did not change from before to after regulation among full sample (828 v 846 kcal, P = 0.22) 18 kcal ns change. Modest decrease after adjustment for restaurant chain,	15% reported using Customers using purchased 106 fewer kilocalories than customers who did not see or use the calorie information

		sandwich, 3 pizza, 2 chicken, 1 taco)	*Customer intercept receipts and survey*			poverty level, gender of customers, type of purchase, inflation adjusted cost (847 v 827 kcal, P = 0.01) 3 chains (42% of customers surveyed) significant reductions in mean energy purchased: ▪ McDonald's 829 v 785 (-44) kcal, P = 0.02 ▪ Au Bon Pain 555 v 475 (-80) kcal, P<0.001 ▪ KFC 927 v 868 (-59) kcal, P<0.01) Mean energy increased for Subway (749 v 882 (133) kcal, P<0.001	(757 v 863 kcal, P<0.001) Nikolaou indicated GOOD quality (low risk bias) GENDER – among those who noticed= -94.6 kcal for men (p=0.003) and 99 kcal for women (p<0.001)
Elbel et al 2009 ***NYC and Newark*** ***US***	Mandatory calorie ML (NEML)	19 FF restaurants (McDonald's, Burger King, Wendy's, KFC) 14 NYC (case) 5 Newark (controls)	Pre- / post-with comparison 4 months interval *customer intercept receipts and survey*	Adult customers n=1,156	Calories purchased Awareness Use	No statistically significant differences in calories purchased (difference-in-difference b=19 kcal (SE=58) Awareness increased NYC from 17% to 54% vs. no change Newark 27.7% of those who saw calorie labelling in New York said the information influenced their choices	No differences by GENDER, age, race
Elbel et al 2011 ***NYC***	Mandatory calorie ML (NEML)	19 FF restaurants (McDonald's, Burger King,	Pre- / post-with comparison 2 weeks pre-	Children and adolescents; 1-17 yrs n=349	Calories purchased (lunch and dinner)	No statistically significant differences in calories purchased at either site	57% adolescents reported noticing (0% pre-) in NYC

(mandatory) and Newark (NJ) ***US***		Wendy's, KFC) 14 NYC (case) 5 Newark (controls)	4 weeks post- *customer intercept receipts and survey*	low-income; high minority groups	Awareness Use		9% considered (used) the information when ordering
Elbel et al 2013 ***Philadelphia and Baltimore,*** ***US***	Mandated calorie ML (NEML)	FF restaurants	Differences-in-differences design Single time pre- post-, with matched comparison city *customer receipts and telephone survey*	Predominantly black and High School educated	Use calories purchased (fast food receipts) Weekly fast-food visits	Post-labelling, 38% (from 9%) of Philadelphia consumers noticed the calorie labels for a 33% point ($P < 0.001$) increase relative to Baltimore (unchanged 14%) Calories purchased and number of fast food visits did not change in either city over time	No difference by GENDER Rated FAIR by Littlewood
Finkelstein et al 2011 ***King County, US***	Mandated calorie ML (NEML)	7 Mexican FF restaurants (Taco Time) 7 control locations (adjacent counties)	Pre- and immediately post-law up to posting of drive-thru menus (Jan - July 2009) and after the drive-thru postings (Aug 2009 - Jan 2010)	>11,000 transactions	Calories purchased	No impact on purchasing behaviour Non-significant increase of 19 kcal No effect at 8 or 13 months post-	Total calories purchased pre- and post- in KC were significantly lower than in counties outside of KC (180 kcal lower, $p<0.05$) – may help explain why mandate did not have bigger impact in KC
Green Brown et al 2015	Mandated calorie ML	29 McDonald's	Single time point post-only	n=329	Awareness	Approximately 60% noticed calorie menu labels; 16%	

	(NEML)	restaurant locations				reported using the information for purchases	
Phoenix, AZ; US			6-7 months post implementation (over 8 weeks) *Street intercept – survey and receipts*		Use Calories purchased	Higher-income individuals had twice the odds of noticing calorie labels (P=0.029) and three times the odds of using them (P=0.004) Significant positive associations were found between individuals with a bachelor's degree or higher and use of calorie menu labels (odds ratio 3.25; P=0.023) Noticing calorie menu labels was not associated with purchasing fewer calories; however, those who reported using calorie information purchased 146 fewer calories than those who did not (P=0.001)	
Krieger et al 2013 ***King County, Washington, US***	Mandated calorie ML (NEML)	50 locations from 10 chain (FF and coffee) restaurants	Pre-post-post- time series, no comparison Baseline and 4-6 months post- and 18-months post- *Receipts and*	Customers n=7325	Calories purchased Awareness	No significant changes overall Mean calories per purchase decreased from 908.5 to 870.4 at 18 months post-implementation (38 kcal, 95% CI=-76.9, 0.8, p=0.06) in *food* chains and from 154.3 to 132.1 (22 kcal, 95% CI=-35.8, -8.5, p=0.002) in *coffee* chains. They decreased more among females than males in coffee chains.	In summary, mean calories per purchase decreased 18 months after implementation of menu labelling in some restaurant chains and among women but not men GENDER effect: -65.4 calories for meal

			exit survey			Calories decreased in taco and coffee chains, but not in burger and sandwich establishments Awareness increased from 18.8% to 58.3% and 61.7% at 6 mo and 18 mo post- respectively in food chains, and from 4.4% to 31.2% and 30.0% respectively in coffee chains (both p<0.001). Among customers seeing calorie information, the proportion using it (about one third) did not change substantially over time. After implementation, food chain customers *using* information purchased on average fewer calories compared to those *seeing* but not using (difference=143.2 kcal, p<0.001) and those *not seeing* (difference=135.5 kcal, p<0.001) such information.	purchased by women (p=0.01) but not for men. In Nik – no effect at 6 months, but a decrease of 22.1 kcal at CC (p=0.002) at 18 mo post-labelling (after 18 mo - -38.1 kcal at food chains not sig) Nikoloau and Littlewood rated GOOD quality
Pulos & Leng 2010 ***Pierce County, Washington, US***	Voluntary Multiple nutrient ML (MNML) – calories – fat – cholesterol – sodium	Six full-service, locally-owned restaurants	Pre-/post- 30 days before and 30 days after (one was assessed almost one year after the labelling)	N=206	Awareness Nutrient content of meals sold	The average post-labelling entree sold contained about 15 fewer calories, 1.5 fewer g of fat, and 45 fewer mg of sodium than did the average entree sold before labelling Decrease in calories was significant (p<0.05) in 4/6 restaurants	71% reported noticing the NI 20.4% reported ordering an entree lower in *calories* as a result of ML 16.5% reported ordering an entree lower in *fat* as a result of ML

							Authors suggest 75 kcal fewer purchased among users
Restrepo et al 2015 ***New York,*** ***US***	Mandated calorie ML (NEML)	Chain restaurant menus	Analysis involving county-level info concerning the timing of calorie labelling laws and surveillance data (2004-2012 waves of the Behavioural Risk Factor Surveillance System; BRFSS)	n=45,939 survey respondents	BMI	Reductions in BMI and the probability of obesity 'Back of the envelope' calculation of the main analysis revealed that implementation of calorie labelling caused an average reduction in BMI of about 0.5 units For a man of average height and weight in the U.S., this roughly translates into a 1.6 kg loss in weight. The corresponding estimate for women is a 1.4 kg loss in weight	Suggests: 1: the impact of calorie labelling is concentrated among consumers with a high estimated propensity to eat fast food and to use NI at restaurants 2: the policy's impacts are larger in the upper half of the BMI distribution Thus heterogeneity in sensitivity to calorie information may help to explain the mixed evidence in previous studies on the policy's effectiveness
Tandon et al 2011 ***Seattle, King County***	Mandated calorie ML (NEML)	FF chain restaurant (unspecified)	Longitudinal pre- post- One meal pre- and one meal	Parents ordering for children aged 6-11 yrs; and parents' choices for	Awareness Calories purchased	Awareness: Significant increase from pre- to post-regulation (44% vs 87%) in parents in KC seeing NI, with no change in SDC (40% vs 34%) Average calories purchased for	

(S/KC) (regulated) San Diego County (SDC), US			post- Asked cohort members to purchase typical meal for $10 gift voucher and mail back receipt	themselves N=133 parent-child pairs: S/KC (n=75) SDC (n=58)		children did not change in either county (823 vs 822 in S/KC, 984 vs 949 in SDC) Parents in the intervention arm ordered an average of 102 fewer calories for their children than did control subjects (569.1 cal vs. 671.5 cal; P = 0.04). With adjustment for parent's gender, race, education, and BMI, fast food frequency, and child's BMI z score, the difference remained significant (P = 0.004) There was an approximately 100-calorie decrease for the parents post-regulation in both counties (823 vs 720 in S/KC, 895 vs 789 in SDC), but no difference between counties	
TNS/NSW Food Authority **January 2013** ***NSW, Australia***	Mandatory NEML+DRV In early 2012, research expanded to include customer education campaign	FF Outlets (February 2012)	Pre- (wave 1) post- (wave 2) post- (wave 3) Sept 2011: ▪ Baseline online survey (Survey 1) ▪ Baseline face-to-face intercept survey (Survey 2)	Online survey n=500 (506, 528, 531 in waves respectively) NSW residents who had consumed food from QSR in past month Intercept survey: n=>800 (815, 807, 805	Awareness, understanding of NEML and DRV Consumption (median and mean per person) Awareness of	Intercept survey only: Significant decrease in median kJ purchased during the evaluation period: an overall reduction of 519 kJ (from 3355 kJ to 2836 kJ, from Wave 1 to Wave 3 respectively; 15% decrease) – due mainly to reductions in sugar and carbohydrate intake Difference in mean kJ purchased was not significant, although trend (3770 kJ, to 3231, and 3196 in waves 1,2 and 3, respectively)	significant increase in participants in the intercept survey noticing nutrition information between the start and the end of the survey period (Sept 2011 and Sept 2012); and in reading the information. The proportion of those nominating kJ labelling as influencing their

	Feb 2012: ▪ Pre-campaign post-ML: Young adults online survey (Survey 3) April 2012: ▪ Repeat of all 3 surveys August 2012: ▪ Repeat Survey 2 Oct 2012: ▪ Repeat Surveys 1 & 3	in waves respectively) at 14 selected standard food outlets in NSW Young adults survey: N=200 (217, 213, 206, resp) Greater Sydney residents aged 18-24 years	NEML Informing kJ consumption levels Awareness Understanding Behaviours	Awareness of correct daily intake value (DRV) increased from 1% to 8% in Wave 2 and 9% in Wave 3 in the intercept survey; and from 8% in wave 1 to 16% and 19% in Waves 2 & 3 respectively, in the young adult survey Proportion who noticed kJ information on menus did not change significantly in online survey or young adult survey where it was already around 50-60% at baseline; but did increase in intercept survey, from 15% at baseline to 40% at Wave 2 and 36% at wave 3 Estimation of kJ content of purchased items (Intercept survey only): ▪ decrease by 10% (from 76% to 66% and then 66%) of respondents were unable to estimate ▪ Of those who estimated: decrease in % underestimated, increase in those overestimated and estimated within 10% (the latter from 7% at baseline to 13% and 14% in waves 2 and 3 respectively) In the general population but	food choice at the POP increased in the general population. In the intercept survey, for those indicating that labelling would influence their choice of food (40% across survey period), the proportion of participants suggesting it will influence their food choice later in the day or in the chain in the future increased during the survey period, with a significant increase in participants suggesting labelling would influence their choice 'a little' later in that day

						not young adults, self-reported use of kJ for purchase choices increased from 7% to 15% to 24% in waves 1 thru 3 Location of noticed NI in outlets on menu board increased from 23% to 82% and 81% respectively; while noticing NI on all other places (packaging/posters/window/flyers/counter/food tray/other) fell significantly Prompted recall of kJ labelling increased from 28% to 80% and 81% resp. Significant increase over the evaluation period in both consumer groups (16 years+ and 18-24 year olds) in nominating the correct range of the average daily energy intake (8000 to 8999 kJ), and nominating the exact value of the average daily energy intake (8700 kJ)	
Vadiveloo et al **2011** ***NYC and Newark, NJ***	Mandatory calorie ML (NEML)	Four popular chain restaurants (McDonald's, Burger King, Wendy's,	Pre- post- with comparison group (Difference-in-difference design)	Adult patrons N = 1170 (total both waves both sites)	Awareness Use Calories Purchased	No significant differences and some unfavourable differences across interventions Pre-post within NYC: ▪ Increase in caloric beverages ($p<0.05$), regular salad dressing ($p<0.01$)	Self-reported use of calorie labels was associated with some favorable behavioral patterns in a subset of adults in NYC

US	KFC)	*Receipt data*	Frequency FF consumption	▪ Decrease in ordering salad (p<0.05), dessert (p<0.10), mean number of FF dinners/wk (p<0.10) Post: 65.5% aware, 41% aware but not used/14.5% aware and used Among those aware who used labels, more likely to order salad and have fewer FF meals per week than those not using. Among those aware who did not use, less likely to eat at FF and less likely to order caloric beverage than those not aware Adults in NYC who reported noticing and using the ML consumed FF less frequently compared to adults who did not notice the labels (4.9 vs. 6.6 meals per week, p<0.05)

Table 3 Summary details of studies evaluating the effectiveness of menu labelling experiments in a field setting (e.g. cafeterias)

Author Date Country	Intervention	Setting	Study design	Sample	Outcomes measured Measurement methods	Primary Findings	Further findings and Comments
Aron et al 1995 ***UK***	▪ No labels ▪ MNML (Energy+fat) Label had calories in bar chart and numeric format and % energy from fat circle plus numeric % fat NI labels positioned by the appropriate foods (not menu board)	Student cafeteria	Quasi-experimental; pre- post- with control group 1 week no labels 1 week labels	N = 65 experimental subjects (EXP) (40 males; 25 females; mean age 21 years) British students who regularly ate midday meal in main campus cafeteria N = 25 control subjects (CON) (16 males; 9 females; mean age 19.5 years) eating at a different cafeteria	Hunger score Eating restraint score Attitudes/beliefs towards low-fat, low-calorie foods Food choices	EXP group significantly increased their energy, g fat and g carbohydrate intakes in week 2 compared to week 1; whereas among CON subjects there was only an increase in % energy from carbohydrate Effect among EXP – unrestrained and male subjects; restrained and female subjects did not change	EXP subjects heavier but only slightly higher BMI than CON g fat and % energy from fat higher for CON in week 1; and slightly more positive attitudes towards low calorie foods in CON Authors considered that, where nutrition and health are not highly valued the NI alone may provide passive info which may be used as a proxy for e.g. sensory quality, value for money,

							and hence may not have desired effect
Arsenault Singleton & Funderburk 2014 ***US***	US Army 2009 Go-for-Green (G4G) nutrition labelling in dining facilities STL colour-labelling scheme with text indicating suggested frequency of consumption and emphasizing performance nutrition	6 military cafeterias	Cross-sectional, single time-point	N=299 completed surveys Intercept survey	Awareness Self-reported use FFQ – fat and F/V servings	47% of soldiers 'always' or 'sometimes' used G4G labels when making food choices (no difference to non-users by BMI, ethnicity, age, gender) Users more likely to be following special diet; had lower fat intake (82.6 g (32% of energy) vs. 98.4 g (36% of energy) p<0.0001) but no difference in F/V servings No association between use of special diet and fat intake in multivariate model	Label in its entirety probably not valid in QSR setting
Atkinson & Palmer 2012 ***Australia***	▪ McDonald's 'Heart Foundation Tick Approved' range ▪ Subway 'Six grams of fat or less' range	McDonald's and Subway	Cross-sectional single time-point (two month period)	Lunchtime diners aged 16+ years N=927 respondents Intercept survey	Frequency of consumption of nutritionally-promoted items Nutrient content of items (lunch) purchased	24/910 respondents (3%) who purchased a main option had purchased a nutritionally-promoted item (older, female, more often involved in health profession) Purchasers of NP items ordered 1.5MJ and 0.6 more veg serves than purchasers traditional foods (p<0.05)	NP foods may reduce lunchtime energy content however these foods infrequently chosen
Balfour et al 1996	MNML as bar chart:	2 workplace self-service	Customers entering	Customers self-selected to view NI	Meal choices (first choice vs.	17% (42 male, 23 female) and 15% (19 male, 28 female) made	Not blinded

UK	– Calories – SatFat – Added sugars – Fibre Content displayed graphically as bar chart in proportion to the dietary reference values (DRV) (as %) Age and sex data used to select appropriate DRVs	restaurants: ▪ Restaurant A = free, large oil company ▪ Restaurant B = hospital, charged per item	restaurants asked to make selections from menu on computer screen Pre- post- in that customers got to make different selection after seeing NI	N=387 (272 male, 115 female; 47% response rate) Rest A N=307; 131 male, 176 female; 45% response rate) Rest B	double choice[8]; first-time users vs. repeat users[9]) Data standardised for gender and restaurant environment effects	second selection after seeing NI at A and B resp. Energy content and SFA and NMES as % of energy decreased significantly in 2nd choice compared to first choice (achieved through omitting dishes (44%); adding dishes (19%); changes within a category (46%); making changes from one category to another (26%)) Nutrient content not significantly different from those who stuck with first choice	Low external validity
Chu et al , 2009 ***US***	MNNL menu board labels based on NFP: – Calories – Serving size – Fat – Protein – Carbohydrates On 12 hot entrees for 14 days	University cafeteria	Quasi-experimental Single-group, interrupted time series 2 weeks pre-treatment; 2 week intervention; 13 days post-	Mainly college students, some staff 42,170 entrees	Energy purchased (transaction data) Revenues	Average kcal of entrees purchased dropped immediately when NI made available (12.4 kcal/d; p=0.007) and increased gradually when HI removed (1.5 kcal/day) Change driven by lower sales higher-calorie items & higher sales lower-calorie items No significant change in number of entrees sold or in revenues between 2 periods	

[8] If they changed their selection after seeing NI
[9] If they had used the NI on a previous day

Cranage et al 2004 ***US***	MNML NFL information on laminated cards next to hot entrée items compared to no NI period	On-campus University café Independent choices for salads, hot meals, sandwiches, desserts	Quasi experimental Pre- post- 2 weeks treatment	N=150 customers	Customer satisfaction Intentions to repurchase Sales of hot entrees	NI associated with higher satisfaction with food quality for both short- and long-term, and higher intentions to re-purchase (higher expectations and lower disappointment) Also associated with increased selection of more healthful food (shift from higher fat & calories to lower fat & calories (higher fat/higher calorie meals dropped from 67% to 47% of total entrees sold; lower fat/lower calorie entrees increased from 33% to 53% of all entrees sold); more veg, salads, fruit, fruit cup, and reduced French fries, cake and other desserts)	Only trend data could be determined as study period not long enough (demand for different meals varied)
Ellison et al 2013 ***Oklahoma, US***	▪ No label ▪ NEML ▪ MENL+STL (calories)	One full-service (sit-down) restaurant University campus	Between group; randomised trial 2 weeks	n=138 adults (63% students)	Calories purchased Factors affecting	No significant difference in total energy ordered between ML conditions. ML mean = 817 kcal (SD = 328); control mean = 765 kcal (SD = 368). For entrees, energy ordered in energy labels + single TL was lower than in the other conditions (-539.7 kJ, p=0.033) For extras, no differences in energy ordered was detected between ML conditions	Greatest impact on those who are least health conscious. Using a symbolic calorie label can further reduce the caloric intake of even the most health conscious patrons. Calorie labels were more likely to influence the selection of the main entrée

							as opposed to supplemental items e.g. drinks and desserts
Ellison Lusk & Davis **(The impact…)** **2014** ***US***	12 weeks menu treatments simultaneously: ▪ no NI ▪ NEML ▪ NEML +STL (calories) + additional 7 weeks price manipulations: ▪ 'fat tax' on several high calorie options and thin subsidy on several low calorie options	Full service restaurant (at University but open to general public; upscale) 51 items	Empirical modelling Restaurant divided into 3 sections – each different menu treatment Patrons blinded to study but repeat customers with different menu possible	Restaurant receipts (approximately 20/day) N=1532 observations (main entrée choice)	Calories purchased (for main entrée item)	NEML resulted in 27.4 cal/meal fewer (4.2% reduction) and NEML+STL led to 55.6 fewer kcal/meal (8.6%) reduction 10% fat tax and 10% thin tax resulted in 3.4% and 1.8% calorie reductions, respectively	A traffic light symbol could enhance the effectiveness of the numeric calorie label
Ellison **(I'll have…)** **2014** ***US***	19 weeks ▪ no NI ▪ NEML ▪ NEML +STL (calories)	Full-service restaurant (at University but open to general public; upscale) 51 items	Empirical modelling Restaurant divided into 3 sections – each different menu treatment Patrons blinded but	n=1,459 observations (single diners removed from data set)	Peer influence on food choices	Menu calorie labels did not change the marginal utility of calories Diners happier if a fellow diner orders an entrée from the same category (diners happier spending money and eating more calories if their peers are)	Results suggest that peer effects may outweigh the effects of nutritional information

			repeat customers with different menu possible				
Ellison et al (The effect of calorie…) **2014** ***US***	Restaurant 1: ▪ no NI 6 weeks ▪ NEML 7 weeks Restaurant 2: 12 weeks simultaneous ▪ No NI ▪ NEML ▪ NEML +STL (calories)	Two full-service restaurants (Restaurant 2 is upscale to restaurant 1)	Restaurant 1: pre- post-design Restaurant 2: Between-groups design, single exposure (restaurant tables received one of 3 menus)	Restaurant 1: n=2151: n=824 patrons visited the restaurant during the pre- label, n=1327 patrons post -label; Study 2: n=946 patrons: (n=302, 301, and 343 for each menu)	Total calories ordered per person Restaurant revenue per person	Restaurant 1: NEML had no significant effect on total caloric intake (an insignificant increase in calories ordered) Study 2: The addition of a traffic light symbol led to a 67.8-kcal reduction in average calories ordered (740.82 vs. 708.36 vs. 673.07 calories/person/meal, respectively) – nb. NEML not statistically significant from no NI Restaurant revenue is unlikely to be affected by the addition of calorie labels on menus	
Feldman Hartwell et al 2015 ***US***	Menu comprising 7 healthy/7 unhealthy items ▪ No NI ▪ STL (for overall healthiness) On a board	University student cafeteria	Not stated	N = 214 control N= 212 treatment	Odds of selecting healthy food	While NI increased the odds of selecting healthy food the overall effect was not significant (OR 1.23; 0.96, 1.57; p=0.11) Odds of selecting healthier food from menu for the top choice = 0.36 (0.23, 0.57) for males vs. females; and for the top 3 choices = 0.42 (0.32, 0.54) Odds for those on a diet vs. not on a diet for top choice = 2.28 (1.38, 3.78); and for top 3	BMI status did not significantly affect healthy food selection

						choices = 2.35 (1.76, 3.13) Athletic students significantly less likely to select healthy foods than non-athletic students (OR 0.69; 0.51, 0.94) for top 3 choices	
Fotouhinia-Yepes **2013** ***Switzerland***	▪ No NI ▪ NEML (format not indicated – presumed NEML on printed menus)	Fine dining restaurant (University campus)	6-week experiment with control – experimental phases of 3 weeks each	n=812 external guests (50%); students (40%); 10% staff n=460 NEML; n=352 no labelling	Calories purchased Response to labelling	A significant reduction in sales of menus with higher calorie content during the labelling phase vs. control phase - a reduction of 227 calories consumed per client during the labelling phase Calorie information was most valued and used by women and older clients	
Freedman **2011** ***US***	POSNI (photographs/ pictures and numeric info) for 4 items and 2 different portion sizes for each POSNI = laminated colour signs at eye level on glass sneeze guards French fries and nachos = 2 portion sizes with photos and	All-you-can-eat dining hall in large urban metro campus (ethnically diverse)	5-week quasi-experimental 1 wk baseline 4 wks intervention 1 wk post-intervention	N=1675 students 18-21 years old on residential campus with university meals	Portions of French fries selected Salad dressing selected Awareness Use *Covert observation*	No difference in % of students choosing French fries baseline vs. intervention; however, significant decrease in choice of large size representing a 17% reduction in choice of large portion size from baseline ($p<0.05$) Significant increase in % of students choosing Thousand Island and Honey Mustard salad dressings (and non-significant decrease in most popular, more energy-dense, Ranch dressing) Almost all respondents reported	Females more likely to use the NI than males

	MNNL (calories, fat, % calories from fat based on 2,000 calorie diet) Salad dressings in order of caloric content; with NI beneath Milk (whole, 1%, low-fat choc, non-fat milk) with NI beneath + signs 'portion size matters' and 'a small change makes a BIG difference'					seeing some POSNI (slogan, photo, drawing, calories, fat) – calories per serving most frequently seen 32% reported POSNI impacted their choice of French Fries; 24% salad dressing (impact of signs on nachos and milk were lower – 15% and 16% respectively) Also how much – 38% affirmative for French Fries and 26% for salad dressing
Gallicano et al 2012 ***The Netherlands***	▪ No NI ▪ *Healthy Choice® label*	Full-service al-a-carte restaurant	Experimental – allocated to different menu condition	Customers N=264	Items chosen	54% of customers chose the healthy choice menu item
Hammond Lillico et al **2015** ***Canada***	NEML on menu boards and food stations, either on the wall or in frames displayed on the counter	University cafeteria	Pre- post- Single site baseline and one week after NI	n=159	Noticing and use of NI Calorie content of food purchased Estimated calorie consumption	Significant increases in noticing NI (92.5% vs. 39.6%; $p < .001$), and the use of NI to guide food purchases (28.9% vs. 8.8%; $p < .001$). Calorie content of foods purchased decreased after calorie labels were posted (B = -88.69, p = .013), as did the

						estimated amount of calories consumed (B = -95.20, p = .006)
Hammond et al **2013** ***Canada***	Four experimental menus: ▪ no labels ▪ NEML ▪ NEML + STL ▪ MNNL = MTL (calories, fat, sodium, sugar)	Subway outlet	Between group experiment; randomised	n=635 adults	Recall of NI Recall of calorie content info Calories consumed	Participants in the calorie conditions were more likely to recall the calorie content of meals (NEML 72%, p<0.001; NEML+STL 71%, p<0.001; vs. NEML+MTL, 49%) and to report using NI Calorie content of meals ordered was not significantly different across conditions Calorie consumption was significantly lower among participants in the NEML condition compared to the no NI condition (mean = -96 kcal, p =0.048)
Holmes Serrano et al **2013** ***US***	ML on combination meals: ▪ No labels ▪ MNNL (calories + fat) ▪ Healthy symbol = healthier choice ▪ Nutrition bargain price (NBP) score	Full service, family-oriented restaurant at private club	Between-group, longitudinal, pre- post- test Each labelling condition 2 months same site (sequential)	Families (n=1275 meals)	Calories purchased (sales data)	No significant changes on total calories and fat ordered under any labelling condition Decrease in calories and fat for combination purchases (-53.4 calories/223.4 kJ) and increase in calories and fat purchased for a la carte items (36.1 kcal/151.2 kJ) p<0.05) for NBP menu
Hunsberger McGinnis et	NEML	Rural middle school	Pre post-single site	Students grades 6-8 (11-17 years)	Gross calories served per	Calorie consumption decreased by an average of 47

al 2015 ***US***	printed, laminated, placed above not and cold items on the sneeze guard	1 month no labels 1 month calorie labels		Daily average n=531 Qualitative interviews (n=32)	student (weight of sold items) Attitudes	calories/day; fat intake reduced by 2.1 grams/day. Five main themes in interviews: awareness of obesity epidemic and belief it is the schools responsibility to help prevent; nutrition knowledge was related to home environment; taste drives intakes; viewed calorie information as important; would like to see the calorie information displayed but that it is only useful "if people actually read it, if they don't it's a waste of time"	
James et al **2015** ***Texas, US***	Menus with: ▪ No labels ▪ NEML ▪ PAE time (mins brisk walking)	University Dining Areas	Quasi-experimental randomised field experiment	Young adults N=300	Energy ordered and consumed at lunch (weight) Post-lunch energy intake (food recall)	PACE group ordered significantly (p = .002) less energy (adjusted mean [CIs]: 763 [703, 824] kcal) at lunch, compared to the no-labels group (902 [840, 963] kcal) but not compared to the kcal-labels group (827 [766, 888] kcal) PACE group also consumed significantly (p = .01) less energy (673 [620, 725] kcal) at lunch, compared to the no-labels group (770 (717, 823) kcal) but not compared to the kcal-labels group (722 [669, 776] kcal) Energy ordered and consumed	There was a trend towards increasing effect of labelling with kcal then kcal + PACE

						were not different between kcal-labels and no-labels groups No difference in post-lunch energy intake by menu type
Levin et al **1996** ***New Mexico US***	Heart symbols on entrée menu for 3 low-fat items And 'Look for the ♥ for your low-fat entrée selection' poster	Two matched urban worksite (government) cafeterias	Repeated measures, comparison site' longitudinal 2 weeks baseline; 4 week intervention; 7 month follow-up (symbols remained)	Approx 400 transactions per day/site Survey: N=138 (raffle tickets; twice as many females as males)	Sales of Targeted labelled, low-fat entrees	Sales of targeted low-fat items remained stable across 6 weeks baseline and intervention period for comparison site but increased significantly at experimental site ($p<0.001$). Sales of targeted items were significantly higher at 7 month follow-up than during 4-week intervention period 84% (n = 116) reported that they noticed the labels Of these, 91% correctly reported the labels to be "hearts" and 46 % said that the labels influenced their entree choice
Levy et al **2012** ***US***	Simple colour-coded labelling and choice architecture intervention ▪ STL (based on F, V, whole grain,	Workplace (Hospital) cafeteria	Two-phase intervention 3 mo baseline 3 mo Phase 1: STL + dieticians	Minority and low-income employees N=4642 employees	Proportion of green/red items purchased	Labelling decreased all employees' red item purchases (−11.2% [95% CI= −13.6%, −8.9%]) and increased green purchases (6.6% [95% CI=5.2%, 7.9%]). Red beverage purchases decreased most (−23.8% [95% CI= −28.1%, −19.6%]). The choice

	protein, low fat, SFA, calories)[10] ▪ Choice architecture: visibility and accessibility		and permanent signage Phase 2: Choice architecture (visibility and accessibility)			architecture intervention further decreased red purchases after the labelling. Intervention effects were similar across all race/ethnicity and job types (p>0.05 for interaction between race or job type and intervention). Mean calories per beverage decreased similarly over the study period for all racial groups and job types, with no increase in per-beverage spending.
Li Behnke & Almanza **2014** ***US***	▪ NEML ▪ Healthy symbol ▪ MNNL	Table service restaurant in University	4 week intervention period (assumed sequential menu format)	Daily sales data N = 173 questionnaires	Calorie content of entrees sold	The NEMLformat was most effective in reducing calories contained in the entrees sold MNNL was most effective in reducing fat and SFA content of entrees sold Healthy symbol was least effective but most preferred format
Loureiro & Rahmani **2013**	▪ NEML on survey menuu prior to	Survey (followed by FF restaurant)	Between subjects experimental with control group	Adults (mean age 24 years) N=174	Calories selected (survey)	ML reduced the average number of calories chosen by 2.96% under survey conditions; however the same NI had no impact on actual food

[10] Every item was labeled green, yellow, or red, and was rated on three positive (fruit/vegetable, whole grain, or lean protein/low fat dairy as the main ingredient) and two negative criteria (saturated fat content and caloric content). Items with more positive than negative criteria were green ("consume often"). Items with equal numbers of positive and negative criteria or only one negative were yellow ("consume less often"). Items with two negative and no positive criteria were red ("there is a better choice in green or yellow"). Water and diet beverages with 0 kcal were green, despite having no positive criteria.

US	subsequent food choice in FF restaurant (no ML)				Calories purchased (FF restaurant)	purchases in FF restaurant Calorie content of participants' actual purchases increased significantly (0.17%) with the number of days elapsed between the survey day (and NI provided) and FF restaurant purchase day
Lowe et al **2010** ***Philadelphia US***	Environmental change (adding 10 low-calorie items + ▪ MNNL (STL for ED, + numeric calories, fat, carbohydrate, protein, ED) Environmental change + education on ED and labels (4 X 60 mins groups) and discounts on low-ED foods	2 hospital cafeterias	Longitudinal RCT pre-post test 3 mo baseline 3 mo intervention – data collected during, 6 mo and 12 mo post-intervention	N = 96 university/hospital staff who reported eating lunch in the cafeteria at least 2X per week	Mean calories purchased (dining card scans) Total calories consumed in 24 hours (dietary recall) Anthropometric/Physiologic measures Cognitive restraint test	No differences across groups or over time within groups in kcal per meal or per 24 hour period Reduction in % of fat in lunches consumed which was associated with an increase in carbohydrate intake (p<0.001) Total energy intake from cafeteria purchased foods and % energy from fat declined over 6-month period among overweight and obese participants (p=0.001)
Nikolaou Hankey et al **2015** ***UK***	▪ NEML (T1) ▪ No labels (T2) ▪ NEML + daily reference value (T3) On laminated cards	University catered dining hall (Hall of Residence)	Single group, experimental, repeat measures Treatment 1 = 20 wks, Treatment 2 = 10 weeks;	n=120 young adults mean age=19yrs	Energy and nutrient content of foods ordered	NEML resulted in reductions in calories, fat and SFA contents of the meals chosen, without compromising micronutrient consumptions Energy content = 658 (±94) vs. 723(±87) vs. 578 (±109) for T1, T2 and T3 respectively (p<0.001)

			Treatment 3 = 10 weeks				
Nikolaou Hankey & Lean **2014** ***UK***	▪ No labels ▪ NEML	Fully-catered University dining hall	Pre post- Pragmatic interrupted time-series study design Year 1: no labels (except for 5 week pilot) Year 2: NEML for 30/36 weeks	N = 120 each year (similar in age, gender, ethnicity)	Weight changes over 36 week period	Mean weight changes over 36 weeks, per protocol, were +3.5 kg (95% CI = 2.8-4.1 kg) (n = 64) in Year 1 and -0.15 kg (95% CI = -0.7-0.3 kg) (n = 87) in Year 2 Weight changes were significantly different between years, for males and females (both P < 0.001). Intention-to-treat analysis showed similar results; Relative Risk for weight gain in Year 2, compared to Year 1, was 0.5 (P < 0.0001)	In catered setting, calorie labelling associated with 3.5 kg less weight gain (and weight loss)
Nikolaou Lean & Hankey **2014** ***UK***	▪ No NI ▪ NEML (on high calorie items only?)	3 University catering outlets (2 intervention, 1 control)	Pre- post- quasi-experimental 1 mo baseline, 1 mo intervention in treatment sites	Sales data Survey n=1166 students/646 staff	Sales Reported use	Intervention vs. control sites – total sales of all labelled items fell significantly (-17% vs. -2%, p<0.001) for the labelling month; substantially reduced sales of high calorie labelled items with no compensatory changes in unlabelled alternative items 56% of survey respondents reported using the labels, 97% of them to make lower calorie choices Caterers perceived the drop in sales of high-calorie items in intervention sites as a positive outcome and responded to it with reformulation of some	

						items in order to better meet customers' wishes	
Olstad et al **2015** ***Canada***	▪ No labels ▪ STL	Sports & Rec eating environment	Pre- post- 1-week pre-1-week post-	N=2101 transactions	Sales	Overall increase in sales of green items (52.2% to 55.5%, P<0.05) and reduction in sales of red items (30.4% to 27.2%, p <0.05) from baseline to the TL labelling period	Effectiveness did not differ by any factors measured in survey Average daily revenues did not differ
Pratt Ellison et al **2016** ***US***	▪ No label ▪ MNNL (NFP) next to each item ▪ Complex graphical sign – all menu items for the day on a single plot on poster next to food displays. Also instructions for how to combine elements. SFA and Na also presented using colour-coding	Cafeteria University campus	12 week experiment Baseline phase, then NFPs, then wash-out period, then graphical (3-week periods for each – data collected in 3rd phase of each study phase)	N=362 meals	Nutrient content of meals Self-reported label use	Nutrition label use was 85% Calories, total fat, and sodium were most consistently ranked in the top 3 nutrients of interest on surveys Signposting information using NFP did not result in a change in calories purchased for total meal, entrée, side, or dessert calories compared with purchases when no nutrition labels were present Graphical format resulted in 16% fewer total calories purchased per patron compared with sales when no NI was present (P < .01) and 20% fewer calories purchased compared with NFP purchases (P < .01). Total g protein did not decrease resulting in more protein per calorie	Nutrition interest (weight etc) impacted on calories purchased

Sato et al **2013** ***Northern California*** ***US***	▪ Labelling not clear – appears to be MNNL (calories, fast, Na) on one HP entrée and one RM entrée per day RM meals provided a mean of 657 kcalories; HP meals provided mean 395 kcalories	Hospital Cafeteria (Kaiser Permanente)	Pre- post- 8-week intervention period; 32 recipes (HP entrees modified to be healthier; RM entrees standardised but no change made to recipes)	Approx 100 customers per day Survey n=131	Mean sales (receipt data) lunchtime	Trend between NI and sales: HP increased from 41.8% (n=47) to 42.5% (n=40) as compared to decrease in RM sales from 58.2% (n=64) to 57.5% (n=54) at the end of the intervention period (note- none of the changes were significant) Total sales decreased from baseline to intervention by 8% ($p<0.0001$) 50% (n=8) of customers who noticed labels and purchased an entrée stated that their purchasing behaviour was influenced by the label	
Shah Bettman et al **2014** ***US***	Four daily menus – manipulated price and certain items as unhealthy: ▪ No NI ▪ Surcharge on 3 most unhealthy entrees ▪ Unhealthy asterisk (above average fat and/or sugar) ▪ Unhealthy surcharge - $ + asterisk ($	Moderately-priced sit-down restaurant – primarily small shared plates	Natural experiment – 16 day span with changing menus	N = 1063 diners (669 women; <5% of tables dining alone)	Observational entrée choices and weighed food intake (before and after) Restaurant perceptions (survey)	Surcharge alone did not affect proportion unhealthy entrée items sold; but unhealthy label and unhealthy+surcharge resulted in lower proportion of unhealthy dishes ordered per person compared to no intervention (although not significantly different from each other) Gender composition of the table significantly interacted with effectiveness of an unhealthy label on demand for unhealthy entrée items – more	Different menus had no impact on ratings of enjoyment of meals but adding a surcharge and adding an unhealthy surcharge significantly increased the likelihood to dine at the restaurant again (perception restaurant concerned with

	increase + statement indicating why $ increase)					men, higher proportion of unhealthy items from menu with unhealthy label; more women=lower % of unhealthy entrees ordered Same findings with weighed food (again, unhealthy surcharge is only directionally better than unhealthy labels, probably because of higher number of female patrons)	health and well-being) Results imply that an unhealthy label alone (without surcharge) can significantly backfire in restaurants with higher proportion of males Unhealthy surcharge reduces unhealthy food selection and consumption regardless of gender
Siegel et al 2015 ***Ohio, US***	• Green smiley face emoticons on healthful foods including an entrée with whole grains, fruits and vegetables, and PWFFM (plain white fat-free milk)	Inner-city primary school canteen	Pre- post-	N = 297 children	Item selections	Increase in % of children selecting of white milk (7.4% to 17.9%, p<0.0001) Concurrent decrease in chocolate milk (86.5% to 77.1%, p<0.001) – no change overall % selecting milk Significant increase from 0.7 to 0.9 pieces VEG/student/day No significant change main meal item or fruits	

Sosa et al **2014** ***Texas, US***	▪ ¡Por Vida! logo ('For Life') Voluntary labelling program	23 restaurants Bexar County	Cross-sectional and survey	N = 152 restaurant patrons	Purchasing targeted items	Strongest predictors of purchasing a ¡Por Vida! item were the patrons' ages being between 18 and 35 years (OR = 1.5; confidence interval = 0.02, 0.81; p<.05) and if patrons saw the logo (OR = 4.33; CI 1.7-11.04; p<.01)
Thorndike et al **2012** ***Boston, US***	2-phase TL and choice architecture intervention ▪ STL healthfulness (F/V, whole grain, protein, low-fat dairy, SFA, calorie content) ▪ Phase 2: Increased visibility/accessibility green items	Large hospital cafeteria (intervention) and 2 smaller cafeterias in same hospital (comparison)	Single-site cross-sectional pre- (3 mo) and post- (6 mo) AND Quasi-exp cross-sectional pre-post-	960,000 – 990,000 items sold per 3 mo period	Sales bottled water, pre-made sandwiches, chips Transactional data	Pre-post-post- study showed increased sales healthy items and decreased sales unhealthy items; with CA further improving effectiveness of labelling Quasi-exp study of beverages, chips, sandwiches showed reduction in sales red items / increased sales green items (sales of bottled water increased at comparison sites baseline to Phase 1) Phase 1 to Phase 2 all measures improved significantly more in intervention site
Thorndike et al **2014** ***US***	▪ STL label green (healthy); yellow (less healthy) red (unhealthy) ▪ Choice architecture (rearranged to make green	Large hospital cafeteria	Time-series Baseline, 12- and 24-months	(i) All cafeteria customers (6511 transactions/day) (ii) 2285 hospital employees (cohort)	Sales	Proportion of red sales decreased from 24% at baseline to 20% at 24 months (p<0.001) and green sales increased from 41% to 46% (p<0.001). Red beverages decreased from 26% of beverage sales at baseline to 17% at 24 months

	items more accessible)					(p<0.001); green beverages increased from 52% to 60% (p<0.001) Similar patterns were observed for the cohort, with the largest change for red beverages (23% to 14%, p<0.001)
Vanderlee & Hammond **2014** ***Ottawa, Canada***	▪ MNNL (energy, fat, sodium) + health logo for 'healthier' items on digital menu boards	Two hospital cafeterias (intervention & control)	Cross-sectional surveys, intervention vs. control 8 months	n=1003 (exit surveys) intervention site (n=497); control site (n =506)	Awareness Perceived influence on food choices Nutritional content of food ordered/ consumed	Intervention respondents consumed significantly less energy (-21 %, P < 0.001), sodium (-23 %, P < 0.001), SFA (-33 %, P < 0.001) and total fat (-37 %, P < 0.001) vs. control site Significantly more intervention respondents reported noticing NI (aOR = 7.6, P < 0.001) and using NI to select their food items (aOR = 3.3, P < 0.001) vs. control site
Van Epps et al **2016**	Website menus: ▪ NEML ▪ STL only ▪ NEML + STL	Online catering company	Not indicated in abstract (full paper not able to be accessed)	Employees of a large corporation	Calories ordered	Each label type reduced lunch calories by about 10%
Webb et al **2011**	1 control/2 interventions: ▪ No NI ▪ MNNL on centrally-	Six Kaiser Permanente hospital cafeterias (in 2 sites) (nb. Only 2	Randomised experiment; pre- post- 4 week baseline; 12 week	Average no. daily purchases = 400 (menu board+poster site) ; 200 (control site)	Proportion of target items purchased (baseline to follow-up) (transaction	Significant increase purchases of lower calorie side dishes (P = 0.0007) and snacks (P = 0.006) at NEML+poster site compared to no-labelling site No significant (and little non-

California **US**	placed posters[11] ▪ MNNL posters plus POP NEML Nb. 'Healthy Picks' logo already in operation across the cafeterias	sites included in purchase data)	intervention (measured last 4 weeks) Transaction data / customer survey	n=554 for survey (menu boards and a poster n= 334; poster only sites n=220)	data) Awareness, attitudes and use of labelling	significant) changes in proportion of More respondents noticed calorie information at poster plus NEML sites than at poster-only sites ($P < 0.05$) > 80% of patrons supported provision of calorie information	
Williams & Poulter **1991** ***UK***	'Star Struck' (foods high in fibre and/or low in fat) ▪ 1 yellow star = medium fat ▪ 2 yellow stars = low fat ▪ 1 green star = medium fibre ▪ 2 green stars = high fibre Placed on menu boards and written menus, plus POS information. Posters explaining the scheme.	Workplace restaurants (1 in staff restaurant in hospital; 1 in private sector restaurant – energy company)	Post-only customer survey 4 week intervention period	Self-selected N=129 at hospital N=239 at private sector Responses combined as considered no substantial differences between sites	Attitudes	90% positive about ML schemes at work (those not interested thought it was a good idea still) 65% said they found the star struck scheme useful – divided as to whether it provided enough info Some wanted more NI – calories most often mentioned 90% said they had not learned anything new and >75% reported that the scheme did not influence choice	Findings indicated the need for more refinement to the 'Star Struck' scheme to meet the operational and information needs of the user groups

[11] No purchase data available from poster only sites – purchase data only from 1 site with poster + POP NEML and 1 site as control (comparison)

Table 4 Summary details for studies examining the effectiveness of menu labelling in artificial settings, i.e. under controlled, simulated conditions including online surveys and laboratory-type rooms

Author Year Location	Intervention	Setting	Study Design	Sample	Outcomes	Findings	Additional Findings Comments
Ahn Park et al 2015 South Korea	▪ MNNL (kcal, sugar, protein, saturated fat, sodium[12])	Online experimental survey using a menu board	Single-group post-selection survey	N = 242 parents children 2-12 years who dined with them at FF restaurants at least once/month	Choice of lowest calorie meals Perceived empowerment, use of NI, perceived difficulties of using	Participants were classified into either the low calorie group (n=42; chose at least one of the lowest calorie meals in each menu category) vs. the high calorie group (n=201) who did not Low-calorie group more interested in NI and used NI more when selecting restaurants and meals for their children; high calorie group had more difficulty using the NI	
Antonelli & Viera 2015 US	Mock generic FF menus – imagine in FF restaurant and ordering for child ▪ No label ▪ NEML ▪ NEML + PAE time (mins	Internet survey	Randomised choice experiment (hypothetical orders)	N = 1000 (823 respondents) Adults (from 47 US states)	Calories selected (choice) Rating likelihood of labels to influence food choice and PA	Median calories ordered = 1580 calories from the no-label menu, 1200 from the NEML menu, 1140 from the NEML + PAE time menu, and 1210 from the NEML+PAE distance menu (p = 0.0001). 40% of respondents reported that PAE labels were "very likely" to influence food item choice vs. 28% for calorie-only labels (p<0.0001). 64% reported that	Although there was no difference in median calories ordered across labelling conditions, respondents indicated that PAE labelling was more likely to

[12] This NI are required to be presented on children's menus at restaurants with more than 100 units in South Korea

	walking) ▪ NEML + PAE distance (miles walking)					PAE labels were "somewhat likely" or "very likely" to influence their level of PA vs. 49% for calorie-only labels (p<0.0001)	influence food choice
Boonme Hanus et al **2014** **US**	Simulated FF restaurant No NI ▪ Heart icon (for threshold energy content) ▪ MNNL (Calories + fat)	Online survey	Randomisation to one of 3 menu designs	N = 250 (230 usable) Respondents at main University who had dined at FFR in prior 7 days	Selection of healthier items	Calories + fat information – no effect Heart icon – more than twice as likely (OR 2.21) to select a healthy meal than an unhealthy one; heart icon most influential construct in selecting healthy food in model	High level of self-control resulted in lower odds for choosing a healthy item (contrary to expectations) Proposed that these customers made a conscious decision to eat 'in a FF restaurant' in order to indulge themselves, or eating in a hurry
Brochu & Dovidio **2014** **US**	Manipulated weight-based threat (brief vignette linking poor diet to ill-health – those in this 'threat condition' were then measured for BMI) with and	Online survey Scenario – family-based sit-down meal with friend Menu based	Randomised to weight-based threat	N = 176 from online source (service – representative)	Calories selected Nb. Price of meals statistically controlled for in analysis (as per Dumanovsky et al 2011)	Study 1 – ordered more calories in stereotype threat condition as BMI increased vs. no association between BMI and calories in control (no threat) condition Study 2 – participants under stereotype threat ordered more calories from a conventional menu as BMI increased, whereas no association	NEML can mitigate the detrimental effects of weight-based stereotype threat on overweight persons calorie selection From the level of psychological

	without NEML Study 1: No NI Study 2:NEML	on popular restaurant chain in US 45 menu items				between BMI and calories was found among participants who ordered from a calorie menu	analysis, found ''mixed'' results for the effect of menu labelling on restaurant food choices
Burton Tangari et al **2014** **US**	• Study 1: Daily reference values for energy + Na • Study 2: No NI • Study 3: NEML vs. no NI • Study 4: 3 menu conditions: no NI; NEML and MNNL (Calories + Na +SatFat) – nb. Calorie levels for items very similar and Na varied	Web-based survey 20 items from well-known FF chains (Burger King, McDonald's, Subway) from four categories (salads, grilled chicken sandwiches, hamburgers and fries, fried chicken sandwiches)	Study 1: Repeated-measures Study 2: diary of FF visits Study 3: web-based survey with 2 menu versions Study 4: web-based survey with 3 menu-versions	Study 1 & 2: N = 102 undergrad students who frequented FF outlets Study 3: n=239 (mean age 47 years) Study 4: n =114 (mean age 56 years)	Calorie and Na content estimation Perceived healthfulness of items Study 4: purchase intentions	Study 3 showed an effect of interaction of NEML by item interaction for purchase intentions (p<0.01) – NEML had no impact on Na estimates Study 4 showed that main effect of menu condition – as they received more NI they became more accurate in their estimates; but was a menu-condition, nutrient, meal 3-way interaction. When given MNNL overestimated calorie content compared to NEML condition; although as expected, Na estimates more accurate under MNNL Na disclosure strongly influenced purchase intent of high Na meals only among those with hypertension Providing calorie information (alone) provides little help for sodium estimation	Our findings show that while consumers have a difficult time estimating calories, their judgments of sodium content are much worse, and health halo effects appear much stronger for sodium
Davis Bujisic et al	Real drive thru menus:	Scenario-based experimenta	Randomisation not indicated	Undergraduate students aged 18-24 years who had	Food selected	Consumers ordered significantly more items with the NFD menus that with FDA format (mean no.	Note – did not provide number of calories

2014 **US**	▪ NEML (FDA-proposed) ▪ Colour-coded calorie-specific menu categories (low (green), regular (blue), high (red)) – (NFD menu)	l design accompanied by survey		ordered from drive-thru recently n=159 usable surveys (mainly female, n=121)	Consumer preferences	2.14 vs. 1.74, p<0.01). Also more likely to select lower calorie menu choices (p<0.001) Consumers made healthier choices (low calorie meals) more often with colour-coded menus compared to FDA suggested format (calories only) Consumer preference higher for color-coded menus in ease of reading, layout and convenience	ordered and as NFD (colour-coded) menu resulted in more items selected then potentially more calories selected (although selected lower calorie items)
Dodds et al **2014** **Hunter New England, NSW** **Australia**	Different labelling menus: ▪ No NI ▪ NEML (kJ) ▪ STL[13] Figure 1	Mailed survey then telephone survey regarding intended food purchases for adult and child Menus contained	Randomised, between-subjects experiment	n=329; English speaking parents of children aged 3-12 yrs from an existing research cohort	Energy content of purchases	82% of the energy labelling group and 96% of the STL labelling group reported noticing labelling information on their menu. No significant differences in total energy of intended purchases of parents, or intended purchases made by parents for children, between the menu labelling groups, or between menu labelling groups by socio-demographic subgroups	Rated FAIR by Littlewood

[13] NI included: For foods/beverages with a red symbol 'These foods lack adequate nutritional value, are high in saturated fat and/or added sugar and/or added salt, and can contribute excess energy'; for foods/beverages with an amber symbol 'These foods have some nutritional value, have moderate levels of saturated fat and/or added sugar and/or salt, and can, in large serve sizes, contribute excess energy; and, for foods/beverages with a green symbol 'These foods are good sources of nutrients, contain less saturated fat and/or sugar and/or salt, and help to avoid an intake of excess energy

		items in common FF outlets					
Domoff Kiefner-Burmeister et al **2015** **US**	▪ No NI ▪ MNNL (calories+fat) "If you are eating at a restaurant and are given the following fixed-price menu for this child, what would you order? Select one entrée and one side dish"	Online survey	Repeated measures	N=170 mothers of children 3-6 years (Online Amazon workforce)	Frequency of menu item choices	Significantly fewer mothers chose a higher-calorie entrée when there was MNNL Greater endorsement of goal of feeding for child's familiarity with food item was associated with choosing high-calorie/-fat sides and entrée Greater endorsement of feeding for natural content was associated with choosing low-calorie/-fat entrées. Significantly fewer mothers chose a higher-calorie entrée when there was menu labelling	Weak study design
Dowray et al **2013** **North Carolina, US**	Imagine in a FF restaurants and order meal from online menu ▪ No labels ▪ NEML ▪ NEML + mins walking (PAE: time) ▪ NEML + miles walking (PAE:distanc	Internet survey – link in online employee newsletter (target population 12,700)	RCT, between-group experiment Single exposure	University employees in Medical Centre/ School N = 802	Calories selected	Energy selected was significantly lower for all menu labelling conditions (p = 0.02), with the calories +distance group ordering significantly fewer calories than no label (p = 0.0007) but not compared to other ML conditions (average calories ordered = 1020, 927, 916, and 826, respectively) – significant difference mainly attributable to burger items (and for side orders; compared to salad, dessert and drinks)	Littlewood rated this study as FAIR

	e)					82% of their participants reported a preference for exercise equivalents over calories only or no NI on menu labelling	
Feldman Su et al **2014** **US**	3 menus (printed) ▪ Generic control menu ▪ 2-page folded experimental menu (TM) with healthier options identified; 5 healthy items boxed + chef's special (with enticing words) ▪ MNNL (+/- calories, fat, "nutrients to encourage" labels)	Intercept survey	Controlled experiment	University students, intercepted on way to lunch (recruited outside Univ main cafeteria) N=266	Selection of healthier items (asked to select five possible menu choices, in order of preference)	Position of healthier item had an insignificant effect Placing boxes around healthier items had a significant effect (p=0.025), although this effect was mitigated when NI labels were added Language embellishment has modest, insignificant increases in healthy-item selection NI was found to be ineffective for promoting healthier meal choices	Positive trend observed but no significant differences between health selection of labelled and unlabelled dishes (p=0.16) Placing boxes around menu items appeared to be the most effective treatment for promoting healthy food choice compared to NI Embellishment of text/numbers worth investigating
Gerend **2009**	Simulated FF menu for 3 different scenarios:	Survey (laboratory – groups of 1-5 students)	Randomised, between group experiment	N=288 Introductory Psychology students	Kcal 'ordered' per meal	Effect only for women: Women ordered fewer calorie meals and meal items with	

US	*quick dinner, starving, not too hungry*: ▪ No labels ▪ NEML (printed next to items) No figure available	Menus modelled after McDonald's and included typical FF items	Single exposure			NEML vs. no labels (difference of 146 kcal; p<0.05) and chose lower-priced meals	
Giesen Payne et al **2011** **US**	3 between-subject factors: ▪ $10 or $20 budget ▪ NEML vs. no NI ▪ Dietary restraint	Menu on computer screen (3 sections: main courses, desserts/ snacks, drinks)	Between subjects design, repeat measures Choice from a menu 3 times with the prices for high-calorie foods increasing each time (125%, 150%)	University students N=178	Calories of hypothetical purchases Hunger prior to viewing menus Restraint	Fewer calories selected when calorie information provided (estimate = -0.345, p=0.007) and for tax (estimate = -0.435, p<0.001) Significant tax × calorie information interaction Price increase for the high-calorie foods reduced the percentage of calories chosen for lunch but only in the absence of calorie information (p=0.001) Demand for calories decreased with increase in restraint score; and increased with level of hunger	A tax of ≥25% on high-calorie foods may decrease the demand for calories and could be a good policy measure to decrease the prevalence of obesity. However, calorie information seems to interfere with the effect of a tax on high-calorie foods
Girz et al **2012**	▪ no NI ▪ information that the salad was low in calories and	Simulated (laboratory) – assume	Between subjects design Participants fasted for 3 hours prior to	Undergraduate students; dieters vs. non-dieters Study 1: n=149;	Energy consumed (for choice of pasta or salad dish)	NEML influenced food selection for dieters, but not for non-dieters Dieters were more likely to order salad when the salad was	Participants ate alone Although restrained eaters (dieters) are

Canada	pasta was high in calories ▪ information that salad high in calories and pasta low in calories ▪ information that both were high in calories (study 2 only) + daily recommend ed caloric intake (DRV)	paper-based (not indicated)	study Told they would be rating a potential new menu item for a local restaurant Salad and pasta dish were same actual energy content (1200 calories per serve) and same ED (1.6 calories/g)	females only Study 2: n=254		labelled as low in calories and more likely to order pasta, even high-calorie pasta, when the salad was labelled as high in calories NEML did not alter intake for participants who chose pasta. Participants who chose high-calorie foods over low-calorie foods did not eat less in response to calorie information, although non-dieters reduced their intake somewhat when calorie labels were put in the context of recommended daily calories (RDV)	responsive to calorie labels when selecting menu options, the NI seems to move them away from healthier but less preferred salads when the salad is seen accurately as highly caloric, i.e. restrained eaters altered ordering behaviour in response to NEML only when the labels violated expectations about the healthfulness of foods
Goswami & Urminsky **2015** **US**	▪ Industry-standard low salience NEML ▪ Salient calorie information – larger, red-font (either numeric or PAE)	Virtual burger choice Study 2: Hypothetical chicken burger choice (from 6 'unbranded' McDonald's	Between subjects design	N = 545	Calories selected	Calorie labelling, when sufficiently visually salient, shifts choices, regardless of whether the information is framed in terms of calories or equivalent exercise Findings were highly robust across demographics Authors propose that visually	Visual salience is crucial, not only for information to be noticed, but primarily because it facilitates actively deliberating about cues (Shen and Urminsky, 2013) and incorporating cues into

	▪ NEML + 'mere-reminder' (asked to estimate the number of calories OR equivalent mins of running)	chicken burgers) *Two other studies were on snack foods*				salient information affects choices primarily via a reminder effect, prompting people to consider nutrition rather than merely providing new information. As a result, they found that even non-informative "mere-reminders" yields similar results as salient new information	decisions (Weber and Kirsner, 1997)
Harnack et al **2008** **US**	Four menus: ▪ No labels ▪ NEML ▪ NEML+value pricing ▪ Value pricing	Laboratory Simulated McDonald's (in hotel conference rooms and basement urban church – all close to a McDonald's) Paper menus in similar format to menu boards	Randomised controlled 2X2 factorial experiment	N = 594 adolescents and adults ≥ 16 years who regularly ate at FF restaurants (Minneapolis)	Kcal ordered and consumed per meal (plate waste)	No significant differences in the energy composition of meals ordered or eaten between menu conditions. Average energy content of meals ordered by those randomized to NEML and did not include value size pricing was 842 kcals vs 827 kcals for those who ordered their meal from a menu that did not include calorie information but had value size pricing (control menu) Results were similar in most analyses conducted stratified by factors such as age, race and education level	Significant differences in energy intake between experimental conditions based on those who reported that nutrition was very important or somewhat important when buying foods at a FF restaurant ($p<0.01$)
Haws & Liu **2016**	4 versions of a menu: ▪ NEML vs. no	Online Calorie and price levels	Randomised 2X2 factorial between-subjects design	n=245 adults mean age 35 years	Calories ordered	When linear pricing is used, calorie information leads people to order fewer calories	Considering the impact of calorie information on consumers'

US	labels ▪ Linear pricing vs. quantity discounted Full portion and half portion Scenario: 'Imagine going out for dinner tonight…'	based on actual restaurant prices for casual, full-service restaurants 5 'healthier in nature' entrees; 5 'less healthy in nature' entrees			Price paid Importance of attributes (healthiness, price, taste, hunger)	This decrease occurs as people switch from unhealthy full sized portions to healthy full sized portions, not to unhealthy half sized portions In contrast, when non-linear pricing is used, calorie information has no impact on calories selected	choices from menus with more than one entrée portion size option is increasingly important, and the present research demonstrates that calorie information and pricing scheme may interact to affect choices from such menus
Hee Park & Oh **2009** **South Korea**	▪ No NI ▪ NEML ▪ MNNL (calories, fat, satfat, sodium) No figure available	Survey at FF restaurants Burger menu (6 items: single hamburger; double burger; grilled chicken burger; fried chicken; shrimp burger; low-fat shrimp burger)	Repeat measures	N = 245 Random sample of customers at FF restaurants in Daegu (43% undergraduate students)	Frequency of burger item chosen	Frequency of burger choice varied according to ML There were significant reductions in the choice of less healthy burger options for both labelling conditions although no differences between labelling conditions in burger choice (i.e. provision of NEML alone is equally as effective in choice of healthier items compared to MNNL)	Poor quality study and poorly described
Heiman & Lowengart	Menu containing FF	Simulated FF	Between-subjects	N = 511	Preferences for and	Fairly accurate estimation of energy content was improved	Provide 'advice' for marketers in

2014 **Israel**	items: hamburger, chicken sandwich, salad, French fries, soft drink with price ▪ NEML ▪ NEML + PAE (burn time)			Middle school; high school; army base; universities and colleges, two large workplaces – all located nearby McDonald's restaurants	perceptions of 3 food items Perceptions of: taste, healthfulness, nutritional value, calorie density, contribution to weight, price Accuracy energy content Preferred choice of main dish and ranking of all 5 products	when 'burn time' was added Strong perceived correlation between calories, weight and health While females increased consumption of salad in the desired direction post-exposure to NEML only, males responded positively to NEML+PAE	terms of 'counterbalancing' regulators' mandatory calorie posting
Howlett Burton et al **2012** **US**	Study 2: ▪ NEML ▪ MNNL (calories+Na + SFA)	Online survey Two menu items (grilled chicken sandwich 1240 calories, 14 g SFA, 2510 mg Na[14];	2X2X2 mixed-factor design (Na disclosure and hypertension status = between-subjects factors) (specific menu item – within-	Adults aged ≥ 40 years (mean age 53) Recruited through national marketing research panel N = 189	Perceived CVD risk (high BP and stroke) if meal consumed regularly Likelihood of purchase	Significant interaction between hypertension status and Na disclosure for CVD risk (perceived risk among consumers with hypertension increases with Na on ML for both menu items $F(1,185)=22.7$, $p<0.001$ vs. no hypertension $F(1,185=2.92$, $p>0.05$) Similarly, for purchase intentions, for hypertensive consumers Na	

[14] Note that both dishes had higher than daily recommended amount for Na therefore valid test for non-hypertensive patrons

		and fiesta lime chicken 1230 calories; 16 g SFA, 4390 mg Na)	subject factor)			disclosure significantly reduces purchase intentions of the higher-sodium item only ($F(1,183)=6.48$, $p<0.02$) but among non-hypertensive consumers there is no additional effect of Na on label in terms of intended purchase
Hwang **2013** **South Korea** **(note – outside inclusion criteria)**	▪ MNNL [Absolute disclosure] ▪ MNNL + 'high' or 'low' based on FDA standards [Evaluative Disclosure]	Online survey Advertisement for single food item (Whopper Burger)	Two 2X2 between-subjects experimental designs with random allocation	N=152 University staff and students	Purchase intention Attitude towards product	Participants in ED condition reported less favourable evaluations of FF item No significant interaction effect with subjective nutrition knowledge Difference in purchase intention and product attitude between low and high BMI in ED condition was much smaller than in AD condition Concluded that ED was more effective than AD in helping consumers select healthier foods
Lee et al **2015** **South Korea**	▪ Numeric multiple nutrients ▪ Numeric multiple nutrients + low calorie symbol (circle with words 'low	FF restaurant (McDonald's, Burger King) menu scenario and family restaurant (Outback Steakhouse, TGI Fridays)	Scenario-based experimental design	Parents of children 3-12 years old, diners N = 984	▪ Perceived restaurant healthiness ▪ Restaurant trustworthiness ▪ Nutrition info credibility	Parents who trusted nutrition information in general reacted more positively to the frame that provided more information (i.e., both numeric values and low-calorie symbols). Conversely, parents who did not trust nutrition information in general reacted more positively to the frame containing numeric

	calorie' beside lowest calorie item each menu category	menu scenario				values only, which provided less information without emphasis	
Liu Roberto et al **2012** **US**	▪ No NI ▪ NEML ▪ Rank-Ordered Calories (low to high) ▪ Rank-ordered + STL (red or green) indicating higher/lower calorie choices NEML included RDV (Reference Daily Value) No figure available	Online Randomly assigned to 1 of the 4 menu options then asked to click on all menu items that they would order for themselves for dinner Items from chain restaurant (Chili's Bar&Grill) and beverages from Applebee's	Randomised between subjects	n=456 consumers (n=37 excluded) (online database of business school of University) Majority female and high education	Calories ordered Degree of hunger prior to ordering Perceived healthfulness of 'restaurant' Accuracy of estimating calories ordered	Participants in the Rank-Ordered Calories condition and those in the Coloured Calories condition ordered fewer calories than the No Calories group There was no significant difference in calories ordered between the NEML and No Calories groups. Participants in each calorie label condition were significantly more accurate in estimating calories ordered compared to the No Calories group Those in the Coloured Calories group perceived the restaurant as healthier	Authors cautioned that the increased perceived healthfulness of a restaurant with coloured calories ML may lead consumers to consume more calories at the meal Note – all NEML included RDV Rated FAIR by Littlewood
Loureiro & Rahmani	NEML on survey menu prior to subsequent	Survey (followed by FF restaurant – with free	Between subjects experimental with control	Adults (mean age 24 years)	Calories selected (survey)	ML reduced the average number of calories chosen by 2.96% under survey conditions; however the same NI had no	Study shows a considerable gap between stated preferences with

2013 **Spain** **(grey literature)**	food choice in FF restaurant (no NI) – with voucher for free meal of their choice (random value of 7,8 or 9$) No figure available	meal of their choice)	group	Convenience sample from University campus or near FF restaurant N=174	Calories purchased (FF restaurant)	impact on actual food purchases in FF restaurant Calorie content of participants' actual purchases increased significantly (0.17%) with the number of days elapsed between the survey day (and NI provided) and FF restaurant purchase day	respect to FF choices and actual choices in the real world
Morley et al **2013** **VIC, Australia**	▪ No label ▪ NEML (kJ) ▪ NEML + %DI ▪ NEML + STL ▪ NEML + STL + %DI STL based on fat, salt and sugar content Figure 6	Online menu boards of FF chain Mains & sides and Drinks & Desserts (burgers, wraps, chips, soft drinks, sundaes)	Randomised; Between subjects experimental Asked to imagine making dinner selection at FF restaurant – up to 3 mains&sides and up to 2 items drinks&desserts	n=1294 adults aged 18-49 yrs Mainly female	Energy selected Self-reported use of menu NI and price	Respondents in the no labelling condition selected meals with the highest mean energy content and those viewing the NEML and NEML+STL selected meals with a significantly lower mean energy content (reduction of around 500 kJ; $p<0.05$ for both) When %DI was included to labelling conditions there were no significant differences to the no labelling condition Respondents most commonly reported using the STL in making their selection	Rated FAIR by Littlewood
Nikolaou Hankey et al **2015** **UK**	▪ No NI ▪ NEML ▪ NEML + RDV	University catered dining hall (Hall of Residence)	Single group, experimental Treatment 1 = 20 weeks, Tnt 2	n=120 young adults mean age=19yrs	Energy and nutrient content of foods ordered	Calorie labelling resulted in reductions in calories, fat and satfat contents of the meals chosen, without compromising micronutrient consumptions	

			= 10 weeks; Tnt 3=10 weeks				
Pang & Hammond **2013** **Canada**	Menus – asked to select a snack: • No NI • NEML • NEML + contextual Health Statement (HS[15]) (DRV) • NEML + PA E (mins) scale	Controlled setting on University campus	Randomised, between-group experiment	University undergraduate students N=213	Calories selected Ratings understandability/perceived effectiveness	Significantly higher calories selected among no label condition vs. NEML (P=0.002) and NEML+HS (P=0.001) For snacks, energy selected was lower for all ML conditions v. no labels (1393·3 kJ): NEML (−144·3 kJ, P=0·02); NEML +DRV (−156·9 kJ, P=0·01); and NEML +PAE (−90 kJ, P=0·05 NEML+DRV perceived most understandable NEML+PAE perceived as most effective in helping to promote healthier eating	Significant gender difference across labelling conditions Rated WEAK by Littlewood
Parker & Lehmann **2014** **US**	3 menu options: • No NI • NEML • NEML + calorie Study 1: + manipulation	Simulation of RWI (calorie-organised Applebees, Chili's, and Ruby Tuesday; and calorie-posted PF	Four controlled experiments	Participants were from national online subject pool (paid) Study 1: n=272 Study 2: n=433 Study 3: n=274 (mainly male)	Item/dish and beverage chosen (calories, price) Recall (or estimation) of calorie	Study 1: choices from calorie-organised menu not significantly different from no NI but were significantly higher in calories than NEML Study 2: When choosing from NEML chose fewer calories compared to no NI; but when choosing from calorie-organised menu these benefits were	Younger participants tended to chose higher calorie dishes but age, hunger level, gender and BMI levels were not significant covariates

[15] Daily reference value

	of price-calories correlation Study 2: Price and calories not correlated Study 3: + 2 X deliberation time (20 s vs. 40s) Study 4: + menu with calorie-organising but no NI (grouped under 'Timmy's Favourites': LCORg) and calorie-organised ('Under 600 calories': CCOrg)	Chang)		Study 4: n=227	content of chosen dish	eliminated Study 3: Supported findings from 1&2; short deliberation times resulted in positive impact of NEML eliminated by further calorie-organising. However, when given more time to choose – calorie-organisation accentuated the positive effect of NEML Study 4: Shorter deliberation times (not manipulated) led to lower-calorie choices from NEML vs. no NI. Addition of CCOrg with LCORg eliminated the confound between the grouping of low-calorie options and the labelling of these options - showed that dishes in category labelled 'Under 600 calories" were expected to be unappealing whereas low-calorie options labelled with appealing name more likely to be chosen	No evidence that different menu formats would affect likelihood of visiting restaurants Findings from study 4 could result in backlash from consumers if they feel that the labelling is deceptive Organising a menu by calories may be particularly counter-productive in FFR/QSR Also – calorie information may interfere with the 'pleasure of dining out' (worthy of further research)
Platkin Yeh et al **2009**	Fast food menu choices (actual food and packaging from Burger	Controlled setting on university campus	Three group repeated-measures experimental study	Females aged 18-34, predominantly non-white, overweight or obese	Food/calories consumed (weighed measurements)	There were no absolute differences between groups in calories ordered/consumed from L1 to L2 NEML and NEML+PAE ordered	Study underpowered

Florida, US	King) – paper menu format as per menu boards ▪ No labels ▪ NEML ▪ NEML + mins walking (PAE: distance)			N = 62	Lunch 1 – no labels any group Vs. Lunch 2 (one week later) – experimental condition	about 16% (206 kcal) and 14% (162 kcal) fewer calories from Lunch 1 to Lunch 2, respectively; whereas, the no information group ordered only 2% (25 kcal) fewer 92% of participants said they believed that a combination of calories and PACE would influence the foods they ordered at a FF restaurant	
Roberto et al **2010** **Connecticut, US**	▪ No NI ▪ NEML ▪ NEML+DRV	University classroom (laboratory environment)	Randomised experiment; parallel Single exposure	n=303 (295) adults recruited from community	Food choices and intake during (weighed plate waste) Food intake after study dinner (24-hour dietary recall) Caloric estimation of foods chosen/eaten	Participants in both calorie label conditions ordered fewer calories than no NI average 326 calories fewer (14%) p=0.03) NEML condition consumed more calories after the study dinner than those in both other conditions Calories consumed during and after the study dinner combined, participants in the NEML+DRV consumed an average of 250 fewer calories than those in the other groups (p=0.03)	NEML+DRV more likely to accurately estimate the caloric content of their dinner (p=0.02 for no NI vs. labels; and p=0.003 for no labels vs. labels + DRV)
Roseman et al [91] **2013**	▪ No labels ▪ NEML	Street corner intercept; hypothetical menus	Randomised, between-group, single exposure	N=302 adults	Label usage Item selection Attitudes	Participants who believed they would make healthy menu selections with nutrition labels on restaurant menus made healthier menu selections, regardless of whether the menu displayed calories or not	Rated WEAK by Littlewood

US						No differences in energy selected between ML conditions	
Schornack & Rozensher **2014** **US**	• No NI • NEML (complying with New York Health Code 81.50)	Mock, typical FF menu board (printed, assumed from article)	Post-test only, with control group, random assignment	Undergraduate students private college New York State N=90 students aged 18-22 years	Energy selected Self-reported awareness of calorific content of foods chosen	No significant differences (non-significant 894.67 vs. 862.20 calories selected) No gender effect; nor dieters effect	Females in general ordered fewer calories than men; and dieters ordered fewer calories than non-dieters Much higher self-reported awareness of calorie content of food by females than males
Scourboutakos Corey et al **2014** **Canada**	• NEML • NEML + numeric Na • NEML + numeric Na + serving size • + RDV (2,000 kcal) and upper tolerable intake for Na (2,300 mg)	Online survey Four restaurant scenarios: – FF burger restaurant – Sit-down breakfast restaurant – Sub shop – Sit-down dinner restaurant	Repeated-measures experiment Asked to order from four mock menus and then allocated to one of 3 ML options and asked if wanted to change order	N = 3080 consumers	Difference in nutrient levels before and after In the subset of panellists who opted to change their order, the effect of serving size labelling on the nutrient density of meals ordered	Restaurant type affected the proportion of consumers who changed their order (varied from 17% to 30%) Na levels decreased in meals chosen from all restaurant types after ML ($p<0.0001$); however in 3 out of 4 restaurant types NEML+Na selected meals with significantly less Na than consumers who saw only NEML ($p<0.01$), lower Na by 171-384 mg depending on restaurant type. Subset of consumers who saw Na info and changed their orders selected 681-1360 mg less Na	

						Gender, intent to lose weight and number calories ordered at baseline were important predictors of using ML information	
Shah Bettman et al **2014** **US**	*Study 1A:* ▪ control ▪ $ surcharge on unhealthy options ▪ Unhealthy label (asterisk + explanation at bottom menu = unhealthy as exceeded values for fat and/or sugar content) ▪ $ surcharge + unhealthy label *Study 1B:* same as 1 but half given MNNL (calories+ satfat) *Study 2*: effect	3 laboratory experiments and one field experiment (Restaurant) Hypothetical menus containing 6 choices (chicken, seafood, beef) and health and unhealthy choices within each category Mock FF	Study 1A: Received one of 4 menus Study 1B: 2 (NEML+health info +/-) X 3 (menu condition) Study 2: 2 (dining alone, with same-sex friend) X 4 (menu conditions) between-subjects design	Recruited online survey panel Study 1A: N=1200 Study 1B: N = 894 Study 2: N=1987	Choice of entrée How made decision Preferences	For both genders: Neither a price surcharge nor an unhealthy label is enough to curtail the demand for unhealthy food but is effective when combined For women: unhealthy label is as effective as the unhealthy label surcharge For men: unhealthy label alone leads to more ordering of unhealthy food	Authors considered that an unhealthy surcharge highlights both the financial disincentive and potential health costs

	of dining alone vs. same-sex friend						
Streletskaya Amatyakul et al **2015** **US**	• NEML • NFP (MNNL) • Health-related claims (very detailed)	Laboratory setting Lunchtime experiment using menus on computer screens (menu items and prices those used in Univ cafeteria)	Randomly assigned to control group and 3 treatments Repeated measures – control selection followed by treatment selection from labelled menu	N=232 University students (recruited via experimental lab platform – online ads) Health-related claims group had significantly more females, who were less educated than others involved overall	First and second selections	Average number calories = 554 +/- 292 from unlabelled menu Calories = 539 +/- 275 from second choice Compared to control group; second selection treatment with NEML chose 144 calories fewer (20%; p<0.05); NFP labelling reduced calories selected by 120; 17% (p<0.05) NFP was only treatment to reduce empty energy content (by 65 empty calories) Only treatment to affect the added sugar content All treatments reduced calories from fat, by 78, 58, and 53 calories among NFP, NEML and health-related claims respectively; and from carbohydrate and satfats according to fat effect NFP only treatment to affect added sugars Cholesterol, protein and sodium contents were not affected by	$10 to spend showed that a significant number of people, even when under a strong incentive to spend all $10, will underspend, possibly in accordance to their lunch habits Concluded that, in general, while NEML had most dramatic effect on reducing calories, treatments that provided more NI, particularly NFP, seemed to have more comprehensive effect on dietary quality

						any treatment
Stutts et al **2011** **US**	▪ No NI ▪ Heart icon + statement at bottom menu board 'Healthier choice in terms of calories and fat' ▪ MNNL = Calories+ Fat	'Laboratory' – children one at a time in separate room while at scouts (menu read to those who couldn't read) Menu boards (trifold poster boards) with items from McDonald's and Wendy's	3 (ML) X 2 (gender) X 2 (age; 6-8 or 9-11) X 2 factorial experimental design Experimental condition = between-subjects Restaurant = within-subjects	Children aged 6-11 years N=236 Recruited through girl and boy scouts	Child food, drink, condiment choices and intended amount to be consumed BMI Parental-report frequency dining FFR + other	Children exposed to menus with heart symbols chose healthier meals than children exposed to menus with calories and fat content, or menus with no NI (note – no difference in planned calorie and fat consumption my menu condition except among those that visit FFR frequently) NI (calorie+fat) only effective for children from high-SES families Non-Caucasian overweight children planned to eat more calories and fat than non-Caucasian normal weight or obese children and Caucasian children
Sun **2013** **Taiwan**	▪ Calories + % fat, % protein, % carbohydrate ▪ Descriptive NI, e.g. 'This dish contains carrots, broccoli,	Surveys Nutrient-balanced restaurant menus with only combination meals	2 X 2 factorial experiment Random assignment	Undergraduate students; 63% female, mean age = 21 years N=456 (useable) Stratified random sampling by department, class,	Attitudes Dining intentions	Quantitative NI had no effect on attitudes nor dining intentions but descriptive NI did Affected by consumer psychosocial factors. For those with high vegetable psychosocial scores, quantitative NI alone can affect dining intentions

	and tomatoes, which are high in vitamins A and C'			year, gender			
Tandon et al **2010** **Seattle, Washington, US**	▪ No NI ▪ NEML	Cross-sectional survey-based experiment Parents were presented with a McDonald's menu and were asked to select meals for themselves/ their child	Randomised to order from menu with/without ML Single exposure	n=99 Parents of children 3-6 years; visiting a paediatric clinic	Calories ordered	Parents in the intervention arm ordered an average of 102 fewer calories for their children than did control subjects (567.1 cal vs. 671.5 cal; P = .04). With adjustment the difference remained significant (P = .004). There was no difference in energy between the 2 groups in the parents' choices for themselves.	
Temple et al **2011** **US**	▪ No NI ▪ NFL[16] ▪ STL[17] labels (+/- video on reading nutrition labels)	University buffet lunch	Experimental	University adults N=47 Mean age = 29.9 years	Calories consumed (weighed samples)	Fewer calories were consumed with either labelling condition, but only for lean women	STL were told that 'green' = low, yellow = moderate and red = high, in calories, added sugar and fat

[16] NFL = nutrition facts label (on packet in US; similar to NIP in Australia)

[17] STL = single traffic light symbol to denote healthiness (red, yellow, green)

Tian **2015** **Grey literature (Masters Thesis)**	Green symbol indicating 'lower than 600 calorie' item	Online survey	Randomised to menu	Young Millennials (age 18-24) N=505	Calorie choices	Participants who randomly received the menu with green symbols (signifying a lower-than-600-Calorie item), participants who have started to control their daily Calorie consumption, participants who were of normal weight status, and participants who were female were significantly more likely to choose menu items lower-than-600 Calories	Results suggest that including calories on menus will only influence the choices of certain demographics
Wei & Miao **2013** **US**	▪ No NI ▪ NEML From healthy and unhealthy FF categories	Online survey	2 X 2 factorial experiment	N=178 adults (mid-Western town Indiana)	Perceptions and behaviours related to calorie counts on menus Kcal selected	In a perceived 'healthful' restaurant, those with access to NEML chose about 100 fewer calories than those with no NI No differences in a perceived 'unhealthful' restaurant; although NEML resulted in 50 more calories Calorie-labelling mean = 643.44 kcal (SD=263.6); control mean = 663.65 kcal (SD=279.53)	54% always believed that calorie information on menus can assist weight maintenance or weight loss. 41% always wanted to see calorie counts on menus at *all restaurants*; only one tenth of respondents indicated that they always changed menu selections or eating habits after knowing the calorie count. There were

							differences in perception and behaviour score among different levels of nutrition education
Wisdom Downs et al **2010** **US**	• RDV • NEML	Simulated SUBWAY restaurant	Cross-sectional simulation experiment	N=638 (study 1= 292; study 2= 346)	Calories of selected items	61 fewer calories selected when provided item calorie information; 38 fewer calories selected when provided *daily* calorie information; additive, not interactive, effects of *item* calorie and *daily* calorie recommended information; lower calories selected worked via decrease in non-sandwich choices; no difference between overweight and non-overweight respondents for item calorie labelling in particular.	
Yamamoto et al **2005** **Hawaii, US**	• No labels • MNNL (Calorie + fat)	Simulated FF environment – 3 menus from McDonald's, Panda Express and Denny's	Within-subject, repeat measures; control then NI and choice of changing food selected	Adolescents aged 11-18 years N=106	Selected calories, fat and price	75 did not change orders when shown ML; for the 31 who changed order: 43 meals reduced calories; 11 meals increased calories (price did not seem to affect changes) Provision of NI did not modify the food ordering behaviour for the majority of adolescents but for some it resulted in calorie/fat reduction	Among those who reduced calorie/fat reduction there was no impact on restaurant's revenue
Yang Hanks et al	• NEML • Calorie-	Mock menus based on	Within-subject, repeat	University students	Preferences	Calorie-group menu and price group menu rated significantly	

2015 **US**	grouping – high, medium, low • Price-grouping +NEML	McDonald's drive-thru	measures; each participant viewed the 3 menus in random order	N=152	Perceived ease of use	higher than NEML (traditional; p<0.001) Calorie-grouping preferred for decision-making (m=5.38) vs. price-grouping (m=4.65) vs. NEML (traditional; m=4.44); p<0.001)
Fotouhinia-Yepes **2015** **Switzerland**	5 combinations of 3 ML formats: • No NI • NEML • NEML + graphic summary (calories chosen as % of daily requirements) • TL colour-codes • TL colour codes + graphic summary • TL colour-codes + NEML	Virtual fine dining	Between subjects, experimental Asked to select 4 courses from iPad menu	Young adults (mean age = 22.7 years) N=126	Attractiveness ranking Perceived influence on food choice Calories selected	TL + %DI received highest attractiveness ranking. This attractive graphic format also showed a significant positive correlation to its perceived influences on food choices No significant difference in calories chosen
Zigmont and Bulmer	• No NI • NEML	Online survey; FF items	Within-subject, repeat measures	University students	Estimated calorific content	The majority of students underestimated calorie content for fast food items.

2015 **US**	N=201	Intention to purchase in future	After NEML, those who initially underestimated calorie content were significantly more likely to change their intention to purchase that food item in the future

Table 5 Summary details for menu labelling interventions involving physical activity [energy] equivalents (PAE)

Reference	Intervention	Setting	Study design	Sample	Outcomes measured Measurement methods	Findings	Further findings and Comments
James et al **2015** **Texas**	Menus with: ▪ No labels ▪ NEML ▪ PAE time (mins brisk walking)	University Dining Areas	Quasi-experimental randomised field experiment	Young adults N=300	Energy ordered and consumed at lunch (weight) Post-lunch energy intake (food recall)	PACE group ordered significantly (p = .002) less energy (adjusted mean [CIs]: 763 [703, 824] kcal) at lunch, compared to the no-labels group (902 [840, 963] kcal) but not compared to the kcal-labels group (827 [766, 888] kcal) PACE group also consumed significantly (p = .01) less energy (673 [620, 725] kcal) at lunch, compared to the no-labels group (770 (717, 823) kcal) but not compared to the kcal-labels group (722 [669, 776] kcal)	There was a trend towards increasing effect of labelling with kcal then kcal + PACE

						Energy ordered and consumed were not different between kcal-labels and no-labels groups No difference in post-lunch energy intake by menu type	
Viera & Antonelli **2015** **US**	Mock generic FF menus – imagine in FF restaurant and ordering for child ▪ No label ▪ NEML ▪ NEML + PAE time (mins walking) ▪ Calories + PAE distance (mins walking)	Internet survey	Quasi-experimental randomised choice experiment (hypothetical orders)	Parents (child mean age = 9.5 years) N = 1000	Calories selected (choice) Rating likelihood of labelling leading to prompting by parents for child to exercise	Parents whose menus displayed no label ordered an average of 1294 calories, whereas those shown calories only, calories plus minutes, or calories plus miles ordered 1066, 1060, and 1099 calories, respectively (P = .0001) 20% indicated calories only 'very likely' to prompt child to exercise vs. 38% for calories + mins vs. 37% calories + miles (P<0.0001)	No significant difference within labelling conditions suggesting PACE not more effective than calories only PACE labelling may influence parents' encouragement of child exercise
Antonelli &	Mock generic	Internet	Randomised	N = 1000 (823	Calories selected (choice)	Median calories	Although there was

Viera **2015** **US**	FF menus – imagine in FF restaurant and ordering for child ▪ No label ▪ NEML ▪ NEML + PAE time (mins walking) ▪ NEML + PAE distance (miles walking)	survey	choice experiment (hypothetical orders)	respondents) Adults (from 47 US states)	Rating likelihood of labels to influence food choice and PA	ordered = 1580 calories from the no-label menu, 1200 from the NEML menu, 1140 from the NEML + PAE time menu, and 1210 from the NEML+PAE distance menu (p = 0.0001). 40% of respondents reported that PAE labels were "very likely" to influence food item choice vs. 28% for calorie-only labels (p<0.0001). 64% reported that PAE labels were "somewhat likely" or "very likely" to influence their level of PA vs. 49% for calorie-only labels (p<0.0001)	no difference in median calories ordered across labelling conditions, respondents indicated that PAE labelling was more likely to influence food choice
Goswami & Urminsky **2015**	▪ Industry-standard low salience NEML ▪ Salient	Virtual burger choice Study 2:	Between subjects design	N = 545	Calories selected	Calorie labelling, when sufficiently visually salient, shifts choices, regardless of whether the information is	Visual salience is crucial, not only for information to be noticed, but primarily because it facilitates actively

US	calorie information – larger, red-font (either numeric or PAE) ▪ NEML + 'mere-reminder' (asked to estimate the number of calories OR equivalent mins of running)	Hypothetical chicken burger choice (from 6 'unbranded' McDonald's chicken burgers) *Two other studies were on snack foods*				framed in terms of calories or equivalent exercise Findings were highly robust across demographics Authors propose that visually salient information affects choices primarily via a reminder effect, prompting people to consider nutrition rather than merely providing new information. As a result, they found that even non-informative "mere-reminders" yields similar results as salient new information	deliberating about cues (Shen and Urminsky, 2013) and incorporating cues into decisions (Weber and Kirsner, 1997)
Platkin Yeh et al **2014** **US**	Fast food menu choices (actual food and packaging from Burger King) – paper menu format as per menu boards	Controlled setting on university campus	Three group repeated-measures experimental study	Females aged 18-34, predominantly non-white, overweight or obese N = 62	Food/calories consumed (weighed measurements) Lunch 1 – no labels any group Vs.	There were no absolute differences between groups in calories ordered/consumed from L1 to L2 NEML and NEML+PAE ordered about 16% (206	Study underpowered

	▪ No labels ▪ NEML ▪ NEML + mins walking (PAE: distance)				Lunch 2 (one week later) – experimental condition	kcal) and 14% (162 kcal) fewer calories from Lunch 1 to Lunch 2, respectively; whereas, the no information group ordered only 2% (25 kcal) fewer 92% of participants said they believed that a combination of calories and PACE would influence the foods they ordered at a FF restaurant	
Heiman & Lowengart **2014** **Israel**	▪ Menu containing FF items: hamburger, chicken sandwich, salad, French fries, soft drink with price ▪ NEML ▪ NEML + PAE (burn time)	Middle school; high school; army base; universities and colleges, two large workplaces – all located nearby McDonald's restaurants	Between-subjects	N = 511	▪ Preferences for and perceptions of 3 food items ▪ Perceptions of: taste, healthfulness, nutritional value, calorie density, contribution to weight, price ▪ Accuracy energy content ▪ Preferred choice of main dish and ranking of all 5 products	Fairly accurate estimation of energy content was improved when 'burn time' was added Strong perceived correlation between calories, weight and health While females increased consumption of salad in the desired direction post-exposure to NEML	Provide 'advice' for marketers in terms of 'counterbalancing' regulators' mandatory calorie posting

						only, males responded positively to NEML+PAE	
Pang & Hammond **2013** **Canada**	Menus – asked to select a snack: ▪ No labels ▪ NEML ▪ NEML + contextual Health Statement (HS)[18] ▪ NEML + PAE	Controlled setting on University campus	RCT, Between-group experiment	University undergraduate students N=213	Calories selected Ratings understandability/perceived effectiveness	Significantly higher calories selected among no label condition vs. calories-only (P=0.002) and NEML+HS (P=0.001) NEML+HS (reference statement) perceived most understandable NEML+PAE perceived as most effective in helping to promote healthier eating	Significant gender difference across labelling conditions
Dowray et al **2013** **North Carolina, US**	Imagine in a FF restaurants and order meal from online menu ▪ No labels ▪ NEML	Internet survey – link in online employee newsletter (target population 12,700)	RCT, between-group experiment Single exposure	University employees in Medical Centre/ School N = 802	Calories selected	Energy selected was significantly lower for all menu labelling conditions (p = 0.02), with the calories +distance group ordering significantly fewer	Littlewood rated this study as FAIR

[18] This was equivalent to the reference statement (average daily energy intake level) in NSW

	▪ NEML + mins walking (PAE: time) ▪ NEML + miles walking (PAE:distance)		calories than no label (p = 0.0007) but not compared to other ML conditions (average calories ordered = 1020, 927, 916, and 826, respectively) – significant difference mainly attributable to burger items (and for side orders; compared to salad, dessert and drinks) 82% of their participants reported a preference for exercise equivalents over calories only or no NI on menu labelling

Table 6 Summary of study details: Effect of menu labelling on nutrient content of food items

Author Year Location	Intervention	Setting	Study Design	Sample	Outcomes
Bleich Wolfson et al 2015[14] **US**	Voluntary calorie ML	Large chain restaurants	Time-series with comparison groups 2012 - 2014	Audit (MenuStat) menu items at 66 of the largest US restaurant chains	Mean per item calorie content was lower in all years (2012-2014) for restaurants with ML (-139 calories in 2012, -136 calories in 2013, and -139 calories in 2014) New menu items introduced in 2013 and 2014 showed a similar pattern
Namba Auchincloss et al 2013[79] **US**	Mandatory calorie ML since 2008 in several states	QSRs (not coffee shops)	Time series; Pre- post- with comparison 2005-2011 Note: *different restaurant chains for cases and controls (control restaurant chains did not have outlets in jurisdictions requiring ML)*	Audit of 3887 items: 5 FF chains in jurisdictions requiring labelling (cases) 4 FF chains in jurisdictions with no labelling requirements pre-post-(controls)	Although the overall prevalence of "healthier" food options remained low, prevalence of healthier food options increased from 13% to 20% at case locations while remaining static at 8% at control locations (P = 0.02), after 2008 Since 2005, the average calories for an a la carte entree remained moderately high (approx. 450 kilocalories), with less than 25% of all entrees and sides qualifying as healthier and no clear systematic differences in the trend between chain restaurants in case versus control areas for calorie content (P ≥0.50)
Bruemmer Krieger et al 2012[20] **King County, Washington,**	Mandatory ML in sit-down and QSRs Effective Aug 1, 2008; not enforced until Jan 2009	Chain restaurants (sit-down and QSR) Subject to	6-months post- 18-months post- (2008 – 2010)	Audit of one establishment per chain at each measurement period (37 eligible chains of 92 regulated chains)	Modest improvements in the energy, saturated fat, and sodium content of entrées at chain restaurants at 18 months compared with 6 months following implementation of mandatory menu labelling Energy contents were lower (all chains -41 kcal, sit

US	Calories at POP + DRV statement; SFA, carbohydrate, Na also required but not on menu board or at POP	King County regulations with 4 or more establishments			down -73 kcal, and QSR -19 kcal; paired t tests P<0.0001) for entrees that were on the menu at both time periods. Overall levels for these nutrients remained excessive
Saelens Chan et al 2012[92] **King County, Washington, US**	Mandatory ML Effective Aug 1, 2008; not enforced until Jan 2009 Calories at POP + DRV statement; SFA, carbohydrate, Na also required but not on menu board or at POP	QSRs King County (case) Multnomah County (control)	Pre- 6-months post- 8-months post-	Environmental audit Same 50 restaurants across top 10 QSR chains at each measurement time (note: 49 in wave 2 and 47 in wave 3)	Overall availability of healthy options and facilitation of healthy eating (other than the ML itself) was not different across counties. KC restaurants demonstrated modest increases in signage that promoted healthy eating, although the frequency of such promotion remained low, and the availability of reduced portions decreased in these restaurants. The healthfulness of children's menus improved modestly over time, but not differentially by county

APPENDIX 2: EXAMPLES OF MENU LABELLING USED IN EXPERIMENTAL STUDIES

Figure 1 Arsenault et al 2014

Figure 2 **Boonme et al 2014**

Source: Author

Figure 3 **Cranage et al 2004**

Cranage, Conklin, and Lambert

APPENDIX A. Nutrition Label–Broccoli and Cheese Quiche

Nutrition Facts	
Serving Size–1 slice (161 grams)	
Servings per Container–6 per pie	
Amount Per Serving	
Calories	560
Total Fat	40 g
Saturated Fat	14 g
Cholesterol	40 mg
Sodium	330 mg
Total Carbohydrate	41 g
Dietary Fiber	2 g
Protein	8 g
o Vitamin A 15%	o Vitamin C 30%
o Calcium 15%	o Iron 25%
The information provided is based on standardized nutrient databases and manufacturer's information and is believed to be accurate, but no guarantee of its accuracy is made.	

Figure 4 **Davis et al 2015**

FIGURE 1 FDA menus—example of quick-service restaurant menu meeting FDA guidelines—McDonald's.

FIGURE 2 An example of nutritionally focused drive-thru menus—McDonald's.

Figure 5 Dodds et al 2014

Table 1
Menu labelling information and selected menu items as presented to participants.

Item type	Traffic light[a]	Item	Kilojoules (kJ) [b]	Price
Drinks		Bottle of water (250 ml)	0 kJ	$1.95
		Soft drink (regular) 410 ml	647 kJ	$2.60
		Orange juice (small) 300 ml	568 kJ	$2.75
Main meal		Cheese burger	1190 kJ	$2.15
		Garden salad with balsamic, Italian dressing, or no dressing	142 kJ	$8.95
		Chicken Nuggets (6 pack)	1160 kJ	$4.95
		Garden salad with caesar dressing	597 kJ	$8.95
		French fries (medium)	1540 kJ	$2.35
		Grilled chicken MINI wrap, with mayonnaise	868 kJ	$2.45
		-no mayonnaise	498 kJ	$2.45
		Crunchy chicken MINI wrap with mayonnaise	1130 kJ	$2.45
Dessert		Fruit salad (small)	778 kJ	$4.95
		Icecream sundae (regular)	1330 kJ	$2.45
		Apple pie	970 kJ	$2.25

The average adult daily energy intake is 8700 kJ[b]
These foods lack adequate nutritional value, are high in saturated fat and/or added sugar and/or salt, and can contribute excess energy[a]
These foods have some nutritional value, have moderate levels of saturated fat and/or added sugar and/or salt, and can, in large serve sizes, contribute excess energy[a]
These foods are good sources of nutrients, contain less saturated fat and/or added sugar and/or salt, and help to avoid an intake of excess energy[a]

[a] Only appears on Group 2 – traffic light labelling menu.
[b] Only appears on Group 3 – energy labelling menu.

Figure 6 Domoff et al 2015

Table 1. Menu without Calorie and Fat Information

Side item	Entrée
French fries	Grilled chicken
Mixed vegetables	Mac & cheese
Mozzarella sticks	Baked fish
Sliced fruit	Chicken nuggets
Bread sticks	Vegetable and rice stir fry
House salad	Cheeseburger

Table 2. Menu with Calorie and Fat Information

Side item	Nutritional information	Entrée	Nutritional information
French fries[b]	231 cal, 11.5 g fat	Grilled chicken[a]	210 cal, 8 g fat
Mixed vegetables[a]	35 cal, 0 g fat	Mac & cheese[b]	490 cal, 30 g fat
Mozzarella sticks[b]	215 cal, 11 g fat	Baked fish[a]	180 cal, 9 g fat
Sliced fruit[a]	35 cal, 0 g fat	Chicken nuggets[b]	275 cal, 17 g fat
Bread sticks[b]	156 cal, 6 g fat	Vegetable and rice stir fry[a]	140 cal, 0 g fat
House salad[a]	60 cal, 1 g fat	Cheeseburger[b]	330 cal, 14 g fat

[a]Lower-calorie/-fat foods were coded as "0" and [b]higher-calorie/-fat foods were categorized as "1" in the analyses.

Figure 7 Dowray et al 2013

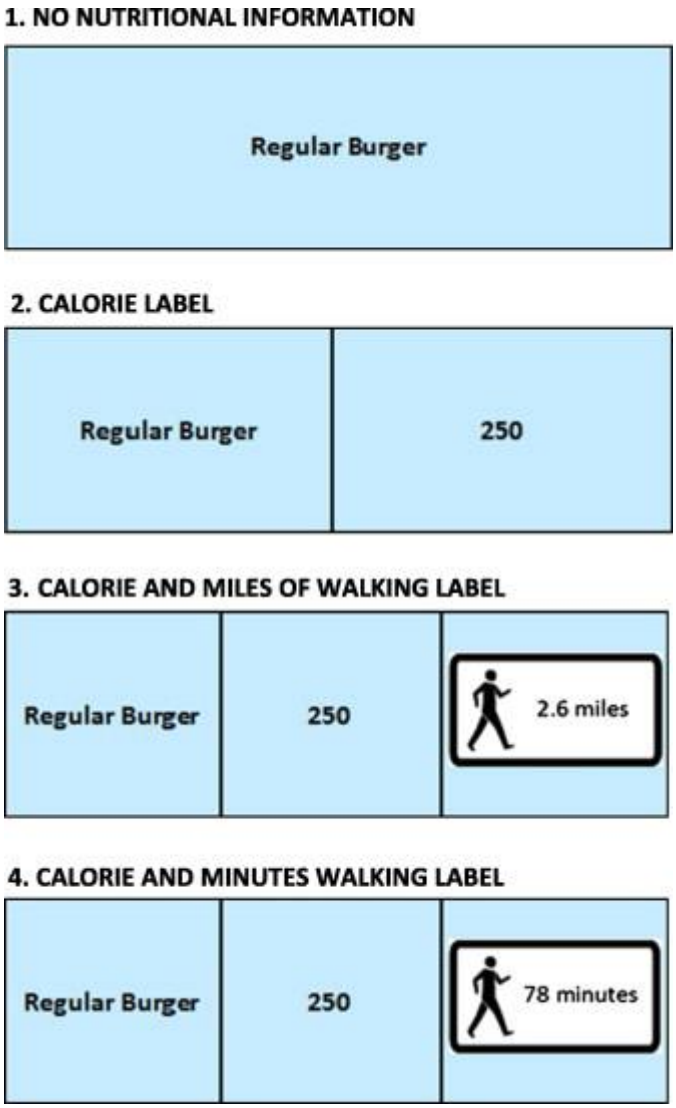


Figure 8 Ellison Lusk & Davis 2014

...the "new kid on the block" from our stone hearth oven...

Pizza "Rita" (350 calories)
fresh mozzarella, basil pesto, fire-roasted tomatoes, and black olives 11

Pizza "Biancoverde" (360 calories)
parmigiano, pecorino and herbed ricotta cheeses
roasted garlic and arugula 11

Pizza "Proscuitto e Funghi" (375 calories)
Dry-cured ham, exotic mushrooms, smoked mozzarella,
grilled onion, roasted garlic and fresh rosemary 12

...hot plates for knife and fork...

President Hargis' Vegetable Stir-Fry (410 calories)
stir-fried garden vegetables seasoned with ginger-plum sauce
cilantro and roasted peanuts served with jasmine rice 10
add stir-fried chicken (180 calories) 13

Orecchiette and Butternut Squash (410 calories)
"little ears" pasta with apple-wood smoked bacon, butternut squash,
sage, red chili flakes, cream and fresh pecorino cheese 11

Rigatoni & Meat Ragù (470 calories)
rigatoni pasta with a "carnivores' delight" of beef, pork and veal in a
fire-roasted tomato sauce seasoned with garlic, onions, pancetta,
red wine, fresh herbs and parmigiano-reggiano cheese 12

Pappardelle and Duck (490 calories)
"broad noodle" pasta with duck breast confit, mushrooms, garlic, onions,
marsala wine, fresh rosemary, cream and parmigiano-reggiano cheese 13

Taylor's Bistro Chicken (440 calories)
grilled marinated chicken breast topped with ginger-apricot chutney
served on a bed of roasted root vegetables and potatoes 12

Gaucho Ribeye Steak (665 calories)
grilled gaucho style and drizzled with chimichurri, served with
roasted Yukon gold potatoes, peppers and Spanish onions 14

...proper, messy finger food with fresh cut potato chips and slaw...

Turkey Meatloaf "Burger" (540 calories)
grilled and served on a homemade scallion roll with avocado
red onion, mixed greens and chipotle mayo 9

Grilled Bistro Panino (580 calories)
sliced house smoked pork loin, artisan salami, provolone, tomato,
arugula and balsamic onion jam on homemade artisan bread 9

...PLEASE COME HELP US CELEBRATE AUTUMN AGAIN SOON...

*Caloric values are estimates—actual values may vary due to individual meal preparation.

Figure 1. Sample Menu Page from Restaurant 1 (with calorie labels)

Comfort

Soup and Salad

STOCK POT seasonal preparation cup (50 calories) 3 bowl (80 calories) 5

Ranchers house with SEASONAL GREENS and preparation half (70 calories) 5 full (90 calories) 6

CAESAR with romaine, grana padano, creamy Caesar, olive oil croutons half (330 calories) 5 full (550 calories) 7

WEDGE with crisp iceberg, bacon, shaved red onion, Roquefort , butter milk ranch half (420 calories) 5.5 full (620 calories) 7.5

Add chicken (250 calories) 4, shrimp (60 calories) 6, 6 oz sirloin (290 calories) 8

Burgers and Sandwiches

SIGNATURE CHEESE BURGER with cheddar, lettuce, shaved red onion (820 calories) 8.5

BACON CHEESE BURGER with apple smoked bacon, shaved red onion, cheddar cheese (920 calories) 8.5

MUSHROOM SWISS BURGER with gruyere cheese, crimini mushrooms (820 calories) 8.5

BLEU CHEESE BACON BURGER with apple smoked bacon, shaved red onions, lettuce (920 calories) 8.5

WEST COAST CHEESE BURGER with colby jack, avocado, apple smoked bacon, lettuce, chipotle mayo (970 calories) 8.5

WEST COAST RANCHER with chicken, colby jack, avocado, apple smoked bacon, lettuce chipotle mayo (590 calories) 9.5

RANCHERS CLUB with sliced Berkshire ham, prime rib, avocado, apple smoked bacon, lettuce and chipotle mayo (760 calories) 9

PRESSED CUBAN with sliced Berkshire ham, chipotle mayo, pickles, bacon, gruyere, cowboy toast (660 calories) 9

PRIME RIB sandwich with caramelized onion, white cheddar, roasted garlic mayo, butter toasted roll (890 calories) 14

CRAB CAKE sandwich with fresh Maine crab, lemon aioli, lettuce, butter toasted roll (350 calories) 10

Combo Meals

PONY EXPRESS with 1/2 sandwich (chicken salad or ham n cheese), soup or salad, drink (370 calories) 7

COWBOY COMBO with petit house salad, sandwich or burger, dessert, drink (sandwich + 370 calories) 13

Prime rib is an additional 5

Homemade Pasta and Rice

Shaved garlic, extra virgin olive oil, SPAGHETTI cherry tomatoes half (340 calories) 6 full (550 calories) 10

Fennel sausage, RIGATONI, greens half (260 calories) 8 full (490 calories) 12

Black pepper, LINGUINI FINI, grana padano, pecorino half (370 calories) 7 full (660 calories) 11

Curried LENTILS with jasmine rice (210 calories) 8

PINCHITOS of farmers market vegetables, mozzarella, and cous cous (280 calories) 8

We proudly serve locally grown produce, meats, and cheeses.

**Caloric values are estimates - actual values may vary due to individual meal preparation.*

Figure 3. Sample Menu Page from Restaurant 2 (calorie-only menu treatment)

Figure 9 Feldman et al 2014 Two-page, folded experimental menu (TM)

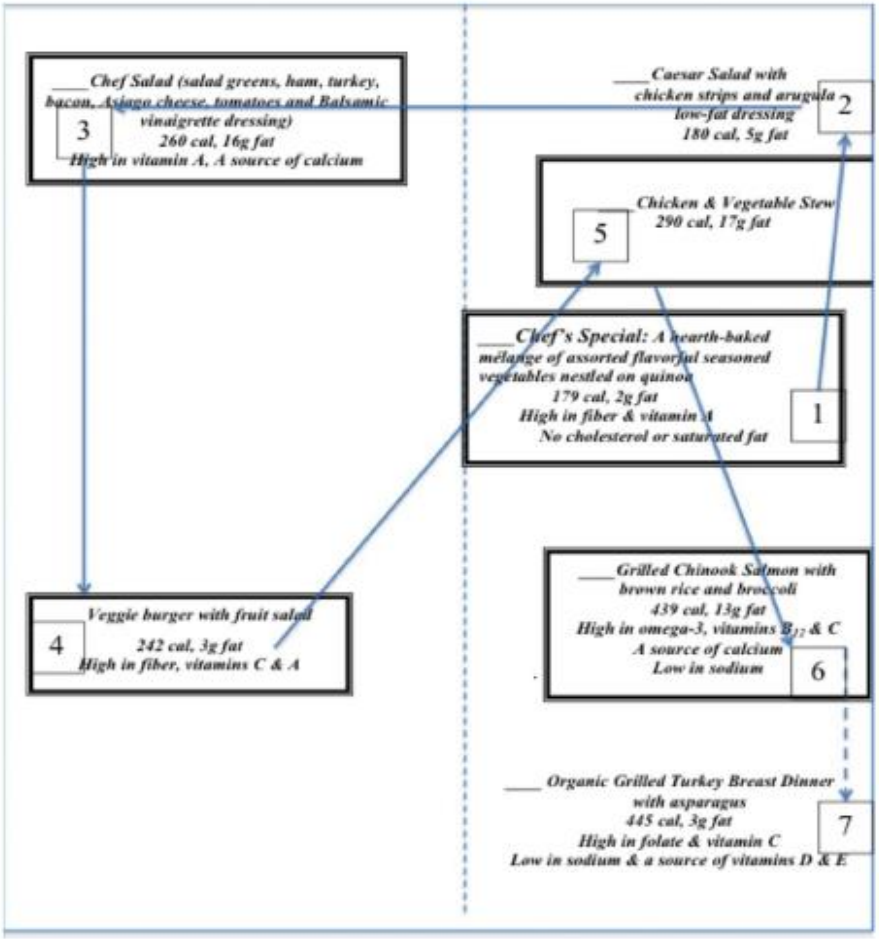


FIGURE 1 Visual placement of healthy items based on eye motion. Based on Bowen and Morris (1995), Gallup Organization (1987), and Feldman et al. (2011) (color figure avaliable online).

URE 2 Treatment menu with nutrition labels (TMNL) (color figure avaliable online).

Figure 10 Feldman et al 2015

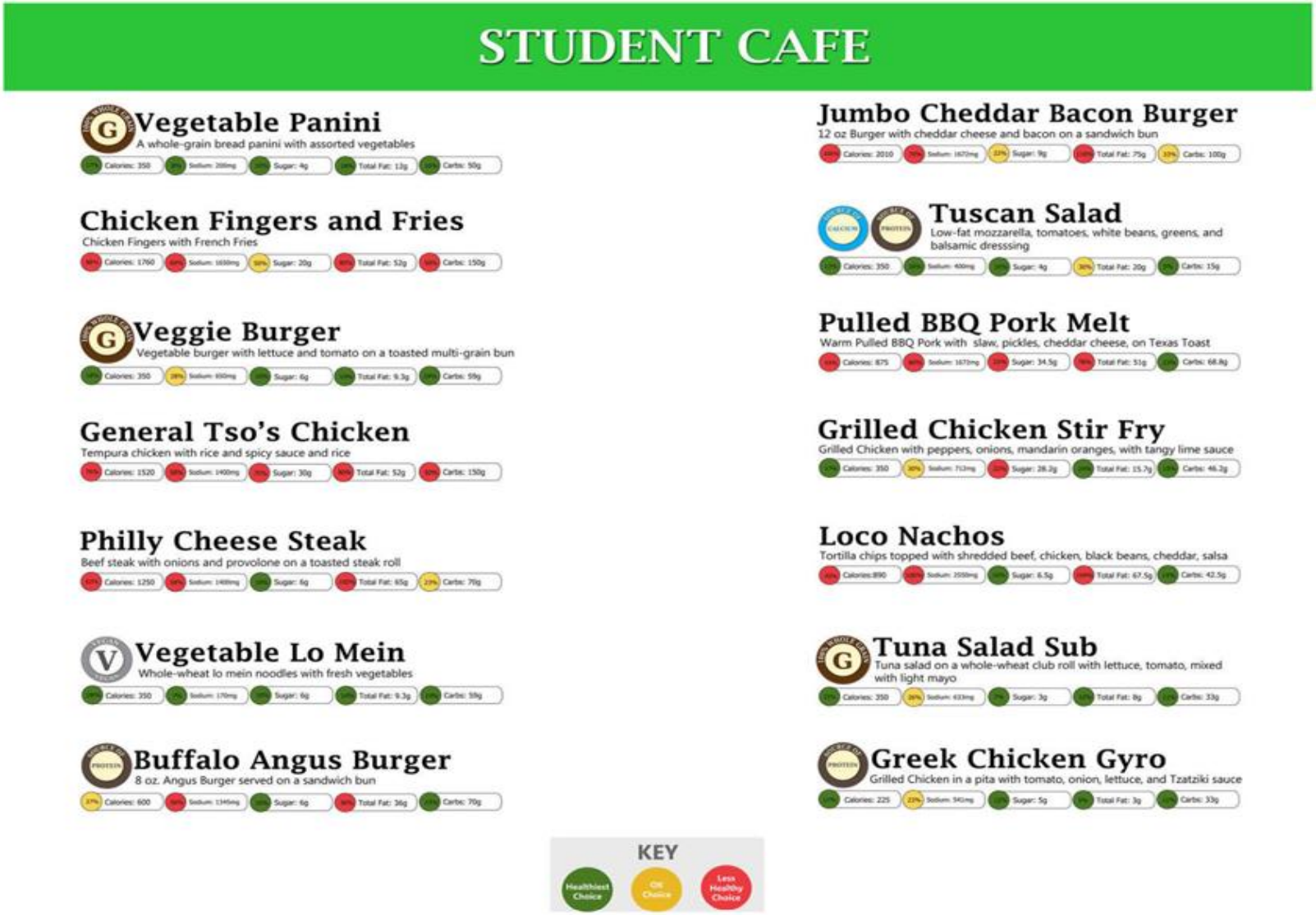


Figure 11 Giesen et al 2011

TABLE 2
Products on menu with calorie information and reference price

Product	Calories	Price
	kJ	*US$*
Main courses		
High in calories		
More expensive		
Bacon cheeseburger	920	4.99
Steak fajita quesadilla	794	4.35
Less expensive		
Ham submarine sandwich (prepacked)	859	3.98
Peanut butter and jelly sandwich (prepacked)	716	2.79
Low in calories		
More expensive		
Deli vegetable sandwich	230	4.69
Classic Caesar salad with light Italian dressing	155	5.99
Less expensive		
Vegetable wrap (prepacked)	210	3.79
Vegetable salad (prepacked)	185	4.55
Desserts/snacks		
High in calories		
More expensive		
Brownie à la mode	300	2.25
Glazed donut	180	1.75
Less expensive		
Chips, barbecue	130	0.90
Chocolate candy bar	280	0.95
Low in calories		
More expensive		
Pineapple pieces	78	2.00
Strawberries	46	2.35
Less expensive		
Apple	55	1.00
Pear	75	1.00
Drinks		
High in calories		
More expensive		
Cola	250	1.39
Citrus soda	290	1.49
Less expensive		
Cola	250	1.19
Citrus soda	290	1.25
Low in calories		
More expensive		
Mineral water	0	1.49
Vegetable juice	70	1.85
Less expensive		
Water	0	1.29
Tomato juice	60	1.49

Figure 12 Hammond et al 2013

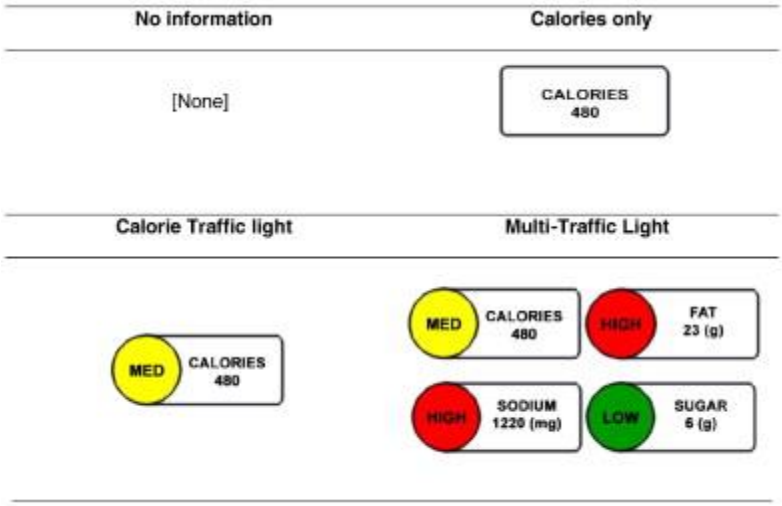


Figure 13 Hammond et al 2015

Figure 1
Images of Calorie Labeling in the Cafeteria during the Follow-up Period

(Images from top left to bottom right: desserts, soup of the day, drink fridge, hot entrée)

Figure 14 Pratt et al 2016

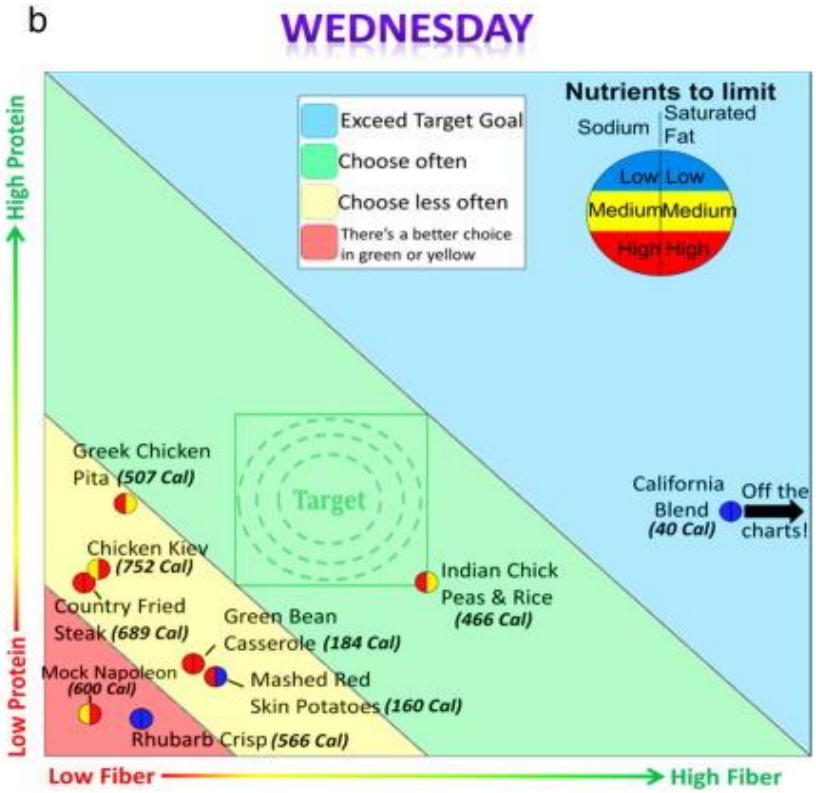


Figure 15 Harnack et al 2008

FRENCH FRIES	calories	PRICE
Small Fries	230	$0.89
Medium Fries	350	$1.09
Large Fries	520	$1.59

Figure 2
Excerpt from calorie menu.

Figure 3
Calorie reference information provided in the bottom right hand corner of the calorie and calorie plus price menus.

FRENCH FRIES	PRICE
Small Fries	$0.71
Medium Fries	$1.09
Large Fries	$1.63

Figure 4
Excerpt from price menu.

FRENCH FRIES	calories	PRICE
Small Fries	230	$0.71
Medium Fries	350	$1.09
Large Fries	520	$1.63

Figure 5
Excerpt from calories plus price menu.

Figure 16 Haws & Liu 2016 Menu with calorie information and non-linear pricing (3 other versions; 2 X 2 factorial with and without NEML and linear vs. non-linear pricing)

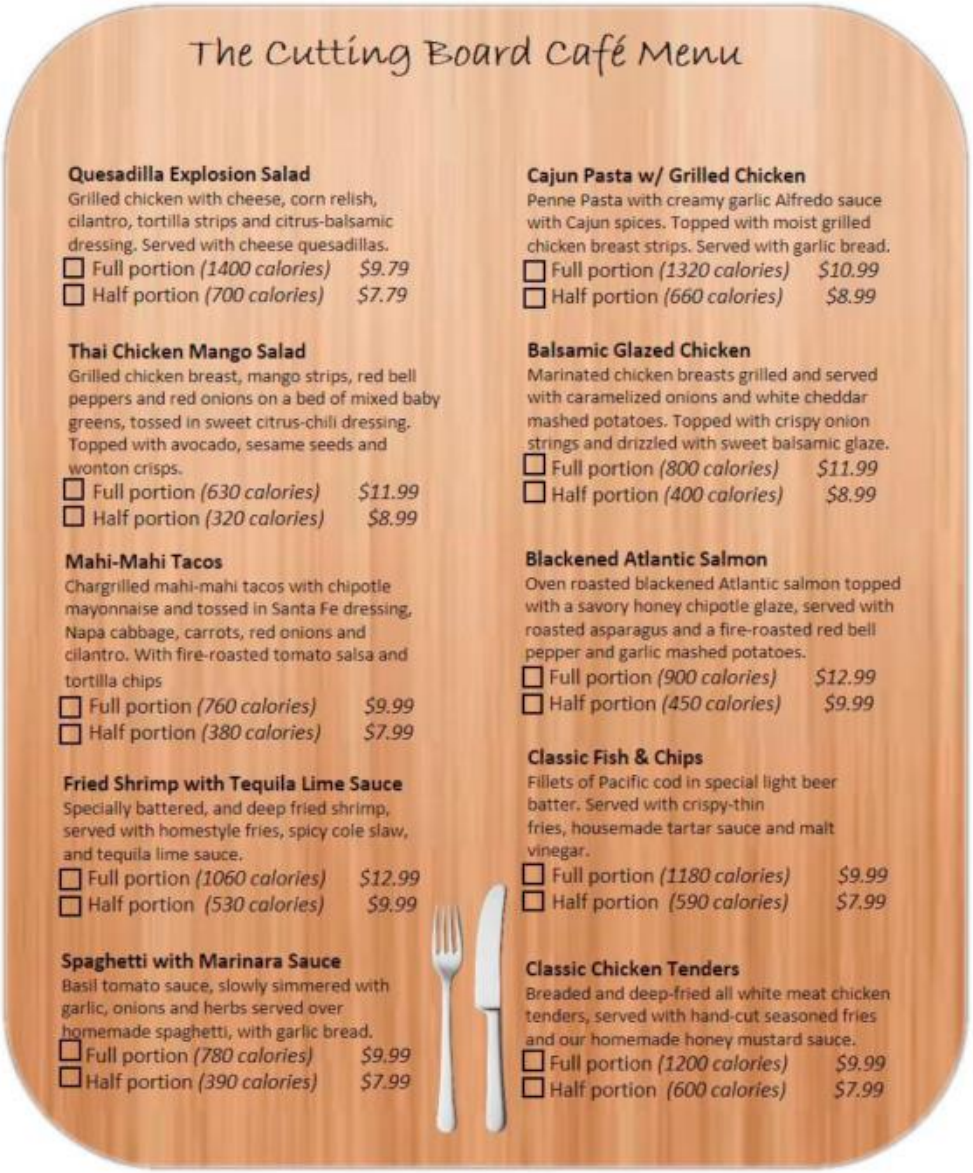


Figure 17 Hur & Jang 2015

a. General Health Claim & Integrated Calorie Framing (Experiment 1)

b. Specific Health Claim & Segregated Calorie Framing (Experiment 1)

c. Unhealthy Anchor + Healthy Tie-in & Integrated Calorie Framing (Experiment 2)

d. Healthy Anchor + Unhealthy Tie-in & Segregated Calorie Framing (Experiment 2)

Figure 18 a,b Morley et al 2013

MAINS & SIDES			
Hamburger			
Single	$2.50	983 kJ	(11%DI)
Double	$3.50	2060 kJ	(24%DI)
Cheeseburger			
Single	$2.50	1190 kJ	(14%DI)
Double	$3.50	1800 kJ	(21%DI)
Chicken burger			
Grilled	$3.50	1930 kJ	(22%DI)
Crispy	$3.50	2350 kJ	(27%DI)
Chicken tandoori wrap			
Grilled	$3.50	1340 kJ	(15%DI)
Crispy	$3.50	1810 kJ	(21%DI)
Chicken snack wrap			
Grilled	$2.50	868 kJ	(10%DI)
Crispy	$2.50	1130 kJ	(13%DI)
Chicken nuggets			
3 pack	$2.50	582 kJ	(7%DI)
6 pack	$3.50	1160 kJ	(13%DI)
Chips			
Small	$1.50	1070 kJ	(12%DI)
Medium	$2.50	1540 kJ	(18%DI)
Large	$3.50	1900 kJ	(22%DI)
Garden salad	$1.50	63 kJ	(1%DI)
Fruit bag	$1.50	153 kJ	(2%DI)

DRINKS			
Soft drink			
Regular	$1.50	428 kJ	(5%DI)
Large	$2.50	937 kJ	(11%DI)
Diet soft drink			
Regular	$1.50	4 kJ	(0%DI)
Large	$2.50	9 kJ	(0%DI)
Spring water	$1.50	0 kJ	(0%DI)
Juice			
Regular	$1.50	568 kJ	(7%DI)
Large	$2.50	814 kJ	(9%DI)
Fruit smoothie	$2.50	1620 kJ	(19%DI)
Flavoured shake			
Regular	$1.50	1290 kJ	(15%DI)
Large	$2.50	2110 kJ	(24%DI)

DESSERTS			
Apple pie	$1.50	970 kJ	(11%DI)
Sundae			
Regular	$1.50	1390 kJ	(16%DI)
Large	$2.50	2130 kJ	(25%DI)
Ice cream with M&M minis	$1.50	1990 kJ	(23%DI)
Soft serve cone	$1.50	627 kJ	(7%DI)
Cookies	$1.50	1180 kJ	(14%DI)

Percentage daily intakes are based on an average adult diet of 8700 kJ.
Your daily intakes may be higher or lower depending upon your energy needs.

MAINS & SIDES

Hamburger		
Single	$2.50	983 kJ
Double	$3.50	2060 kJ
Cheeseburger		
Single	$2.50	1190 kJ
Double	$3.50	1800 kJ
Chicken burger		
Grilled	$3.50	1930 kJ
Crispy	$3.50	2350 kJ
Chicken tandoori wrap		
Grilled	$3.50	1340 kJ
Crispy	$3.50	1810 kJ
Chicken snack wrap		
Grilled	$2.50	868 kJ
Crispy	$2.50	1130 kJ
Chicken nuggets		
3 pack	$2.50	582 kJ
6 pack	$3.50	1160 kJ
Chips		
Small	$1.50	1070 kJ
Medium	$2.50	1540 kJ
Large	$3.50	1900 kJ
Garden salad	$1.50	63 kJ
Fruit bag	$1.50	153 kJ

DRINKS

Soft drink		
Regular	$1.50	428 kJ
Large	$2.50	937 kJ
Diet soft drink		
Regular	$1.50	4 kJ
Large	$2.50	9 kJ
Spring water	$1.50	0 kJ
Juice		
Regular	$1.50	568 kJ
Large	$2.50	814 kJ
Fruit smoothie	$2.50	1620 kJ
Flavoured shake		
Regular	$1.50	1290 kJ
Large	$2.50	2110 kJ

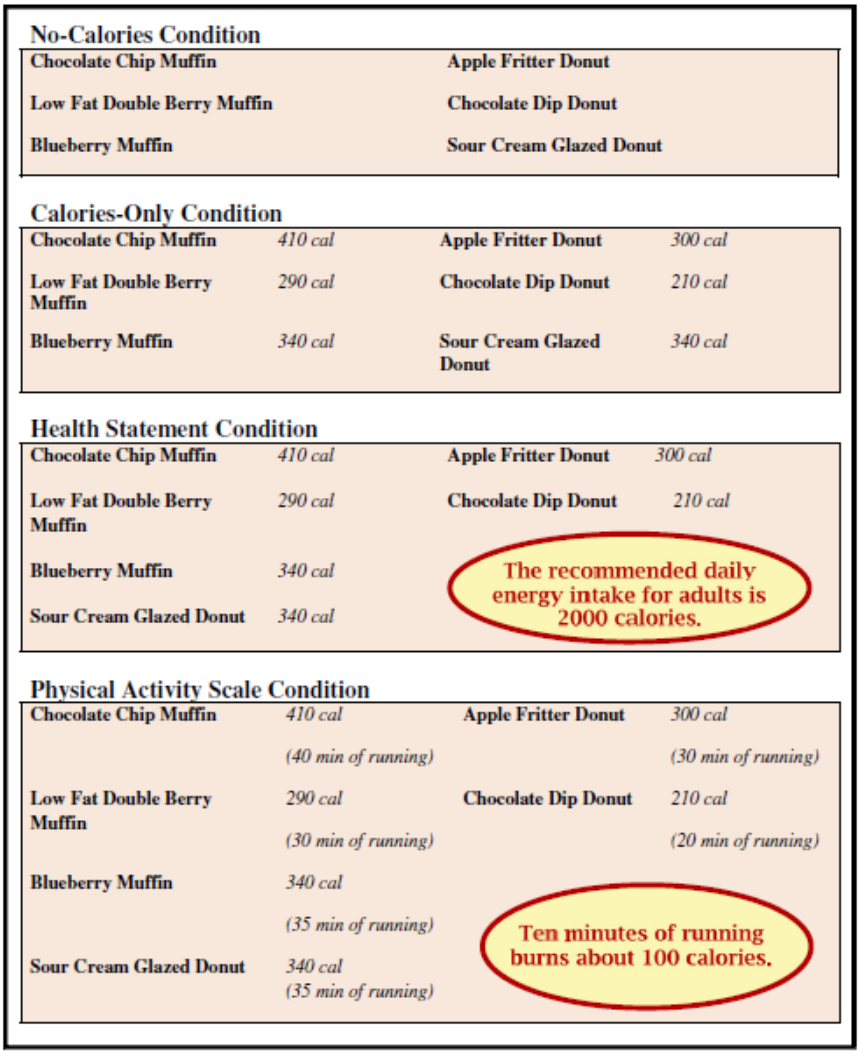
DESSERTS

Apple pie	$1.50	970 kJ
Sundae		
Regular	$1.50	1390 kJ
Large	$2.50	2130 kJ
Ice cream with M&M minis	$1.50	1990 kJ
Soft serve cone	$1.50	627 kJ
Cookies	$1.50	1180 kJ

● **Healthier choice** ● **OK choice** ● **Least healthy choice**

The average adult daily energy intake is 8700 kJ.

Figure 19 Pang & Hammond 2013



No-Calories Condition

Chocolate Chip Muffin	Apple Fritter Donut
Low Fat Double Berry Muffin	Chocolate Dip Donut
Blueberry Muffin	Sour Cream Glazed Donut

Calories-Only Condition

Chocolate Chip Muffin	*410 cal*	Apple Fritter Donut	*300 cal*
Low Fat Double Berry Muffin	*290 cal*	Chocolate Dip Donut	*210 cal*
Blueberry Muffin	*340 cal*	Sour Cream Glazed Donut	*340 cal*

Health Statement Condition

Chocolate Chip Muffin	*410 cal*	Apple Fritter Donut	*300 cal*
Low Fat Double Berry Muffin	*290 cal*	Chocolate Dip Donut	*210 cal*
Blueberry Muffin	*340 cal*	The recommended daily energy intake for adults is 2000 calories.	
Sour Cream Glazed Donut	*340 cal*		

Physical Activity Scale Condition

Chocolate Chip Muffin	*410 cal (40 min of running)*	Apple Fritter Donut	*300 cal (30 min of running)*
Low Fat Double Berry Muffin	*290 cal (30 min of running)*	Chocolate Dip Donut	*210 cal (20 min of running)*
Blueberry Muffin	*340 cal (35 min of running)*	Ten minutes of running burns about 100 calories.	
Sour Cream Glazed Donut	*340 cal (35 min of running)*		

Figure 1. Menus for snack items, by experimental conditions, in a menu labeling study to assess efficacy and consumer preference.

Figure 20 a,b,c,d Parker & Lehmann 2014

Timmy's Diner

Open Daily from 11:00 AM to 11:00 PM

Salads

Boneless Buffalo Chicken Salad
Breaded chicken drenched in medium-spicy buffalo sauce, applewood smoked bacon, blue cheese crumbles, tortilla strips, house-made pico de gallo, and ranch dressing.
$8.99 *Calories: 1150*

Quesadilla Explosion Salad
Grilled chicken with cheese, corn relish, cilantro, tortilla strips and citrus-balsamic dressing. Served with cheese quesadillas.
$7.79 *Calories: 1400*

Caribbean Crispy Chicken Salad
Fresh Pineapple, mandarin oranges, dried cherries, green onions, cilantro, sesame seeds, and fat free Caribbean Dressing.
$8.99 *Calories: 1375*

Sandwiches

Oldtimer Burger w/ French Fries
Mouth-watering burger with mustard, tomato, lettuce, and red onion.
$6.99 *Calories: 1260*

Ground Peppercorn Burger w/ French Fries
Crusted with ground black pepper and spices, then topped with crispy onion strings and blue cheese dressing.
$8.99 *Calories: 1520*

Crispy Chicken Wrap w/ French Fries
With fire-roasted corn, tortilla strips, cheddar, avocado and tomatoes. Served with ancho-chile ranch.
$9.29 *Calories: 1610*

Platters

Cajun Pasta w/ Grilled Chicken
Penne Pasta with creamy garlic Alfredo sauce with Cajun spices.
$7.69 *Calories: 1350*

Fried Shrimp w/ Tequila Lime Sauce
Served with homestyle fries, spicy cole slaw, and tequila lime sauce.
$9.59 *Calories 1050*

Crispy Honey-Chipotle Chicken Crispers w/ French Fires
Tossed in our honey-chipotle sauce. Served with corn on the cob, homestyle fries, and ranch dressing
$8.99 *Calories: 1950*

Under 700 Calorie Menu

Asian Grilled Chicken Salad
Lettuce with Napa cabbage, edamame, green onions, cilantro, sesame seeds, and Asian vinaigrette.
$10.29 *Calories: 620*

Grilled Chicken Sandwich w/ Grilled Veggies
With applewood smoked bacon, Swiss and honey-mustard dressing on a sesame seed or wheat bun.
$9.99 *Calories: 610*

Classic Sirloin Steak w/ Rice & Grilled Veggies
100% USDA Choice 8 oz. sirloin. With a carne asada rub, grilled veggies and Spanish rice.
$13.79 *Calories: 490*

Beverages

Soft Drinks	Iced Tea	Milkshakes
Coke, Dr. Pepper (250 cal.)	*Sweetened (50 cal.)*	*Chocolate*
Sprite (140 cal.)	*Unsweetened (0 cal.)*	*Vanilla*
Diet Coke, Sprite Zero (0 cal.)	*Green Tea (0 cal.)*	*Strawberry*
$1.59	*$1.59*	*$2.79 Calories: 900*

FIGURE 4

CALORIE-POSTED AND CALORIE-ORGANIZED MENU (STUDY 2)

Harvest Moon
Main Courses

Sandwiches & Burgers
Chicken & Steak
Seafood
Pastas
Under 500 Calories

Harvest Moon
Main Courses

Sandwiches & Burgers

Philly Cheese Steak Sandwich $11.99 1190 calories
Thin-sliced prime sirloin steak, grilled peppers and onions topped with provolone cheese on a fresh toasted hoagie, served w/ French fries

Grilled Chicken Sandwich $10.99 1045 calories
Grilled chicken breast topped with fried onion strings, Swiss cheese, honey mustard, lettuce and tomato, on an onion roll, served w/ French fries

All-American Cheeseburger $11.99 1000 calories
½ pound ground sirloin patty, topped with Swiss, Cheddar, and American cheeses, lettuce, tomato, on a sesame seed bun, served w/ French fries

Bacon Cheeseburger $12.99 1300 calories
½ pound ground sirloin patty, topped with aged cheddar and apple-wood smoked bacon on brioche, w/ lettuce and tomato on the side, served w/ French Fries

Harvest Moon
Main Courses

Chicken & Steak

Fried Chicken Platter $13.99 1250 calories
Buttermilk batter w/ our own blend of spices cover three large pieces of free range white meat chicken, served w/ mashed potatoes and gravy and green beans

Country Fried Steak $14.99 1500 calories
10 ounces of round steak, pounded thing, battered in our buttermilk batter, deep fried, covered with white gravy, served w/ French fries

New York Strip Steak $15.99 1175 calories
12 oz. cut, topped with a garlic herb melted butter sauce, served w/ a loaded baked potato and green beans

Porterhouse Steak $17.99 1290 calories
17 oz. cut, dry-aged, marinated for 24 hours, and seared to perfection, served w/ fresh grilled veggies, French fries, and a whole wheat roll

Harvest Moon
Main Courses

Seafood

Fried Jumbo Shrimp Platter $12.99 1190 calories
Fresh jumbo shrimp (ordered daily), beer-battered and deep fried, served w/ Cajun dipping sauce, a mini corn on the cob, and French fries

Beer Battered Fish & Chips $10.99 1450 calories
Traditional pub-style fish and chips: beer battered-cod, deep fried, served w/ French fries (chips!), tartar sauce and fresh lemon wedges

Fried Catfish Dinner $13.99 1450 calories
Fresh caught catfish, seasoned in a Cajun batter, and deep fried, served w/ traditional hush puppies and a side of coleslaw

Parmesan Crusted Halibut $12.99 1650 calories
Alaskan Halibut (flown in daily), crusted in a garlic herb parmesan mixture and baked, served with classic Italian risotto

Harvest Moon
Main Courses

Pastas

Spaghetti w/ Meatballs $10.99 990 calories
The classic Italian dish with homemade pasta and meatballs, served in a classic marinara sauce with a dusting of parmesan cheese

Traditional Meat Lasagna $12.99 1360 calories
Layers upon layers of fresh pasta, spiced ground meat, mozzarella cheese, and classic marinara sauce, served w/ a side of garlic bread

Fettuccine Alfredo $11.99 1290 calories
The classic pasta, tossed in garlic Alfredo sauce and grilled chicken, served w/ a side of garlic bread.

Spicy Sausage Ravioli $13.99 1310 calories
Jumbo ravioli, stuffed with spicy Italian sausage and topped with our spicy marinara sauce, served w/ a side of garlic bread

Harvest Moon
Main Courses

Under 500 Calories

Turkey Club Sandwich $11.99 450 calories
Triple-stacked sandwich with layers of fat-free turkey, fat-free ham, and turkey bacon, lettuce, tomato, and low-fat chipotle mayo, served w/ fresh veggies

Broiled Chicken Platter $14.99 475 calories
Broiled chicken breast coated in our signature 7 herbs & spices mix, fresh grilled veggies and a whole wheat roll

Blackened Baked Salmon $13.99 410 calories
Fresh Atlantic salmon, blackened with Cajun spices, served w/ New Orleans dirty rice and fresh grilled veggies

Pasta Primavera $12.99 390 calories
Our homemade rigatoni pasta, tossed in a light pesto sauce with fresh veggies and a touch of parmesan.

CALORIE-ORGANIZED MENU (STUDY 3)

CLEAR-CALORIE-ORGANIZED MENU (STUDY 4)

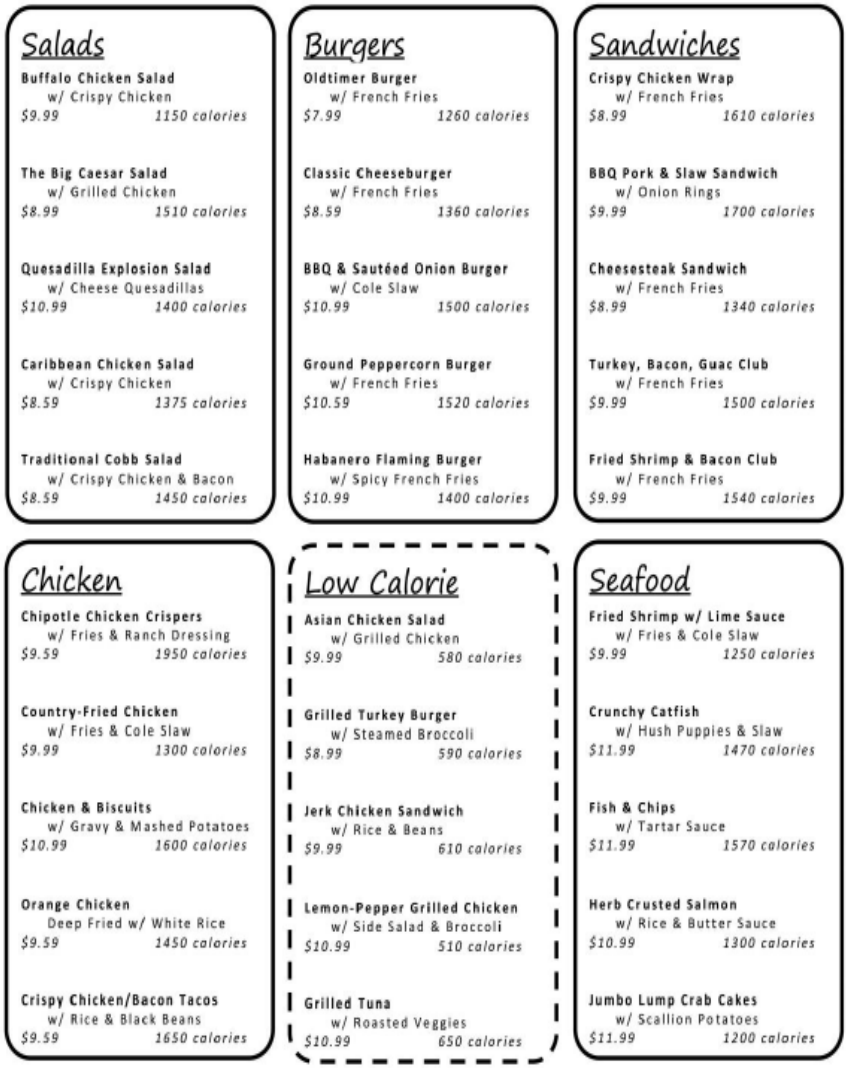


Figure 21 a,b,c Yang et al 2015

FIGURE 1 Traditional drive-thru menu format as required by FDA— Control menu (Menu A).

FIGURE 2 Experimental menu 1— Menu items grouped by calories (Menu B).

FIGURE 3 Experimental menu 2— Menu items grouped by price (Menu C).

Figure 22 Yepes (2015)