Article Title Page

Fighting to eat healthfully: Measurements of the military food environment

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Structured Abstract:

Purpose – To report on a quantitative study of the food environment designed to measure aspects of support for healthy eating.
Design/methodology/approach – An ecological view of eating behaviour was taken by examining the food environment that surrounded a military population of interest. Food outlets (n=34) were assessed using the NEMS-S, NEMS-R and mNEAT instruments to determine how well food outlets supported healthy eating.
Findings - Despite better than average provision of healthy options on-base, the total environment surrounding the military base barely supports healthy eating. Average support to healthy eating was 45% (NEMS) or 27% (mNEAT) of support that could be measured. Individuals accessing this food environment would find few healthy alternatives, little information directing them to healthy choices and pricing and promotion that drives unhealthy eating behaviours.
Research limitations/implications – This study focussed on one food environment; replication is recommended to establish foundation data for benchmarking outlets, and further develop these measures for Australian settings. Future studies may assess the media environment to further extend the ecological model used.
Practical implications – A method to measure the food environment is demonstrated which provides formative research insights for use when planning social marketing interventions. Consideration of these influences together with intra- and inter-personal influences offer the potential to better design social marketing healthy eating interventions, by addressing multiple levels within an ecological framework.
Originality/value – This paper answers calls for social marketers to consider the influence of the surrounding environment, employing methods not previously used in Australian settings.

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Fighting to eat healthfully: Measurements of the military food environment

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Introduction

Eating well is beneficial for military personnel to support their demanding job roles. The evidence is clear that optimal nutrition plays a key role in both health (World Health Organization, 2003) and performance (ACSM/ADA/DC Joint Position Statement, 2009), alongside exercise or training. The Australian Defence Force (ADF) desires these high standards of fitness and health from its members, and has developed policy to ensure that on-base catering provides nutritionally balanced food on aggregate (Department of Defence, 2004). Following the release of the revised Australian dietary guidelines (National Health and Medical Research Council, 2013); a guide for healthy eating was devised that takes into account the specialised nutrient needs of military personnel. This guide recommends personnel *"eat a wide variety of nutritious foods from five food groups every day in proportions that are consistent with general dietary guidelines for Australians but also cater to the specific demands of ADF military operations"* (Booth, 2013, p. 4) and gives examples of how to construct a daily eating plan.

Despite these requirements for health and fitness, many ADF personnel do not consume a healthful diet, instead consuming a diet too high in fat, and unbalanced with respect to the recommended food groups (Booth and Coad, 2001; Forbes-Ewan *et al.*, 2008). Consequently, the rates of overweight and obesity in the ADF (48% and 14% respectively) are similar to the national average (35% and 21% respectively for the equivalent age group of 20–50 years) (AIHW, 2010). Overweight and obesity pose additional undesirable consequences for military personnel and organisations. Fat mass is related to poor physical performance in the military (Mattila *et al.*, 2007), and increased body weight elevates the risk of injury, illness (Peake *et al.*, 2012) and premature separation or discharge (Packnett *et al.*, 2011). This increases costs to the military in terms of health care, and lost duty time (Sanderson *et al.*, 2011). Currently, overweight military personnel are referred to a medical officer to determine an appropriate weight management plan; those who are unable to meet fitness standards are subject to administrative action which may ultimately lead to their discharge from the services (Lourensen *et al.*, 2002; Naghii, 2006). Therefore, there is a need for initiatives to improve (healthy) eating behaviour of military personnel. There remains a recognised deficit in knowledge of how to treat obesity in military populations (Sanderson *et al.*, 2011), and to the authors' knowledge, there are no published studies of the food environments accessed by military populations.

Although one of social marketing's core strengths is its consumer-centric or citizen-centric focus (French, 2011); many are urging the field to move beyond individual behaviour change to other levels. Consideration has been given to ecological frameworks (Lindridge *et al.*, 2013), an upstream-midstream-downstream continuum (Hoek and Jones, 2011), new models of behaviour (Carvalho and Mazzon, 2013) or the utilisation

of novel tactics (Spotswood *et al.*, 2012). However, recent reviews (Luca and Suggs, 2013; Carins and Rundle-Thiele, 2014) indicate the focus of social marketing interventions remain squarely on the individual—failing to consider the ecological framework surrounding the individuals whose behaviour social marketers are trying to alter. As a result, social marketing effectiveness is likely to be reduced (at best), or '*negated if the context … is ignored'* (Wymer, 2011).

Part of the challenge faced by social marketers is determining how to capture the context in a way that is meaningful, and provides direction for the intervention planning process. This paper describes one approach—the use of an ecological model to measure the food environment—to explore whether the food environment studied allows or supports healthful eating choices.

No human lives in a vacuum—individuals are shaped by the world surrounding them. Social Ecological Models (SEM) of behaviour offer a theoretical framework to guide the examination of these influences. Fundamentally, ecological models assert that behaviour has multiple levels of influence (Sallis *et al.*, 2008). Many models have been proposed, for example, Bronfenbrenner (1977; 1979) describes four levels—the micro-, meso-, exo- and macro-systems; and Sallis *et al.* (2008) describe six levels—intrapersonal, interpersonal, organisational, community, physical environmental, and policy. In a food consumption context, *intrapersonal* influences on behaviour may be an individual's knowledge of foods, food preparation skills and motivation to follow a particular dietary pattern. *Interpersonal* influences may include social support provided by family, peer pressure or social norms that exist within a friendship group. *Organisational* influences and *community* influences could be practices, policies or support programs available through the workplace or community, whereas *physical environmental* influences involve the amount and type of foods available and how accessible they are. *Policy* may influence food consumption by regulating food availability (e.g. banning/restricting particular food types) or by shaping buyer behaviour (e.g. increasing taxes or providing incentives for purchases). These influences can be direct, indirect and interactive; for example sociocultural factors and physical environments are believed to cut across levels (Sallis *et al.*, 2008). Interventions that address multiple levels are considered to be most effective in promoting healthy behaviour (Sallis *et al.*, 2008).

The food environment

Energy-dense but nutrient-poor diets and more sedentary lifestyles are contributing to the growing obesity issue in Australia and worldwide (World Health Organization, 2003), and the food environment appears to be a major influence (Vandevijvere and Tseng, 2013). Policy solutions for deprived communities without good access—food deserts—have focused on improving provision of food retail as part of a wider suite of

recommendations for population dietary change focused around awareness, affordability, and acceptability (Cummins *et al.*, 2005). The influence of the food environment on consumption has been described and measured in different ways. The first approach is on a global scale, via the measurable increase in low-cost energy-dense but nutrient-poor products in the food supply chain. In the United States, increases in the energy content of the food supply over the past 30 years was sufficient to explain the increase in obesity (Swinburn *et al.*, 2009). Strong correlations have been found between trends in total energy per capita and changes in the prevalence of overweight and obesity in Australia (Silventoinen *et al.*, 2004). The second method takes a spatial approach, via the enumeration and classification of food outlets in a given area (Charreire *et al.*, 2010). Access to supermarkets has been a focal concern for researchers who have identified that lowest income neighbourhoods had nearly 30% less supermarkets than the highest income neighbourhoods in the US (Walker *et al.*, 2010). A lack of access to a supermarket within a geographic area is commonly known as a food desert. Research indicates that substantial increases in consumption of fruit and vegetables (between 0.25 and 0.5 portions per day) were reported when distance travelled to the main food store fell to under one kilometre owing to the installation of a large scale grocery store in Scotland (Cummins *et al.*, 2005). Socio-economic differences in access to food outlets has also been observed in Australia-in Adelaide (O'Dwyer and Coveney, 2006), Melbourne (Burns and Inglis, 2007) and to a lesser extent Brisbane (Winkler *et al.*, 2006). The third approach relies on quantification of aspects of accessibility, availability, quality, information, advertising and pricing and is the focus of the community nutrition environment model (Glanz *et al.*, 2005 described in the next section). This approach is believed to be a more discrete indicator of the food environment than measures of spatial availability alone (Farley *et al.*, 2009), which assume that outlets of a particular type can be considered to be equivalent in terms of offerings they provide. This quantitative approach was chosen for the current study.

Community nutrition environment model

To explain eating behaviour, Glanz *et al.* (2005) proposed a conceptual model for the study of nutrition environments based on an ecological approach. This model described policy, environmental and individual variables, with a focus on the environmental variables—or the food environment. This model goes beyond measuring availability of outlets, or access to foods, by considering what individuals encounter within a food outlet. These aspects of the food environment—the availability of healthful foods, information highlighting or identifying these foods, pricing favouring their purchase, and processes or structures that facilitate (or do not hinder) their selection—all combine to support healthy eating. The community nutrition environment model is shown in Figure 1.

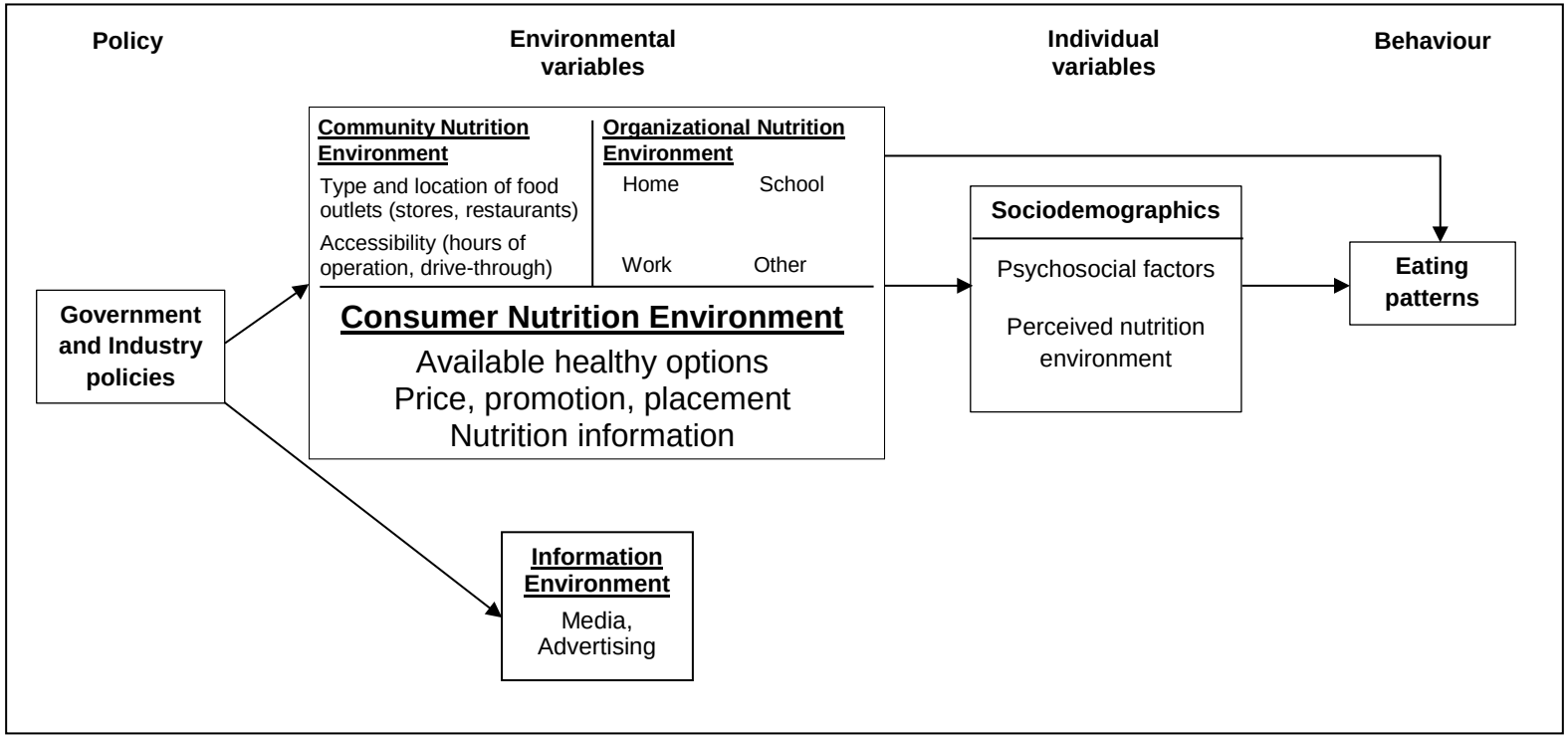

Figure 1: Community nutrition environment model

Source: (Glanz *et al.*, 2005). Reproduced with permission of American Journal of Health Promotion via Copyright Clearance Center, Inc.

Glanz and colleagues have developed instruments based on this model, and grounded in evidence-based nutrition science. Indicator foods are used to measure the availability of foods that either promote wellness or contribute to obesity and chronic disease, in accordance with dietary guidelines (Glanz *et al.*, 2005; University of Pennsylvania, undated). The instruments also assess the cost of food, the information available in outlets, and the facilitators or barriers to healthful eating; as they have been found to exert influence on food choice (Glanz *et al.*, 1998; Seymour *et al.*, 2004; Chandon and Wansink, 2012). Environments examined using this method include the original neighbourhood studies (Glanz *et al.*, 2007; Saelens *et al.*, 2007), university campuses (Horacek *et al.*, 2013a; Horacek *et al.*, 2013b), and hospitals (Lesser *et al.*, 2012), which all found limited support for healthy eating in those environments.

This paper reports on one study from a program of research aiming to improve the eating behaviour of ADF personnel through a social marketing intervention. In addition to the current study, the formative research stage for this program involves other studies using depth interviews with military personnel to examine motivations to follow a healthy diet (Carins and Rundle-Thiele, 2013), and observations to quantify actual eating behaviour. The aim of the current study was to measure the 'consumer nutrition environment' that includes and surrounds an Australian military base.

Methods

The study design was based on that used in the Nutrition Environment Measures Study (NEMS) (Frank *et al.*, 2006; Glanz *et al.*, 2007; Saelens *et al.*, 2007) using protocols specified in the NEMS training manual (found at: www.med.upenn.edu/nems). Briefly, the process involved designating the area of interest, enumerating the outlets within this area, and finally assessing each of these outlets. For this project, the area of interest was a military base. The base chosen was representative of large Australian military bases, covering approximately 10 square kilometres, and at any given time could be home or workplace for up to several thousand personnel. First, the details of each of the food outlets on the base were recorded, which included dining hall facilities and cafes/convenience stores. Concurrent research from the larger research project indicated that many personnel leave the base to obtain meals, suggesting that outlets within one kilometre of the base should be assessed. One kilometre was considered a reasonable distance to travel for lunch or dinner either on foot, or by car. Other Australian studies have used 800 metres (Timperio *et al.*, 2008); 2.5 kilometres (O'Dwyer and Coveney, 2006; Winkler *et al.*, 2006); and the NEMS training manual recommends a buffer of one mile (1.6 km).

Maps of the area were sourced, and a one kilometre radius drawn around each of the gates that allow access and egress from the military base. Streets that fell within each of these one kilometre circles were traversed

by car or on foot, with the details of all food outlets found on these streets noted (name, address, and type of outlet). No major supermarkets were found within the one kilometre zone—and considering their use was noted in other aspects of the project—the details of major supermarkets between one and two kilometres from the gates were also captured. Outlets were sorted into types (military dining facilities, fast-food restaurants, sit-down food restaurants, grocery stores and convenience stores) and designated the correct assessment instrument in preparation for measurement. A total of 34 outlets were identified, both on and off the base.

Food outlet assessment

The food environment was assessed using two instruments—the first was the validated NEMS for both restaurants (Saelens *et al.*, 2007) and stores (Glanz *et al.*, 2007). Both NEMS instruments have been used successfully in the US suburban context, but not within an institutionalised eating context, such as a military base. Therefore, a second instrument was used—the military Nutrition Environment Assessment Tool (mNEAT) which assesses military dining facilities, restaurants and stores (Navy and Marine Corps Public Health Center, 2013). The mNEAT was developed for US military bases which are larger and include many commercial food outlets (Fisher, 2010), whereas Australian bases contain military dining facilities, and very few commercial options (Phillips, 2011). No validation data for the mNEAT was found in the open literature. As both instruments were developed in the US, some modifications were needed, which chiefly involved the identification and inclusion of replacement foods. Categories were retained, with some items changed to include foods identified as the leading food types and brands in Australia (Euromonitor, 2013). For example, in stores, hot dogs were replaced with sausages, and bagels replaced with breakfast muffins. Modifications to the instruments and scoring were in accordance with the recommendations found at www.med.upenn.edu/nems, were done in consultation with the NEMS training coordinator, and pilot tested prior to the study. Details of all modifications and the revised instruments can be obtained from the researchers on request.

Each of the instruments measures availability of key indicator foods, facilitators/supports for healthful eating, barriers to healthful eating, pricing and signage/promotion (See the Appendix of Glanz *et al.*, 2007; the appendix of Saelens *et al.*, 2007; and the website of Navy and Marine Corps Public Health Center, 2013 for a full copy of the instrument measurement forms), and can be completed objectively and independently by a rater through answering a series of yes/no or multiple choice questions. Each instrument can be completed in a relatively short period of time when visiting a food outlet.

Procedure

Prior to the study, two researchers completed the NEMS online training (10-20 hours) and conducted practice assessments on outlets of each type in a separate area to the study area. It was during this time that modifications were pilot tested and adjusted as necessary.

Each outlet was given an identification number, randomly assigned to one of the two researchers, and was assessed using both the mNEAT and the NEMS instruments. On arrival at an outlet, the type of outlet was checked, and assessment commenced. Generally, assessments were conducted discretely, however, in smaller stores the attendant was asked if they were comfortable with an assessment taking place within the store. Each researcher carried a formal letter to give to attendants/operators should they ask for further information about the study. All assessments were completed within a one month period. Some outlets were assigned duplicate measurements. This means they were rated independently by both researchers—to compare inter-rater agreement or they were rated a second time by the original researcher on a separate day—to compare test-retest agreement. The NEMS training manual recommends duplicates are assigned at ~10% per outlet type, this study exceeded that rate with 36% of outlets cross-rated or repeat-rated (see Table 2).

Data analysis

After all assessments were completed, scores were calculated using the protocols documented in the NEMS training manual (found at www.med.upenn.edu/nems/), subject to the modifications detailed in Appendix A. Points are given for the presence or absence of certain foods, signage, promotions, pricing and facilitators and barriers (defined in Table 1). Points for each item can be positive or negative and are added together to produce a total score for *support for healthy eating* for each outlet (NEMS raw score). The scores could range from -24 to +63 for restaurants (military dining facilities, fast-food and sit-down); and -9 to +52 for stores (grocery and convenience). The lowest possible NEMS raw score indicates no support for healthy eating, and the highest possible score indicates very high level of support for healthy eating. The range of possible NEMS scores differs for stores and restaurants, so a percentage of the possible score was calculated (NEMS score %) to allow comparison between the outlet types. Sub-scores for four aspects of support for healthy eating can be calculated using the NEMS; these aspects are detailed in Table 1 below.

Table 1. Aspects of support for healthy eating as assessed using NEMS and mNEAT

Aspect	Definition	Measures include	NEMS		mNEAT		
			Restaurants	**Stores**	**Military**	**Restaurants**	**Stores**
Availability	Availability of healthier alternatives	• Presence of indicator foods (+) • Indicator foods has healthy alternative (low fat/sugar) (+) • Presence of healthy dishes (+) *(restaurants)*	Assessed	Assessed	Assessed (criteria differs for each meal)	Assessed	Assessed
Price	Pricing support for healthy choices	• Healthier indicator foods are cheaper (+) *(stores)* • Healthier dishes are cheaper (+) *(restaurants)* • Pricing favouring overeating (–) *(restaurants)*	Assessed	Assessed	Not assessed	Assessed	Assessed
Information	Presence of information or promotion that supports healthy eating	• Nutrition information provided (+) • Healthier dishes identified (+) • Information promotes overeating (–) • Healthy eating promotion (+) • Dietetic menu advice • Catering staff training	Assessed Not assessed	Not assessed	Not assessed Assessed	Assessed Not assessed	Not assessed
Facilitators/ Barriers	Presence of facilitators of, and barriers to, healthy eating	• Smaller portions available (+) • Healthy requests encouraged (+) • Super-sizing encouraged (–) • All-you-can-eat/unlimited (–)	Assessed	Not assessed	Not assessed	Assessed	Not assessed

A *support for healthy eating* score was also obtained for each outlet by entering mNEAT raw data into the tool (http://www.med.navy.mil/sites/nmcphc/health-promotion/healthy-eating/). Again, points were both positive and negative, with a negative score indicating a very low level of support for healthy eating. The mNEAT gives a score as a percentage support for healthful eating, rather than a raw score, and does not provide sub-scores for the aspects of support for healthy eating. Some aspects of the mNEAT are comparable to those found in the NEMS (refer back to Table 1), however mNEAT contains items specific to military dining facilities, and there are differences in item details and scoring between the instruments.

Data analysis was completed using Microsoft Excel (Microsoft Office 2010) and SPSS (IBM Statistics Version 22). Descriptive and inferential statistical analyses were conducted using mNEAT scores, NEMS scores and NEMS sub-scores. Analysis of Variance (ANOVA) with either Tukey's-b post-hoc test (when equal variance could be assumed) or Games-Howell post-hoc test (when equal variance could not be assumed) was used to determine differences between mean scores for outlet types. Correlations were used to examine the association between variables.

Results

A total of 34 outlets, both on and off the base formed the basis of this study. Of these outlets, one closed down before assessment could take place, and four were considered not suitable for measurement (two wedding/occasion cake stores, two spice/nut stores). A further four were not assessed, due to owner/operator refusal (two) and a lack of assessable information available (two). In total, 25 outlets were successfully assessed involving an average of 45 minutes spent in each outlet. Note that one business contained a fast-food establishment and a convenience store on the same premises (ID: 4) so each area was treated as an outlet and assessed with the appropriate instrument. Details are shown in Table 2.

Table 2. Number and type of food outlets identified and assessed in the area surrounding the military base.

Outlet Type	Enumerated n	Assessed n	Cross-rated (two raters) n	Repeat-rated (one rater) n
Military Dining Facility	3	3	3	3
Restaurant (Fast-food)	7	7	3	2
Restaurant (Sit-down)	7	7	1	1
Stores (Grocery)	4	4	1	2
Stores (Convenience)	8	4	1	1
Baker/Cake shop	*3*	*0*	*0*	*0*
Speciality Food Shop	*2*	*0*	*0*	*0*
Total	**34**	**25**	**9**	**9**

Support for healthful eating

The individual scores for each outlet, the average scores for outlet types and overall averages across all outlets are shown in Table 3. Data from the founding NEMS study has been included in Table 3 for comparison.

Table 3. Support for healthful eating as determined using mNEAT, and NEMS.

Outlet Type	ID	mNEAT Score	NEMS Raw Score	NEMS Score %	NEMS Raw Score (US Average)[1]	NEMS Score % (US Average)[1]
Military Dining	1	43%	17	47%		
	2	33%	17	47%		
	3	36%	17	47%		
Type Average		**37%**	**17**	**47%**	*n/a*	*n/a*
Restaurant (Fast-food)	4	30%	13	43%		
	17	28%	11	40%		
	18	-2%	0	28%		
	19	45%	22	53%		
	20	25%	13	43%		
	21	20%	8	37%		
	27	-6%	3	31%		
Type Average		**20%**	**10**	**39%**	6	38%
Restaurant (Sit-down)	24	17%	12	41%		
	25	10%	12	41%		
	26	-10%	0	28%		
	28	35%	16	46%		
	29	-5%	6	34%		
	30	5%	9	38%		
	31	6%	9	38%		
Type Average		**8%**	**9**	**38%**	7	39%
Stores (Convenience)	4	3%	14	38%		
	9	45%	25	56%		
	11	-9%	7	26%		
	13	-12%	12	34%		
Type Average		**7%**	**15**	**39%**	6	24%
Stores (Grocery)	32	82%	35	72%		
	33	82%	33	69%		
	34	89%	36	74%		
	35	85%	34	70%		
Type Average		**85%**	**35**	**71%**	23	53%
Grand Average		**27%**	*n/a*	**45%**	*n/a*	*n/a*

[1] **Data sourced from the founding NEMS study (Frank et al., 2006; Glanz et al., 2007; Saelens et al., 2007).**

The NEMS raw scores for restaurant outlets (military dining; fast-food and sit-down) ranged between 0 and +22 (of a possible -24 to +63) and stores (grocery and convenience) ranged from +7 to +36 (of a possible -9 to +52). These ranges represent NEMS % scores of 28% and 53% (for restaurants) and 26% and 74% (stores). The mNEAT scores ranged from -12% to 89% (of a possible -28% to +100%). The majority of outlets scored below the half-way point on either of the measures used—that means they scored less than half the available points that could be assigned during an assessment.

Analysis of Variance revealed significant differences between outlet scores, for both NEMS ($F(4,20) = 16.00$, $p<0.001$) and mNEAT measures ($F(4,20) = 16.78$, $p<0.001$). Post-hoc comparisons revealed that grocery stores scored significantly better than all other outlets on both the NEMS and mNEAT measures. Although the measures produced slightly different scores for each outlet, they were significantly and strongly correlated ($n = 25$, $r_s = 0.97$, $p<0.001$).

Aspects of the consumer nutrition environment

Comparisons were made between the four aspects of the nutrition environment using the NEMS (see Table 4).

Table 4. Scores for aspects of the nutrition environment, as determined using NEMS.

Outlet Type	n	Availability	Price	Information	Facilitators/ Barriers
Military Dining Facility	3	70% [a b]	75% [a]	20% [a]	39% [a]
Restaurant (Fast-food)	7	35% [c]	50% [a b]	31% [a]	50% [a]
Restaurant (Sit-down)	7	23% [c]	75% [a]	31% [a]	48% [a]
Stores (Grocery)	4	95% [a]	40% [b]	-	-
Stores (Convenience)	4	35% [b c]	48% [a b]	-	-
Average		**46%**	**58%**	**31%**	**47%**

Means sharing the same superscript (a, b or c) are not significantly different from each other (Games-Howell, $p< 0.05$)

Analysis of Variance revealed significant differences between outlet scores, for both NEMS availability ($F(4,20) = 21.77$, $p<0.001$) and NEMS price ($F(4,20) = 53.00$, $p<0.001$). While differences in NEMS availability scores were similar to NEMS total scores for each outlet, NEMS price scores followed a somewhat different pattern. Post-hoc comparisons revealed that grocery stores had significantly higher NEMS availability scores than sit-down restaurants, fast-food restaurants and convenience stores. Military dining facilities had significantly higher NEMS availability scores than sit-down restaurants, fast-food restaurants. However, for NEMS price, grocery stores scored significantly lower than military dining

facilities and sit-down restaurants, but not significantly lower than fast-food restaurants and convenience stores. There were no significant differences between outlets for NEMS information and NEMS facilitators/barriers.

For stores, a significant positive correlation was found between distance from the base and total NEMS score ($n = 8$, $r = 0.72$, $p = 0.044$) but not mNEAT score ($n = 8$, $r_s = 0.06$, $p = 0.117$), this trend was not observed in restaurants, where correlations were not found to be significant.

Military dining facilities scored above the average for this environment on both the NEMS and nMEAT measures (refer Table 1). The ANOVA results indicate these institution-provided facilities also had significantly higher scores for availability than other restaurants, and significantly higher scores for price than grocery stores. However, scores across the total environment were low—most outlets scored less than half the available points, and few outlets scored in the top end of the range. Taken together, this indicates an environment offers considerable room for improvement.

Discussion

Drawing on an ecological framework (Glanz *et al.*, 2005) the current study sought to assess the food environment surrounding military personnel. The advantage of using such a model is that it provides an understanding of the influences on the individual. The evidence presented in this paper suggests that even the highest motivated individuals are limited when seeking to make healthy eating choices. For most, healthy eating is a conscious choice requiring willpower and persistent attention—evidenced by the finding that military personnel in this environment have a relatively good knowledge of healthy eating and are motivated to eat healthy, but consider it to be hard work requiring constant vigilance and determination (Carins and Rundle-Thiele, 2013). Considering that many eating decisions occur at a low level of consciousness (Cohen and Farley, 2008), a failure to address non-supportive eating environments will render other efforts to improve eating behaviour through individual behaviour less effective. Glanz's model (2005) examines the number and type of outlets in a given area, and the features of these outlets known to affect food consumption. The model acknowledges a number of other influences, but the instruments do not measure them directly at present. The information environment is one, and given that media and advertising for food products totals millions each year ($400 million on food marketing in Australia in 2010) (Hilpern, 2010), this area may be important to measure. Policy can affect a large number of people, regardless of individual inclination to act (Kumanyika *et al.*, 2008), and a measure of policy could greatly inform any assessment of the nutrition environment. Perception of the consumer nutrition environment has been shown to differ greatly

from objective assessments (Williams *et al.*, 2011), and this may need to be taken into account when considering the total range of influences.

The results suggest the density of food outlets surrounding the military base was slightly higher than that found in other Australian studies. On average, five outlets were found within 800m of homes in Melbourne (Timperio *et al.*, 2008) and up to 20 outlets found within 2.5 kilometres of households in the Brisbane (Winkler *et al.*, 2006). A wider array of food outlets surrounding the food base offers more alternatives to military personnel seeking food. The higher number of outlets suggests more food may be purchased in food outlets in this area when compared to other studies offering fewer food outlet alternatives.

Scores from both measures (NEMS and mNEAT) indicate most outlets scored less than half of the available points, indicating a low level of support for healthy eating. Other NEMS studies have reported similar results and interpretations: on university campuses, scores were only a fraction of the total maximum points and were considered to be unhealthful dining environments (Horacek *et al.*, 2013a) and in hospitals, scores were mid-range and venues were considered to have substantial room for improvement (Lesser *et al.*, 2012).

Individuals accessing this food environment would find it difficult to obtain healthy alternatives; only sparse information to enlighten them as to the healthy choices; and healthier choices that are priced at a premium, or pricing and promotion that drives them toward unhealthy eating behaviours. Availability of healthy options is only one factor contributing to healthy eating—provision of nutrition information at the point-of-purchase through either nutrition information or identification of healthy options can result in healthier purchases (Bassett *et al.*, 2008). However, those who are fiscally motivated, or who place importance on value for money, may still make a less healthy choice if pricing favours combo deals and super-serves. Larger meal deals often appear to make financial sense, and ‘better value’ has been found to be the primary justification for supersized packages and portions (Vermeer *et al.*, 2010).

In this study, grocery stores provided the most support. This is confirmed by high scores by grocery stores for the availability sub-score relative to some other outlets. However, the low price sub-score for grocery stores indicates that although healthy alternatives were available, they were usually priced at a premium when compared to less healthy counterparts, which may offers insights into contradictory evidence observed in food desert studies (see Cummins *et al.*, 2005). Specifically, provision of a supermarket in a lower socio-economic area would not be expected to increase healthy eating if favourable pricing was not observed for healthy foods in the supermarket. Healthy foods have been shown to cost more than less healthy alternatives in grocery stores (Glanz *et al.*, 2007; Horacek *et al.*, 2013b).

Military dining facilities provided higher levels of support for healthy eating when compared to other outlet types. The buffet-style dining setting provided access to some healthy alternatives (non-fried vegetables and fruit) that were not readily found in other outlets. The absence of pricing promotions in these facilities contributed to higher price sub-score. However, room for improvement in military dining facilities remains. Specifically, availability of healthy alternatives can be increased, and appropriate information provided to consumers so that they can identify and make healthier choices. The target audience indicate high motivation to eat healthy (Carins and Rundle-Thiele, 2013). Moreover, many consumers wish to see this kind of information (Mackison *et al.*, 2009).

Eating healthfully is important for military personnel. Assessing the food environment indicates whether intentions to eat well may be supported or frustrated, and provides avenues for change beyond the individual. The unique insights generated in this study extend our understanding of how behaviour change can be better facilitated, via changes in the surrounding environment. When changes to environments are made, they affect the entire population, not just those who are motivated to change (Glanz and Mullis, 1988), and as such larger behaviour change gains are expected.

Implications for social marketing

This study measured aspects of the food environment to determine support for healthy eating, taking a novel approach to formative research in social marketing. Such measures have been utilised in the health literature; however it has been acknowledged that this area of the measurement is still at an early stage (Holsten, 2008), and systematic measurement determining food availability in stores is needed (Gustafson *et al.*, 2012). Tackling multiple levels of influence during any behaviour change intervention is hypothesised to be more likely to promote healthy behaviour (Sallis *et al.*, 2008). Pairing such measurements with other formative research (as is intended in the larger project of which this study is part) and using it to guide social marketing intervention planning is recommended (Kubacki and Rundle-Thiele, 2013) and is expected to increase the likelihood of intervention success.

The effect of the surrounding environment on a population is evidenced by Timperio *et al.* (2008) who demonstrate that healthy eating is lower in less healthy environments. Any assessment of individual behaviours should take these confounding factors from the surrounding environment into account. This study supports the need to move up the continuum towards an upstream focus to influence policy makers to change the environment to provide an environment of supportive eating (Rothschild, 1999).

Limitations and future research directions

The results of the current study must be viewed in light of limitations, many of which present opportunities for future research. This assessment focussed on the food environment frequently accessed by military personnel stationed at one Australian military base and the results of the current study cannot be generalised beyond the context studied. Other bases may have a different number or mix of outlet types in the surrounding area. Further research is recommended to extend our understanding beyond the Australian context and a multi-site study is recommended to gain foundation data for benchmarking that can be used by researchers to identify best practice food outlets and to establish healthy eating goals for each measure. Replication studies in other Australian settings would assist to further validate the NEMS and mNEAT measures that were adapted for the Australian context and are reported in this study. This study is further limited by the one kilometre radius chosen. Examination of a wider radius as used elsewhere (O'Dwyer and Coveney, 2006; Winkler *et al.*, 2006) is recommended to understand whether the NEMS and mNEAT averages differ based on measurement of a wider radius. Such endeavours would better inform future research decisions regarding the optimal radius to select. Another limitation is inherent to the observational NEMS and mNEAT instruments, both of which rely on the provision of nutrition information or identification of healthy options by the outlet. It does not take into account the precise nutritional value of the foods which would require laboratory analysis. Future research may strengthen the Glanz *et al.* (2005) model by conducting simultaneous assessments of the media environment surrounding the individual, and perceptions of the consumer nutrition environment. Measures may then be incorporated into a modified NEMS instrument to simultaneously measure the consumer nutrition environment, information environment and perceptions of the nutrition environment. Employment of NEMS and mNEAT to study the environment offers a unique perspective for critical marketers that warrants ongoing research attention.

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