Public Health Nutrition: 15(3), 561–566 doi:10.1017/S1368980011002163

Short Communication

Tailored nutrition education: is it really effective?

Helen Eyles* and Cliona Ni Mhurchu
Clinical Trials Research Unit, School of Population Health, University of Auckland, Private Bag 92019, Auckland 1142, New Zealand

Submitted 20 December 2010: Accepted 27 July 2011: First published online 11 October 2011

Abstract

Objective: There has been a growing interest in tailored nutrition education over the previous decade, with a number of literature reviews suggesting this intervention strategy holds considerable potential. Nevertheless, the majority of intervention trials undertaken to date have employed subjective self-report outcome measures (such as dietary recalls). The aim of the present review is to further consider the likely true effect of tailored nutrition education by assessing the findings of tailored nutrition education intervention trials where objective outcome measures (such as sales data) have been employed.

Results: Four trials of tailored nutrition education employing objective outcome measures were identified: one was undertaken in eight low-cost supermarkets in New Zealand (2010; *n* 1104); one was an online intervention trial in Australia (2006; *n* 497); and two were undertaken in US supermarkets (1997 and 2001; *n* 105 and 296, respectively). Findings from the high-quality New Zealand trial were negative. Findings from the US trials were also generally negative, although reporting was poor making it difficult to assess quality. Findings from the high-quality online trial were positive, although have limited generalisability for public health.

Conclusions: Trials employing objective outcome measures strongly suggest tailored nutrition education is not effective as a stand-alone strategy. However, further large, high-quality trials employing objective outcome measures are needed to determine the true effectiveness of this popular nutrition intervention strategy. Regardless, education plays an important role in generating social understanding and acceptance of broader interventions to improve nutrition.

Keywords
Tailored nutrition education
Health education
Nutrition therapy
Health behaviour
Intervention

Tailored nutrition education is an individual-level intervention defined by Kreuter *et al.*[1] as '…any combination of information or change strategies intended to reach one specific person, based on characteristics that are unique to that person, are related to the outcome of interest, and have been derived from individual assessment'. Over the previous decade, there has been a growing interest in tailored nutrition education, particularly as developments in technology have enabled efficient personalisation and delivery of information to large numbers of individuals. Since 2006, four systematic literature reviews have suggested tailored nutrition education is effective in improving the dietary habits of adults[2–5]. However, the majority of included trials have used subjective self-report outcome measures such as FFQ and dietary recalls. More objective measures of diet include sales receipts and electronic shopping data; although such data have some limitations (e.g. they may reflect food purchases of a household rather than an individual of interest), they can be considered superior to self-report measures because they are not subject to reporting bias.

The aim of the present review was to further consider the likely true effect of tailored nutrition education by assessing the findings of tailored nutrition education intervention trials where objective outcome measures have been employed.

Methods

Randomised controlled trials (RCT) of tailored nutrition education employing objective outcome measures were identified from previous systematic literature reviews[2–5] and an updated literature search (to December 2010) using a previously published search strategy[2]. The definition of tailored nutrition education used for this search was that described by Kreuter and colleagues[1]. A narrative summary of the methods, findings and quality of trials employing

*Corresponding author: Email h.eyles@ctru.auckland.ac.nz

objective outcome measures was undertaken (within the context of previous systematic reviews) to further consider the likely true effect of tailored nutrition education.

Results

Four RCT assessing the effectiveness of tailored nutrition education and employing objective outcome measures of diet were identified: one was undertaken in eight low-cost supermarkets in New Zealand (2010; *n* 1104)[6]; one was an online intervention trial in Australia (2006; *n* 497)[7]; and two were undertaken in supermarkets in the USA (1997 and 2001; *n* 105 and 296, respectively)[8,9]. The New Zealand and Australian trials used electronic supermarket sales data linked to a food and nutrient database to tailor the nutrition education intervention and assess trial outcomes. The US trials used manually entered supermarket till receipts linked to a food and nutrient database. The study characteristics, findings and quality of these trials are summarised in Table 1, and briefly as follows.

Characteristics of included trials

All tailored nutrition education intervention trials employing objective outcome measures compared tailored nutrition education *v.* no education[6,8,9], except for the Australian trial[7] which compared tailored *v.* generic nutrition education.

The New Zealand trial delivered packages of food-group-'themed' information to intervention participants by post[6]; the Australian online trial provided participants with healthier alternatives for selected products containing > 1 % of total energy from saturated fat[7]; and the US trials delivered 5-min education sessions through a kiosk housed in the supermarket. The US interventions also included discount coupons for healthier products[8,9]. Intensity of the intervention was substantially higher for the US trials compared with the Australian and New Zealand trials (fourteen or fifteen weekly sessions compared with a mean of three online shopping episodes and seven packages of mailed information, respectively).

The intervention period was 6 months for all trials, with the exception of the Australian online shopping trial which lasted for 5 months[6–9]. The New Zealand trial also followed up at 12 months, but the primary outcome (change in purchases of saturated fat) was measured at 6 months[6]. Further, the 2001 US trial also followed up at 15 weeks, but did not specify whether this time point or the 6-month follow-up was the primary measure.

Participants in all four trials were primary household shoppers, predominantly female (range: 86 % for the New Zealand trial[6] to 96 % for the 2001 US trial[9]), and had a mean age of approximately 40 years[6–9]. The New Zealand trial included the greatest proportion of participants from priority population groups (range: 3 %[9] to 32 %[6]).

The most commonly measured outcomes were change in purchases of fruit and vegetables, total fat, and fibre (three trials; Table 1)[6–9].

Findings and quality of included trials

The primary outcome of the New Zealand trial was change in purchases of percentage energy from saturated fat at 6 months[6]. The findings of this trial were negative: at 6 months, the difference in saturated fat purchased by tailored nutrition education *v.* control was −0·09 % of total energy (95 % CI −0·47, 0·30 %; $P = 0{\cdot}66$). The authors of this trial also measured a range of other food and nutrient outcomes at 6 and 12 months (Table 1). However, findings for these outcomes were also non-significant. This trial was a high-quality trial conducted and reported according to the Consolidated Standards of Reporting Trials[10], and loss to follow-up was low (7 %; Table 1). Consequently, it is unlikely that the methods were subject to biases that resulted in the tailored nutrition education intervention appearing unjustly ineffective.

The primary outcome of the Australian online shopping trial was similar to that of the New Zealand trial: change in purchases of percentage energy from saturated fat at 5 months[7]. However, in contrast, the findings were positive: at 5 months, the difference in saturated fat purchased by tailored nutrition education *v.* generic nutrition education was −0·66 % of total energy (95 % CI 0·48, 0·84 %; $P < 0{\cdot}001$). The findings of this trial are likely to be a true positive effect of tailored nutrition education as this was a high-quality trial and loss to follow-up was low (8 %; Table 1). However, the findings have limited generalisability because relatively few people shop online for groceries, and those who do are generally more highly educated and have higher incomes than in-store shoppers[11,12].

The US trial undertaken by Anderson and colleagues in 2001 measured three outcomes – percentage energy from total fat, fibre (g/4184 kJ (1000 kcal)) and fruit and vegetables (servings/4184 kJ (1000 kcal)) – at 15 weeks and 6 months, but did not specify which of these (if any) was the primary outcome[9]. They found a positive effect of tailoring on total fat and fibre at 15 weeks, but this effect had disappeared at the 6-month follow-up[9]. Reporting of this trial was poor making it difficult to assess study quality (Table 1). However, loss to follow-up was higher than for the New Zealand and Australian trials (13 %).

Finally, the US trial undertaken by Winnett *et al.*[8] in 1997 measured eleven outcomes focused on fruit and vegetables and total fat and fibre sourced from various foods (Table 1). The primary outcome was not specified. Of eleven outcomes measured, a positive effect of tailoring was found only for total fat from all foods minus beverages, total fat from dairy products, and fibre from all foods[8]. Similar to the 2001 US study, loss to follow-up was high (28 %) and poor reporting makes it difficult to assess the quality of this trial (Table 1).

Table 1 Methods and findings of randomised controlled trials of tailored nutrition education that used objective outcome measures

First author (year), country	Design and objective outcome measure	Intervention and duration	Participants, groups and setting	Outcomes	Results	Quality (risk of bias)[2,19]
Ni Mhurchu (2010), New Zealand[6]	Design: 2 × 2 factorial parallel design RCT Objective outcome measure: electronic supermarket sales data (collected continuously over 15 months and linked to database of 3000 foods)	15-month trial: months 1–3 baseline; 7 food-group-themed packages delivered by post over months 4–9; follow-up over months 10–15	Participants: (*n* 1104) primary household shoppers; mean (SD) age = 44 (13) years; 86 % women; 32 % priority population groups Groups: tailored education (*n* 519) *v.* no education (*n* 509) Setting: 8 low-cost supermarkets in North Island of New Zealand	Primary (6 and 12 months): Saturated fat (%TE) purchased at 6 months post intervention Secondary (6 and 12 months): Saturated fat (% TE) Carbohydrate (% TE) Protein (% TE) Total fat (% TE) Energy density (MJ/kg) Sugar (g/MJ) Sodium (mg/MJ) Foods (g/week) All healthier products Healthier fruit and vegetables Healthier cereal and cereal products Healthier milk and milk products Healthier meat and meat alternatives Healthier fats and oils	 0 0 0 0 0 0 0 0 0 0 0 0 0 0	A priori sample size: Y Random allocation: Y Concealed allocation: *Y* Groups comparable at baseline: Y Blinding: outcome assessors blinded % loss: 7 % ITT analyses: Y
Huang (2006), Australia[7]	Design: parallel design RCT Objective outcome measure: electronic supermarket sales data (collected continuously over 5-month study and linked to a nutrient database)	5-month trial: 5 months intervention; healthier alternatives recommended for selected products >1 % saturated fat (when users logged in; mean number shopping episodes = 3)	Participants: *n* 497 primary household shoppers; mean (SD) age = 40 (10) years; 87 % women; 13 % priority population groups Groups: tailored education (*n* 251) *v.* generic education (*n* 246) Setting: users of an Internet supermarket shopping website in Sydney, Australia	Primary (5 months): Saturated fat (%TE)	 +	A priori sample size: Y Random allocation: Y Concealed allocation: Y Groups comparable at baseline: Y Blinding: outcome assessors blinded % loss: 8 % ITT analyses: Y
Anderson (2001), USA[9]	Design: parallel design RCT Objective outcome measure: supermarket till receipts (collected continuously over 6-month study and linked to a nutrient database) in addition to FFQ	6-month trial: 15 weekly × 5-min sessions delivered by a kiosk in the supermarket; 10 weeks no intervention. Also included discount coupons for healthier products	Participants: (*n* 296) primary household shoppers; mean age = 40 (range 19–77) years; 96 % women; 3 % priority population groups Groups: tailored education (*n* 148) *v.* no education (*n* 148) Setting: 5 supermarkets in Virginia, USA	15 weeks: Total fat (%TE) Fibre (g/4184 kJ (1000 kcal)) Fruit and vegetables (servings/4184 kJ (1000 kcal)) 6-months: Total fat (%TE) Fibre (g/4184 kJ (1000 kcal)) Fruit and vegetables (servings/4184 kJ (1000 kcal))	 + + 0 0 0 0	A priori sample size: NR Random allocation: NR Concealed allocation: NR Groups comparable at baseline: Y Blinding: NR % loss: 13 % (subgroup losses NR) ITT analyses: NR

Table 1 *Continued*

First author (year), country	Design and objective outcome measure	Intervention and duration	Participants, groups and setting	Outcomes	Results	Quality (risk of bias)[2,19]
Winnett (1997), USA[8]	Design: parallel design RCT Objective outcome measure: supermarket till receipts (collected continuously over 6-month study and linked to a nutrient database)	6-month trial: 14 weekly × 5-min sessions delivered by a kiosk in the supermarket; 10 weeks no intervention. Also included discount coupons for healthier products	Participants: (*n* 105) primary household shoppers; mean age = 40 (range 19–77) years; 86 % women; 5 % priority population groups Groups: tailored education (*n* 54) *v.* no education (*n* 51) Setting: 1 supermarket in Virginia, USA	6-months:		A priori sample size: NR Random allocation: NR Concealed allocation: NR Groups comparable at baseline: N Blinding: NR % loss: 28 % (subgroup losses NR) ITT analyses: NR
				Total fat from all foods minus beverages (%TE)	+	
				Total fat dairy products (%TE)	+	
				Total fat meat (%TE)	0	
				Total fat cooking and table fat (%TE)	0	
				Total fat snack foods (%TE)	0	
				Total fat prepared foods (%TE)	0	
				Fibre from all foods (g/4184 kJ (1000 kcal))	+	
				Fibre fruit and vegetables (g/4184 kJ (1000 kcal))	0	
				Fibre bread (g/4184 kJ (1000 kcal))	0	
				Fibre cereal (g/4184 kJ (1000 kcal))	0	
				Fruit and vegetables (servings/4184 kJ (1000 kcal))	0	

RCT, randomised controlled trial; %TE, percentage of total energy; 0, no difference between groups; +, positive effected of tailored nutrition education; −, negative effect of tailored nutrition education; Y, yes; ITT, intention to treat; NR, not reported; N, no.

Discussion

The present review does not provide support for tailored nutrition education as a stand-alone intervention for improving dietary habits. Four RCT employing objective outcome measures were identified through comprehensive literature searching[6–9], three of which reported negative results at the 6-month follow-up[6,8,9]. These findings are in contrast to those of previous systematic literature reviews where included trials have employed predominantly subjective outcome measures[2–5]. The one trial included in the present review that did find a positive effect of tailored nutrition education was undertaken in a sample of online supermarket shoppers and thus has limited generalisability as a strategy for improving dietary habits in large population groups[7].

It is unlikely that ineffective tailoring frameworks were responsible for the negative findings of the trials included in the present review as the frameworks were similar to those used in positive RCT with subjective outcome measures[2]. Furthermore, the negative findings are despite the fact that for three of the four included trials feedback was provided at the supermarket where decision making regarding food purchases occurs; two trials included goal setting (a traditionally effective behaviour change construct[13]); and two trials provided participants with discount coupons for healthier foods.

It is notable that the US trial undertaken by Anderson and colleagues in 2001 found a positive effect of tailoring for two of three outcomes measured at 15 weeks (but not at 6 months), and the US trial by Winnett and colleagues (1997) found a positive effect of tailoring for three of eleven outcomes measured (at 6 months). Due to poor reporting of both of these trials it is difficult to assess whether these are true, positive effects of tailoring: both of these trials failed to report which outcome (if any) was the primary and had higher losses to follow-up than the New Zealand and Australian trials (13 % and 28 % compared with 7 % and 8 %, respectively). The positive findings of Winnett *et al.* in particular could be due to chance effects resulting from the large number of outcomes assessed: including multiple outcomes or endpoints in a study increases the chances of type I error (false positive) because several significant results can be expected to occur by chance alone[14].

The strengths of the present review include the rigorous methodology and use of a comprehensive peer-reviewed search strategy[2]. However, a limitation is that dietary intervention trials employing objective outcome measures outside of diet were not included (e.g. body weight and cholesterol). Nevertheless, including these trials would have been unlikely to have affected the overall findings: a systematic review published in 2007 by Gorber *et al.*[15] compared self-report with objective measures for assessing height, weight and BMI. Sixty-four trials of adults (> 18 years) were included. Overall, trends were found for under-reporting of weight and BMI, and over-reporting of height. The findings of the review by Gorber *et al.* thus strengthen

the findings of the present review, providing further evidence that self-report measures are inadequate for assessing dietary intervention trials.

The four trials of tailored nutrition education included in the present review do not provide substantive evidence that tailored nutrition education is ineffective across all settings and populations, although they do suggest that tailored nutrition education may not be an effective stand-alone dietary intervention strategy. Regardless, some degree of supportive nutrition education remains warranted, particularly for ethnic minority and vulnerable groups. This is because nutrition education provides the context for dietary interventions, i.e. it tells people why they need to make dietary changes. Nutrition education should be included as a component of broader approaches to improving population diets[16], such as pricing incentives, social marketing, food labeling, food reformulation and regulation. This conclusion is in line with the findings of a recently published paper regarding the healthfulness of the US food supply: despite decades of dietary education through guidelines, the US food supply has not improved[17]. The authors of the US paper conclude that policy makers, the agriculture sector and the food industry should make deliberate efforts to provide a supply of foods consistent with nutrition recommendations. Broader approaches to public health have recently become popular[18] and are consistent with a balanced public health paradigm where both individual lifestyle behaviours and factors associated with the wider environment are considered responsible for poor nutrition[16].

Due to the limited quantity and poor quality of two of the four trails included in the present review, further large, high-quality trials of tailored nutrition education employing objective outcome measures are warranted. However, consideration should also be given as to whether other broader, higher-level approaches may be a more appropriate focus for future nutrition research. Regardless of the specific components included, all future nutrition interventions should use objective measures of diet (such as sales data or biomarkers) in combination with more traditional dietary assessment tools. Another important finding of the review is that the quality of two of the four included studies was suboptimal, largely reflecting poor reporting of methods. All researchers of future nutrition trials should thus ensure their reports are consistent with the requirements of the Consolidated Statement on Reporting of Trials[10]. In addition to including objective outcome measures, this would ensure that future research can contribute more effectively to the evidence, and produce results that are more useful for nutrition researchers, policy and practice.

Acknowledgements

Sources of funding: H.E. was supported by a Heart Foundation of New Zealand postgraduate scholarship (Grant no. 1285) at the time of writing. C.N.M. holds the Heart Foundation of New Zealand Senior Fellowship (Grant no. 1380). *Conflicts of interest:* None declared. *Author contributions:* H.E. was responsible for developing the tailored nutrition education programme for the SHOP (Supermarket Healthy Options Project) trial; completing the literature search, analysis and interpretation; and drafting the manuscript. C.N.M. was responsible for the conception, design, analysis and interpretation of the SHOP trial results; and provided input into the manuscript and interpretation of the literature review findings.

References

1. Kreuter MW, Strecher VJ & Glassman B (1999) One size does not fit all: the case for tailoring print materials. *Ann Behav Med* **21**, 276–283.
2. Eyles H & Ni Mhurchu C (2009) Does tailoring matter? A systematic review of the long-term effectiveness of tailored nutrition education for adults. *Nutr Rev* **67**, 464–480.
3. Kroeze W, Werkman A & Brug J (2006) A systematic review of randomized trials on the effectiveness of computer-tailored education on physical activity and dietary behaviours. *Ann Behav Med* **31**, 205–223.
4. Noar SM, Benac CN & Harris MS (2007) Does tailoring matter? Meta-analytic review of tailored print health behavior change interventions. *Psychol Bull* **133**, 673–693.
5. Enwald HPK & Huotari MA (2010) Preventing the obesity epidemic by second generation tailored health communication: an interdisciplinary review. *J Med Internet Res* **12**, e24.
6. Ni Mhurchu C, Blakely T, Jiang Y *et al.* (2010) Effects of price discounts and tailored nutrition education on supermarket purchases: a randomized, controlled trial. *Am J Clin Nutr* **91**, 736–747.
7. Huang A, Barzi F, Huxley R *et al.* (2006) The effects on saturated fat purchases of providing internet shoppers with purchase-specific dietary advice: a randomised trial. *PLoS Clin Trials* **22**, e22.
8. Winett RA, Anderson ES, Bickley PG *et al.* (1997) Nutrition for a lifetime system: a multimedia system for altering food supermarket shoppers' purchases to meet nutritional guidelines. *Comput Hum Behav* **13**, 371–392.
9. Anderson ES, Winett RA, Wojcik JR *et al.* (2001) A computerized social cognitive intervention for nutrition behavior: direct and mediated effects on fat, fiber, fruits, and vegetables, self-efficacy, and outcome expectations among food shoppers. *Ann Behav Med* **23**, 88–100.
10. Schulz KF, Altman DG & Moher D (2010) CONSORT 2010 Statement: updated guidelines for reporting parallel group randomised trials. *BMJ* **320**, c332; doi:10.1136/bmj.c332
11. Kempiak M & Fox MA (2002). Online grocery shopping: consumer motives, concerns, and business models. http://131.193.153.231/www/issues/issue7_9/kempiak/ (accessed March 2010).
12. Morganosky M & Cude B (2000) Consumer response to online grocery shopping. *Int J Retail Distribut Manage* **28**, 17–26.
13. Webb TL & Sheeran P (2006) Does changing behavioural intentions engender behaviour change? A meta-analysis of the experimental evidence. *Psychol Bull* **131**, 249–268.
14. Schulz KF & Grimes DA (2005) Multiplicity in randomised trials I: endpoints and treatments. *Lancet* **365**, 1591–1595.
15. Gorber SC, Tremblay M, Moher D *et al.* (2007) A comparison of direct vs. self-report measures for assessing height, weight and body mass index: a systematic review. *Obes Rev* **8**, 307–326.

16. Margetts BM (2004) Public health nutrition strategies for intervention at the individual level. In *Public Health Nutrition*, pp. 120–132 [MJ Gibney, BM Margetts, JM Kearney *et al*., editors]. Oxford: Blackwell Science.
17. Krebs-Smith SM, Reedy J & Bosire C (2010) Healthfulness of the US food supply: little improvement despite decades of dietary guidance. *Am J Prev Med* **38**, 472–477.
18. Reynolds KD, Klepp KI & Yaroch AL (2004) Public health nutrition strategies for intervention at the ecological level. In *Public Health Nutrition*, pp. 106–119 [MJ Gibney, BM Margetts, JM Kearney *et al*., editors]. Oxford: Blackwell Science.
19. Jadad A (1998) *Randomised Controlled Trials*. London: BMJ Books.