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Difficulty of healthy eating: A Rasch model approach

Spencer Henson, Jose Blandon*, John Cranfield

University of Guelph, Guelph, Ontario, Canada

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ABSTRACT

This study aims to measure the difficulty of healthy eating as a single latent construct and, within that, assess which dietary guidelines consumers find more or less difficult to comply with using the Rasch model approach. Participants self-reported their compliance with 12 health-promoting dietary recommendations related to cooking methods and consumption of specific food items. Data were drawn from a survey elicited using a longitudinal consumer panel established in the City of Guelph, Ontario, Canada in 2008. The panel consists of 1962 randomly-selected residents of Guelph between the age of 20 and 69 years. The response rate was equal to 68 percent. The main assumptions of the Rasch model were satisfied. However, subsequent differential item functioning analysis revealed significant scale variations by gender, education, age and household income, which reduced the validity of the Rasch scale. Conversely, these scale variations highlight the importance of socio-economic and demographic factors on the difficulty of healthy eating.

Introduction

The increasing prevalence of non-communicable chronic diseases in industrialized countries, for example cardiovascular disease, stroke, type-2 diabetes and various cancers, has raised serious concerns about the associated economic and social costs, both in terms of the resources required for medical treatment and the wider economic and social losses associated with escalating rates of morbidity and premature mortality (Cash, Goddard, & Lerohl, 2006; Malla, Hobbs, & Perger, 2007). The incidence of these diseases, and the associated costs, are also rapidly increasing in emerging economies (Potkin, Kim, Rusev, Du, & Zizza, 2006). Thus, non-communicable chronic diseases worldwide are increasingly seen as both a public health and an economic issue (Cash et al., 2006).

Numerous studies suggest that the incidence of key non-communicable chronic diseases are heavily associated with lifestyle, and predominantly dietary factors and physical inactivity (see for example Geleijnse, Kok, & Grobbee, 2004; Katzmarzyk & Janssen, 2004; Meng, Maskarinec, Lee, & Kolonel, 1999; Potkin et al., 2006; Robertson, Bound, & Segal, 1998). Thus, particular attention has been focused on how to bring about significant and persistent changes in dietary behavior (Brownson, Haire-Joshu, & Luke, 2006; Darnton-Hill, Nishida, & James, 2004). Science-based dietary guidelines have been established by a number of industrialized countries (see for example DHHS & USDA, 2005; Health Canada, 2007) and internationally by the World Health Organization (WHO) (WHO, 2004) in order to provide guidance to consumers on the composition of a healthy diet. It is recognized, however, that many consumers struggle to align their diets with these recommendations (Blaylock, Smallwood, Kassel, Variyam, & Aldrich, 1999; Kumanyika et al., 2000; Pronk et al., 2004; Shepherd, 2006; Srinivasan, 2007). Indeed, for many consumers compliance with dietary guidelines implies significant reductions in the intake of fats, simple sugars and salt, and increases in the intake of dietary fiber and fruits and vegetables, which translates into profound changes in food consumption patterns (Putnam, Allshouse, & Kantor, 2002; Srinivasan, 2007).

Clearly, the food choices made by consumers are influenced by a wide range of economic, psychological and social factors, and it is in this context that dietary recommendations and other food and/or health-related information influence what consumers choose to eat (Conner & Armitage, 2006; De Boer, Hoogland, & Boersema, 2007; Divine & Lepisto, 2005; Köster, 2009; Miljkovic, Nganje, & de Chastenet, 2008). The use of psychology-theoretical approaches has thrown considerable light on the key drivers of attempts by consumers to eat a healthy diet (Adams & Mowen, 2005; Baranowski, Cullen, & Baranowski, 1999; Conner, Norman, & Bell, 2002; Sullivan & Rothman, 2008; Wardle, 2006). However, we need to understand better the wide range of factors that make it difficult for consumers to eat healthily if we want to reduce the gap between dietary recommendations and consumer dietary behavior. While socio-economic and demographic characteristics have been

* Corresponding author. University of Guelph, Department of Food, Agricultural and Resource Economics, 50 Stone Road East, 220 J.D. MacLachlan Building, Guelph, Ontario, Canada N1G 2W1. Tel.: +1 519 824 4120x53134; fax: +1 519 767 1510.
E-mail address: jblandon@uoguelph.ca (J. Blandon).

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considered predominant factors (for example gender, age, income and education) (Ball & Crawford, 2005; Beydoun & Wang, 2008; Ricciuto, Tarasuk, & Yatchew, 2006) there is a need to recognize the complex interplay of factors that influence what people choose to eat (Birch, 1999; Blaylock et al., 1999; Conner & Armitage, 2006; De Boer et.al., 2007; Köster, 2009; Rozin, 2006) and the mitigating role of attitudes towards food, diet and health, genetic predisposition, etc. (Miljkovic et al., 2008; Sclafani, 2001).

Consumer awareness of dietary guidelines can positively influence healthy eating. Indeed, empirical studies suggest that better informed consumers are more likely to adopt healthier diets. For example, significant relationships have been found between nutrition knowledge and recommended fruit, vegetable and fat intake (Wardle, Parmenter, & Waller, 2000); nutrition awareness and nutrition related-behaviors (Van Dillen, Hiddink, Koelen, de Graaf, & Woerkum, 2007); knowledge of dietary guidelines and fruit and vegetable, dairy product and whole grain consumption (Kolodinsky, Harvey-Berino, Berlin, Johnson, & Reynolds, 2007); consumer knowledge and whole grain food consumption (Lin & Yen, 2008; Mancino, Kuchler, & Leibtag, 2008); and dietary knowledge and reduction of beef and pork consumption (Yen, Lin, & Davis, 2008).

While previous studies support the notion that consumer awareness of dietary guidelines positively influences healthy eating, it is recognized that awareness is not a sufficient condition to comply with dietary guidelines (Blaylock et al., 1999). Pollard, Miller, Woodman, Meng, and Binns (2009), for example, report that while knowledge of recommended fruit and vegetable consumption in Australia increased from 1995 to 2004, this change in knowledge did not result in significant increases in consumption. Further, Variyam & Blaylock (1998) suggest that, while most US consumers are able to identify foods with high levels of fat, fiber and/or cholesterol, specific knowledge on dietary recommendations tends to be more limited (Hendrie, Coveney, & Cox, 2008; Keenan, AbuSabha, & Robinson, 2002).

The studies reviewed above illustrate the multiple factors that influence consumer compliance with health-related dietary recommendations. However, much of this work has tended to focus on the ability of consumers to comply with dietary recommendations in a rather general way or focuses on compliance with recommendations on a piece-by-piece basis (for example reductions in fat or salt intake). Indeed, most empirical studies examine on quite specific aspects of diet, for example consumption of fruits and vegetables (Pollard et al., 2009), whole grains (Mancino et al., 2008) and meat and fats (Yen et al., 2008), which makes it difficult to compare the difficulty of adherence across dietary recommendations and to measure the problems encountered in healthy eating overall. Indeed, there appears to have been little attempt to compare the ease or difficulty of meeting individual dietary recommendations in a consistent manner and how as a collective these behaviors constitute a single construct of the difficulty of healthy eating.

The aim of this study is to measure the difficulty of healthy eating as a single latent construct and, within that, to assess which dietary guidelines consumers find more or less difficult to meet. Specifically, we evaluate the difficulty faced by consumers in complying with 12 dietary recommendations using a Rasch modeling approach (Bond & Fox, 2007; Fox & Jones, 1998; Rasch, 1960). In the next section we introduce the Rasch model, followed by methods, results, discussions and conclusions.

Rasch model

The Rasch model measures the relationship between a person's ability and an item difficulty, and models this as a probabilistic function. Specifically, raw data from a rating scale is converted to "an equal interval scale" measured in logits (log odd units), reflecting the item difficulty and person's ability (Bond & Fox, 2007; Fox & Jones, 1998). In the case of a Likert response scale, the probability (p) that a person (n) with an ability (β_n) to abide by a dietary recommendation (i) at any given scale level *(k)*, with a level of difficulty (τ_k) and overall behavior difficulty (δ_i), is mathematically expressed in the following equation (Bond & Fox, 2007):

$$p(x = k|\beta_n, \delta_i, \tau_k) = \frac{e^{(\beta_n - \delta_i - \tau_k)}}{1 + e^{(\beta_n - \delta_i - \tau_k)}} \quad (1)$$

In practice, the Rasch model gives two main measures: 1) item difficulty (δ_i); and 2) person ability(β_n). Both parameters are measured in logit units, where zero is generally set as the mean. For item measures, more positive (higher) values indicate higher item difficulty. For person measures, more positive (higher) values indicate higher person ability. Conversely, negative (lower) values indicate less difficulty for items and less ability for persons (Bond & Fox, 2007).

A primary assumption of the Rasch model is that responses should measure a single construct (unidimensionality), that is, the difficulty of healthy eating. This requires that the items evaluated as well as the participant responses fit a single underlying dimension. Unidimensionality can be tested by conducting principal component analysis of the residuals (Bond & Fox, 2007; Fox & Jones, 1998). As a rule of thumb, Linacre (2006) recommends that the variance explained by the Rasch dimension in the data should be greater than 60 percent, while the proportion of the remaining unexplained variance that is explained by the first contrast (second dimension) should be less than five percent.

Using factor analysis, the internal reliability of a scale can typically be assessed by its Cronbach's alpha score. The Rasch model has analogues reliability estimates for items evaluated and participant measures; namely, the item reliability index and the person reliability index. These indices are similar to the Cronbach's alpha, ranging from zero to one (Bond & Fox, 2007; Fox & Jones, 1998) with values above 0.80 generally considered to indicate good reliability.

The validity of the Rasch model construct can be assessed using various sources of information. Concurrent validity implies invariance of Rasch results across tests, but requires data from a validation sample (e.g., Fox & Jones, 1998; McCormack, Mâsse, Bulsara, Pikora, & Giles-Corti, 2006). Alternatively, a differential item functioning (DIF) test can be applied to different sub-samples. The underlying Rasch model assumption is that measures from different sub-samples should not be significantly different (Bond & Fox, 2007; Higgins, 2007). Evidence of construct validity can be obtained from the item ordering; in particular, if the ordering from easiest to most difficult is consistent with theoretical and experience expectations (Fox & Jones, 1998). Further, the fit statistics of the Rasch model provides evidence of construct validity. The infit and outfit mean-square statistics have expected values of one; values greater/less than one indicate more/less variation between the observed and the predicted response patterns (Bond & Fox, 2007). Infit statistics are more frequently used; for rating scales the recommended range is 0.60–1.40, although a range of 0.50–1.50 is generally acceptable (Wright & Linacre, 1994). In addition to item infit statistics, similar person measures are estimated. Fit indices indicate whether items fit within the underlying construct that we intend to measure, and whether participants have responded in the expected way (Bond & Fox, 2007; Fox & Jones, 1998).

The Rasch model has been used in a number of behavioral studies. For example: Fischer, Frewer, and Nauta (2006) modeled household food handling practices directed at enhanced food safety. Heesch, Masse, and Dunn (2006) evaluated the impact of enjoyment, perceived benefits and perceived barriers on physical activity. Kahler, Strong, Read, Palfai, and Wood (2004) employed the Rasch model to analyze excess of alcohol consumption in college students. These studies suggest that the Rasch model performs well in the analysis of health-related behaviors.

Methods

Participants

Data for this study were drawn from a survey elicited using a longitudinal consumer panel established in the City of Guelph, Ontario, Canada. Ethical clearance was obtained before conducting research from the Research Ethics Board of the University of Guelph, according to the University's ethical policies. The panel consists of 1962 randomly-selected residents of Guelph between the age of 20 and 69 years. Members were recruited using stratified sampling on the basis of age, gender and educational status. Strata quotas reflected the demographic profile for these dimensions across the population of the City of Guelph based on the 2006 population census of Canada. Guelph is advantageous for such a panel study as the socio-demographic composition of its population makes it one of the most representative Canadian cities for consumer and marketing research (CBC, 2007). Members of the panel completed an on-line structured questionnaire during the period February–March, 2008; the on-line questionnaire took about 30 min to complete. After dropping questionnaires with missing values, the initial sample size for this analysis was 1331 questionnaires; an effective response rate of 68 percent.

Procedure

Participants were asked to rate 12 separate recommendations associated with cooking methods and the consumption of particular food items. These dietary recommendations were based on those published by Health Canada and the Heart and Stroke Foundation of Canada (Health Canada, 2007; HSFC, 2008). The 12 items (Table 1) were presented to respondents as 'common recommendations for eating a healthy diet, especially to minimize the risk of heart disease'. They rated each of the items according to the degree to which they had abided by it over the last year, using a seven-point scale from 'not at all' (1) to 'completely' (7). Subsidiary data were gathered for socio-economic variables such as age, gender, education and income.

In order to use these 12 dietary recommendations to measure the difficulty of healthy eating we assumed that participants were generally conscious of these dietary guidelines and the importance of diet for health. We based our assumptions on recent findings that suggest that 87 percent of Canadians consider themselves knowledgeable of food and nutrition (Canadian Council of Food and Nutrition, CCFN, 2006). Participants in our study also ranked the importance of food and nutrition for maintaining or improving overall health on a seven-point scale from 'not at all important' (1) to 'extremely important' (7); the response mean and standard deviation for these responses equaled 6.62 and 0.63, respectively. Similarly, according to the Rasch model, we assumed that consumer compliance with each of the dietary recommendations was a function of the item difficulty and consumer ability to comply.

Table 1
Twelve dietary recommendations.

Limit consumption of red meats
Consume the recommended daily intake of fruit and vegetables
Limit consumption of high-fat dairy products
Limit consumption of fatty and/or salty snacks
Limit consumption of fried foods
Consume the recommended daily intake of whole grains and cereals
Use low fat cooking methods such as baking, broiling or steaming
Limit consumption of alcohol
Avoid foods containing high levels of salt
Avoid foods containing trans fats
Control salt added to food in cooking or at the table
Use oils higher in polyunsaturated or unsaturated fats

Analysis

The Rasch model was run using the WINSTEPS software version 3.65.0 (Linacre, 2006), to estimate a single scale of item difficulty (δ_i) for the 12 dietary recommendations. Preliminary analysis of the Rasch model showed that the item rating scale (1–7) was not normally distributed, since lower categories were infrequently used by respondents. Thus, lower categories were combined (1–4 = 1; 5 = 2; 6 = 3; and 7 = 4) and the model re-estimated (Bond & Fox, 2007; Fox & Jones, 1998).

After re-coding the rating scales, the re-estimated Rasch model yielded moderate item difficulty measures ranging from −0.58 to 0.57, but with acceptable infit statistics, except for 'limit consumption of alcohol' (1.53). The proportion of misfit participants based on their infit statistics was 16.4 percent. Misfit participants were dropped from the model in order to improve the general fitness (Bond & Fox, 2007; Curtis, 2004; Fox & Jones, 1998). The final results are presented below.

Results

The final Rasch model included 1113 respondents. Item difficulty ranged from −0.72 to 0.71 and infit statistics from 0.82 to 1.52 indicated good fitness, with the exception of one item ('limit consumption of alcohol') that had a moderate misfit (Table 2). The item and person reliability of the model, which are analogous to the Cronbach's alpha (Bond & Fox, 2007; Fox & Jones, 1998), were 0.99 and 0.88 respectively.

The unidimensionality assumption of the Rasch model was assessed by undertaking principal component analysis of the residuals (Bond & Fox, 2007). In our model 47.3 percent of the variation was explained by the Rasch dimension and 7.5 percent by the first contrast (second dimension). While these measures are not as good as the recommended measures of model performance, this is not unusual among studies employing the Rasch model (Fischer et al., 2006; Higgins, 2007; Linacre, 2006). Moreover, comparable studies suggest that the unidimensionality assumption was met (Reeve & Mâsse, 2004). Table 2 also shows Classical Test Theory (CCT) indicators, which support unidimensionality. The range of item difficulty is shown in the Wright map (Fig. 1).

Differential item functioning (DIF)

DIF tests were undertaken at the 95 percent level (or less) by gender, education, age and household income. The WINSTEPS software provides this output, using the joint standard errors of the compared groups. Before conducting the DIF tests, the item 'limit consumption of alcohol' was dropped. This item had a high infit value (1.52), a relatively low item total correlation (0.37); and the lowest factor loading (0.44) in the principal component analysis (Table 2). After dropping 'limit consumption of alcohol' there were no appreciable changes to the range of the scale and item ordering, however, the variance explained by the Rasch dimension increased from 47.3 to 50.6 percent, and the items had acceptable infit values, ranging from 0.85 to 1.15 (Table 3).

On the basis of the DIF analysis, education was grouped into three categories: 1) high school or less (22.7%); 2) diploma/college (31.9%); and 3) university (45.4%). Age was also grouped into three categories: 1) 20–39 year-old (39.5%); 2) 40–49 year-old (25.4%);

Table 2
Item difficulty of dietary recommendations.

Item	Rasch measures		CCT measures				
	Difficulty	Infit	Mean[a]	Std. dev.	Item total correlation	Cronbach's alpha if item deleted	PCA factor loading[b]
Limit consumption of red meats	0.71	1.07	2.17	1.12	0.54	0.88	0.61
Limit consumption of salty snacks and/or fatty snacks	0.37	0.91	2.36	1.10	0.64	0.87	0.73
Limit consumption of high-fat dairy products	0.25	0.95	2.43	1.06	0.63	0.87	0.70
Avoid foods containing high levels of salt	0.20	0.82	2.46	1.05	0.68	0.87	0.76
Limit consumption of fried foods	0.20	0.83	2.48	0.98	0.68	0.87	0.76
Consume the daily recommended intake of fruits and vegetables	0.10	1.06	2.50	1.01	0.56	0.88	0.64
Limit consumption of alcohol	0.08	1.52	2.52	1.16	0.37	0.89	0.44
Consume the recommended daily intake of whole grains and cereals	0.03	1.05	2.56	1.05	0.57	0.88	0.65
Use low fat cooking methods such as baking, broiling or steaming	−0.26	0.96	2.70	0.98	0.62	0.87	0.70
Avoid foods containing trans fats	−0.28	0.92	2.71	0.97	0.63	0.87	0.72
Control salt added to food in cooking or at the table	−0.65	1.05	2.94	1.09	0.55	0.88	0.63
Use fats higher in polyunsaturated or unsaturated fats such as vegetable oils	−0.72	0.91	2.94	1.02	0.61	0.88	0.68

[a] In a scale from 1 to 4.
[b] PCA: Principal component analysis.

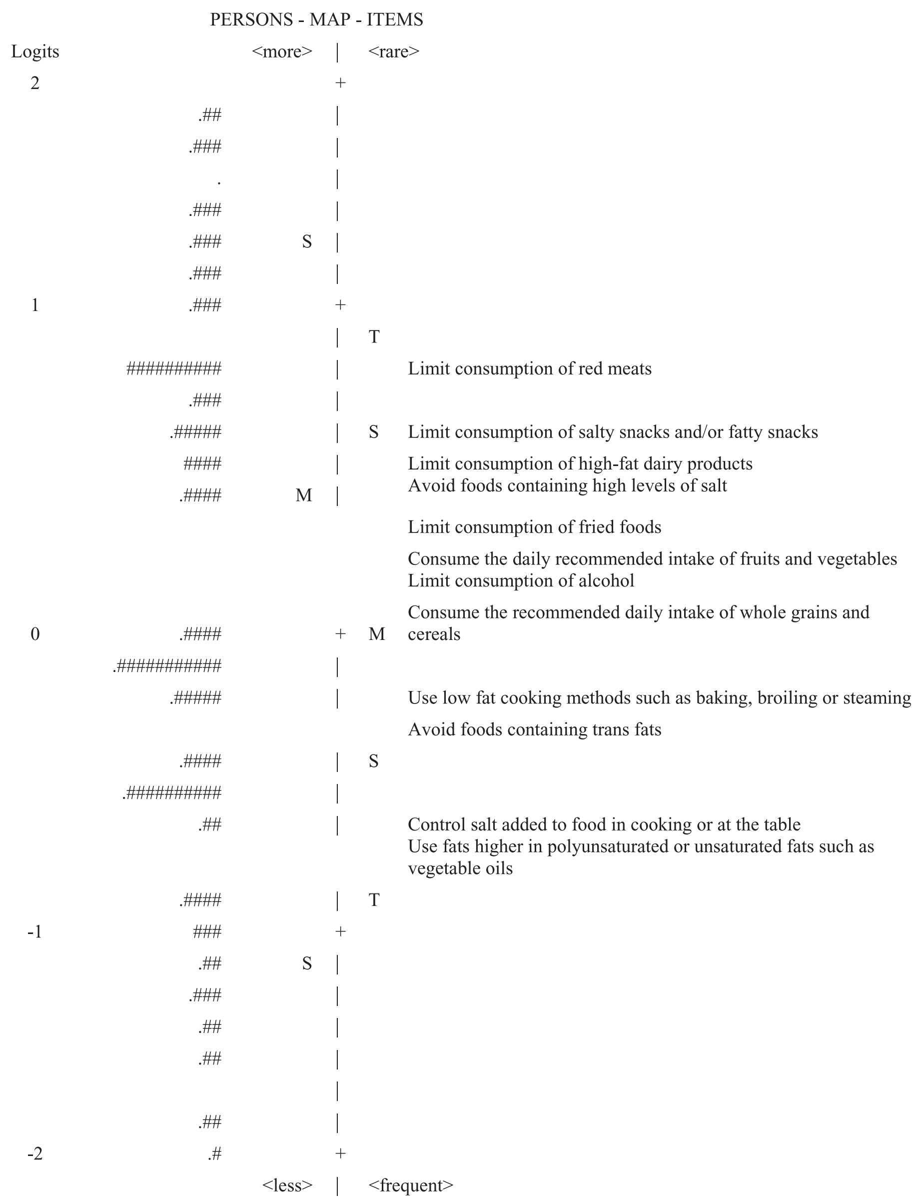

Fig. 1. Wright map.

Table 3
Average Rasch scale and differential item functioning (DIF).

Item	Sample		By gender		By education			By age			By income		
	Average measure	Infit	Males	Females	High school or less	Diploma college	University	20–39 year-old	40–49 year-old	50–69 year-old	Less than $55K	$55 to $89K	$90K or more
Limit consumption of red meats	0.76	1.15	**1.04**	**0.62**	0.64	**0.90**	0.72	**0.55**	0.88	**0.90**	0.73	0.85	0.76
Limit consumption of salty snacks and/or fatty snacks	0.39	0.93	**0.23**	**0.49**	0.33	0.36	0.45	**0.55**	0.34	0.27	0.37	0.47	0.39
Limit consumption of high-fat dairy products	0.27	1.00	0.23	0.29	0.16	0.27	0.32	0.30	0.23	0.27	0.24	0.30	0.33
Avoid foods containing high levels of salt	0.22	0.85	0.19	0.22	0.17	0.17	0.27	**0.46**	0.17	**−0.04**	0.20	0.31	0.19
Limit consumption of fried foods	0.21	0.86	0.32	0.15	0.25	0.15	0.24	0.24	0.15	0.21	0.21	0.21	0.25
Consume the daily recommended intake of fruits and vegetables	0.11	1.10	0.08	0.11	**0.40**	0.19	**−0.07**	**−0.03**	0.21	0.21	0.15	0.02	0.09
Consume the recommended daily intake of whole grains and cereals	0.04	1.10	−0.06	0.10	0.06	0.15	−0.05	**−0.10**	0.10	0.15	0.04	**−0.12**	0.19
Use low fat cooking methods such as baking, broiling or steaming	−0.27	0.99	−0.25	−0.27	−0.29	**−0.50**	**−0.12**	−0.30	−0.27	−0.23	−0.23	−0.20	**−0.47**
Avoid foods containing trans fats	−0.29	0.94	−0.39	−0.23	−0.36	−0.21	−0.29	−0.24	−0.31	−0.35	−0.35	−0.23	−0.18
Control salt added to food in cooking or at the table	−0.69	1.13	−0.65	−0.72	−0.72	−0.78	−0.62	−0.69	−0.71	−0.64	−0.66	−0.76	−0.71
Use fats higher in polyunsaturated or unsaturated fats	−0.75	0.97	−0.72	−0.78	−0.62	−0.72	−0.84	−0.73	−0.78	−0.75	−0.69	−0.87	−0.84

Number in bold have statistically-significant DIF at the 5% level (or less) compared to the average scale.

and 3) 50–69 year-old (35.1%), as was household income: 1) less than CAN$55,000 (31.3%); CAN$55,000–CAN$89,999 (34.5%); and CAN$90,000 or more (34.2%).

Table 3 shows the DIF results. Significant differences were found in two items by gender, namely 'limit consumption of red meats' and 'limit consumption of salty snacks and/or fatty snacks'. While the first of these items was more difficult for men, the second was more difficult for women.

Across education, significant differences were found for three items: 'limit consumption of red meats'; 'consume the daily recommended intake of fruits and vegetables'; and 'use low fat cooking methods'. Compared to the average, 'limit consumption of red meats' was more difficult for diploma/college participants. The item 'consume the daily recommended intake of fruits and vegetables' was more difficult for participants with high school education or less, and easier for participants with university education. 'Use low fat cooking methods' was easier for respondents with a diploma/college level of education, and more difficult for those with at least a university level of education.

Compared to the average, the youngest participants (20–39 year-old) had significantly-different difficulty measures for five items. These participants found it easier to 'limit consumption of red meats', 'consume the daily recommended intake of fruits and vegetables' and 'consume the recommended daily intake of whole grains and cereals', but more difficult to 'limit consumption of salty snacks and/or fatty snacks' and 'avoid foods containing high levels of salt'. No statistically-significant differences were found between the average scale and participants aged 40–49 year-old. However, older consumers (50–69 year-old) found it more difficult to 'limit consumption of red meats', but easier to 'avoid foods containing high levels of salt'.

Finally, when compared across household income groups, significant differences were found for two items. Compared to the sample average, respondents in the middle income group (CAN $55,000–CAN$89,999) found it easier to 'consume the recommended daily intake of whole grains and cereals', while those in the higher income group (CAN$90,000 or above) found it easier to 'use low fat cooking methods' than the average.

Discussion

With the exception of the item 'limit consumption of alcohol', the Rasch model satisfied the unidimensionality assumption, had reliable item and person reliability indices and acceptable infit values. However, subsequent DIF analysis across gender, education, age and household income groups revealed that the construct did not hold the invariant assumption. Previous studies suggest that it is not uncommon to find significant DIF by socio-economic and demographic characteristics (Bond & Fox, 2007; Kahler et al., 2004; Piquero, Macintosh, & Hickman, 2002). Moreover, these differences can be used to explore the development of customized policy strategies targeted to certain groups. Particularly important here is the identification of sub-groups whose members find it more/less difficult to 'limit the consumption of red meats', 'consume the daily recommended intake of fruits and vegetables', 'limit consumption of salty snacks and/or fatty snacks' and 'avoid foods containing high levels of salt'. However, by violating the invariance assumption, our results suggest that we cannot conclude that the 12 healthy dietary recommendations measure a single latent construct of the difficulty of healthy eating, and hence, the Rasch model may not be appropriate for the behavioral variables included in this study.

In addition to the above limitation, explaining observed differences in item difficulty can be problematic, especially where there is appreciable variation across sub-groups. Compared to the average, 'limit consumption of red meats' is revealed to be more difficult for males, diploma/college participants and older consumers (50–69 year-old). Previous studies suggest that women are generally more food conscious (Divine & Lepisto, 2005; Roos, Lahelma, Virtanen, Prattala, & Pietinen, 1998), and may see over-consumption of red meats as unhealthy. Among older consumers, the difficulty faced in reducing red meat consumption may be a matter of food preferences and tradition (Birch, 1999).

Not surprisingly, perhaps, 'limit consumption of salty snacks and/or fatty snacks' is more difficult for women and younger participants (20–39 year-old). This may be associated with craving behavior (Birch, 1999; Higgs, 2006). Similarly, 'avoid foods containing high levels of salt' is more difficult to younger consumers, but conversely, easier for older consumers. A possible explanation is that older consumers are at higher risk of hypertension (Geleijnse et al., 2004) and may better appreciate the need to control salt intake. 'Consume the daily recommended intake of fruits and vegetables' is more difficult for consumers with the lowest level of education and easier for those with a university degree, a result that may be explained by levels of nutrition knowledge (Wardle et al., 2000).

It must be recognized that the difficulty measures reported above were derived on the basis of the self-reported level of adherence to the dietary recommendations. There is evidence that consumers are often poor judges of their own food intake and of their compliance with recommendations with respect to healthy eating (see for example Scaife, Miles, & Harris, 2006; Webb, Sheeran, & Armitage, 2006). Thus, it is important to interpret these results not as strict indicators of the degree of compliance with dietary recommendations but as broader indicators of *relative* difficulty.

Conclusions

The study reported above has illustrated the utility of Rasch modeling for measuring the difficulty of healthy eating as a single latent construct and establishing the relative difficulty faced by consumers in complying with dietary guidelines. Although the Rasch model satisfactorily met the assumptions of unidimensionality, item and person reliability and acceptable infit values, subsequent DIF analysis revealed that the invariance assumption was not met.

Consequently, the results suggest that the difficulty faced in making health-related dietary changes varies appreciably across specific dietary changes and between socio-economic sub-groups. These findings have important implications for public health policy directed at formulating and promoting dietary guidelines. Thus, attention needs to focus on those changes that consumers find most difficult to make, rather than the concept of healthy eating as a whole. Given that the difficulty of many specific dietary changes varies across consumer sub-groups, health promotion efforts need to be targeted at those who find it most difficult to make changes.

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