SHORT RESEARCH ARTICLE

REVISED

Implementation of a worksite educational program focused on promoting healthy eating habits [v2; ref status: indexed, http://f1000r.es/32x]

Dimitra Tanagra[1], Dimitris Panidis[2], Yannis Tountas[1], Elina Remoudaki[1], Evangelos C. Alexopoulos[1,3]

[1]Postgraduate Course of Health Promotion & Education, Medical School, University of Athens, Athens, Greece
[2]Laboratory of Biopharmaceutics and Pharmacokinetics, School of Pharmacy, University of Athens, Athens, Greece
[3]Department of Occupational Health, Onassis Cardiac Surgery Center, Athens, Greece

v2 **First published:** 03 Oct 2013, **2**:201 (doi: 10.12688/f1000research.2-201.v1)
Latest published: 07 Mar 2014, **2**:201 (doi: 10.12688/f1000research.2-201.v2)

Abstract

Objective: To estimate the effectiveness of a short-term educational-counseling worksite program focused on lipid intake, by monitoring the possible change on nutrition knowledge and eating habits.
Methods: an 8-week educational program based on the Health Belief Model was implemented in a honey packaging and sales company in Greece. 20 out of the 29 employees initially enrolled completed the program. Knowledge level and eating habits were evaluated prior and after the intervention by the "Nutrition Knowledge Questionnaire" and the "Food Habits Questionnaire". ANOVA, Spearman rho test and paired Wilcoxon test were employed in statistical analysis.
Results: Non smokers and those with higher educational level had healthier eating habits. Knowledge following the intervention was significantly improved concerning recommendations and basic food ingredients but as far as eating habits were concerned, scores were not improved significantly, while intake of fried food was increased.
Conclusions and Implications: Short-term interventions may produce substantial improvement in knowledge but not necessarily modifications in unhealthy eating habits.

Open Peer Review

Referee Status: ✓ ✓

	Invited Referees 1	2
REVISED version 2 published 07 Mar 2014	✓ report	✓
version 1 published 03 Oct 2013	✓ report	? report

1 **John Mooney**, University of Sheffield UK

2 **Marjorie Freedman**, San José State University USA, **Ashlee Gossard**, San José State University USA

Discuss this article

Comments (0)

Corresponding author: Evangelos C. Alexopoulos (ecalexop@med.uoa.gr)

How to cite this article: Tanagra D, Panidis D, Tountas Y *et al.* **Implementation of a worksite educational program focused on promoting healthy eating habits [v2; ref status: indexed, http://f1000r.es/32x]** *F1000Research* 2014, **2**:201 (doi: 10.12688/f1000research.2-201.v2)

Grant information: During the study, DT was supported by a scholarship from Onassis Foundation while pursuing his MSc in Health Promotion and Education at the Medical School of Athens University in Athens.
The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

Competing interests: No competing interests were disclosed.

First published: 03 Oct 2013, **2**:201 (doi: 10.12688/f1000research.2-201.v1)
First indexed: 06 Jun 2014, **2**:201 (doi: 10.12688/f1000research.2-201.v2)

REVISED **Amendments from Version 1**

In response to reviewers' comments we have added text in the first (*Both questionnaires… was clear*) and the last paragraph of "Methods: Survey questionnaires" section (*The participants' population… 45% were smokers*[17]).

In the "Methods: The Intervention" section (1st paragraph) we have tried to excuse the choice of the Health Belief Model in our setting (*The choice of the HBM… questionnaire analysis (see below, program phase 3)*).

In discussion section we have elaborated (i) the "vacations" issue (1st paragraph: *national holidays… by Greek orthodox religion*); (ii) we have tried to answer the reason why the Diet-Health relationship, showed the least significant change following the intervention (2nd paragraph: *As already discussed emphasis… to control health risks.*); and, (iii) we have added study limitations and recommendations (3rd paragraph: *The good general health… to enhance the validity of the data*).

The Supplemental files (Q1 and Q2) which were presented inversely from their description in text have been reversed and a footnote under Table 4 was added.

See referee reports

Introduction

Over the last decades, obesity has rapidly turned into a global epidemic in both developed and developing countries, affecting adults, children and adolescents as well. Currently, the number of people suffering from obesity is estimated at approximately 400 million people worldwide[1]. Moreover, increased body mass index (BMI) is associated with higher risk of cardiovascular diseases, some types of cancer and type II diabetes[2–4]. Recent data from Greece have shown obesity is an epidemic problem[5,6]. In recent years, Greeks have abandoned the traditional Mediterranean diet; one study reports that only 33% of Greek men and 43% of Greek women adhere to a traditional Mediterranean diet[7].

Among various individual and lifestyle factors, many work-related factors are responsible for the modification of dietary patterns including working conditions, such as: working overtime, high job demands, occupational stress and others[8]. On the other hand, the workplace has been identified as a promising setting for health promotion although the findings of many worksite health promotion (WHP) programs indicate that these programs are associated with only moderate improvement in dietary intake[9]. Furthermore, it was shown that diet mediterranisation is feasible in a food-at-work intervention, affecting lunch consumption at the workers canteen[10]. However in a systematic review, participation levels in health promotion interventions at the workplace were typically below 50%[11].

The purpose of the present study was to evaluate the effectiveness of an educational worksite intervention focused on lowering fat intake, by affecting nutrition knowledge and eating habits.

Methods

Study population

The 48 employees working in the factory premises of a honey company, were asked to participate in this study. Most of the 48 employees were employed in jobs that required mild to moderate manual and intellectual activity (blue collar workers) and five were employed as food scientists and technologists, and supervisors. No inclusion or exclusion criteria were used and as there were no medical contraindications for participation in the program, as judged by the occupational health physician, all employees were eligible for participation. Twenty-nine employees responded positively (60%) to the invitation and gave their written informed consent. The Medical School Review Board judged that further approval was not required, since this program was under the occupational physician's supervision and control. During the program, seven employees failed to attend day 2 and/or 3 and another two did not return the final questionnaires and all nine were excluded from the final analysis (see Table 1).

Survey questionnaires

Initially, all employees were informed about the program and were asked to participate by signing informed consent. Two questionnaires were used in order to estimate (Q1) the employees' nutrition knowledge level and (Q2) their eating habits (see Supplementary File Q1 and Supplementary File Q2). The questionnaires were translated into Greek by two bilingual expert nutritionists and were piloted in 10 college students and blue collar employees for linguistic validation. Both questionnaires in the pre- and post- intervention phase were self-administered. In order to avoid any confusion or misunderstanding, especially in the "Diet Habits" questionnaire (a part of which is proposed to be administered by an interviewer), we had previously explained the way of answering the questionnaire by the means of an oral presentation and we had also reformatted that part of the "Diet Habits" questionnaire so that the sequence of questions/answers was clear.

Table 1. Description of the health promotion program.

Phase	Description	Duration	Participants
0	Informing workers about the health promotion program	0.5 h	48
1: day 1	Presentation and distribution of the questionnaires Measurements of blood pressure/weight/height	1.5 h	29
2: day 16	Lecture, discussion, distribution of printed material	2 h	24
3: day 23	Issues derived from questionnaire analysis (knowledge gaps) Restrictive factors and alternative suggestions (bad habits)	2 h	20
4: day 45	Redistribution of the questionnaires	0.5 h	20
5: day 52	Final meeting, results presentation, individual counseling	3 h	20

Nutrition knowledge was assessed using the "*Nutrition Knowledge Questionnaire"* (see Supplementary File Q1)[12]. The questionnaire covers four sections: (i) knowledge on experts' recommendations regarding the optimum intake of different food groups (maximum score: 11); (ii) nutrient knowledge, (maximum score: 69); (iii) food choice (which asks people to choose between different options, e.g. to pick the snack that is low in fat and high in fibers), (maximum score: 10); and (iv) the relationships between diet and disease (maximum score: 20). This last section looks at beliefs about the associations between food type, food quantity and diseases.

The eating habits of the participants were assessed by the "*Food Habits Questionnaire"* (see Supplementary File Q2)[13,14], which has been widely used to estimate dietary changes[15,16]. Questions were rated on a 4-point scale, where 1 reflects the healthiest and 4 the unhealthiest eating habits, respectively. The questionnaire included five sections regarding the following habits: (i) replacing high fat foods with low fat substitutes (score range: 7–28); (ii) modifying high fat foods, e.g. fat removal from meat (score range: 3–12); (iii) avoiding high fat cooking methods (fried food) (score range: 4–16); (iv) consumption of fresh fruit and vegetables as a snack (score range: 3–12); and (v) choosing specially manufactured low fat foods products instead of high fat ones (score range: 5–20). The total score of eating habits is calculated from the sum of section scores divided by 5 (ranged from 4.4 to 17).

Data on age, family status, children, educational level, job position, smoking habit, BMI, arterial blood pressure and number of cigarettes/years of smoking were also collected (see Table 2). The participants' population reflects sufficiently the general healthy Greek population given that almost 40% of them were overweight or obese and 45% were smokers[17].

Table 2. Demographic and individual characteristics of the intervention group (n=20).

Demographic characteristics	
Age in years *(mean ± SD)*	44.6 ± 9.1
≤ 35 *(n (%))*	4 (20)
36–44	6 (30)
≥ 45	10 (50)
Female *(n (%))*	18 (90)
Family status *(n (%))*	
Married, living with other people	18 (90)
Divorced, living alone	2 (10)
Parenthood *(n (%))*	19 (95)
Educational level *(n (%))*	
< 6 years (elementary)	7 (35)
6–9 years (basic)	4 (20)
9–12 years (high or technical school)	7 (35)
> 12 years	2 (10)
Individual characteristics	
BMI kg/m^2 *(mean ± SD)*	26.5 ± 6.2
< 25 kg/m^2 *(n, %)*	11 (61)
25–29.9 kg/m^2 *(n,%)*	4 (22)
> 30 kg/m^2 *(n, %)*	3 (17)
Smoking	
Smoker *(n, %)*	9 (45)
Pack-years *(mean ± SD)*	8.9 ± 11.6
Non smokers *(n, %)*	11 (55)

The intervention

The intervention took place in three distinct phases over a total of 7–8 weeks (Table 1) and it was based on the Health Belief Model which suggests that health behaviors are determined by health beliefs and readiness to take action. Behavioral theory has increasingly been used to guide nutrition research to improve intervention efficacy. The Health Belief Model was developed in the 1950s to explain health behavior associated with the failure of people to participate in programs that would reduce disease risk. Constructs central to the HBM consist of perceived susceptibility, perceived severity, perceived benefits, perceived barriers, and other mediating variables. The construct of self-efficacy is frequently included in applications of the HBM[18,19]. The choice of the HBM was based both on the specific environmental context and on previous requests of employees on ways towards healthy eating choices and habits, both at work and home. Their interest was mostly healthy choices and on their relevant barriers and less on obesity or disease related risk perception. The environmental context, which is considered equally important in worksite health promotion interventions, was not addressed in our study since almost all employees, during the paid 30 minute meal break, were using homemade food or snacks. A well-equipped and sufficiently large eating room and kitchen was available, so that employees could heat, store safely and consume their own food. Consequently, we have tried to combine the educational measures with suggestions on strategies for change i.e. restrictive factors and bad habits and other issues derived from questionnaire analysis (see below, program phase 3).

In our program (Phase 1), all employees who initially responded to the invitation attended a 30 minute meeting in which a brief presentation of the self-administered questionnaires was done and instructions about the proper completion of both questionnaires were given. Further clarifications were answered the following days during the collection, where necessary. Data on individual characteristics (age, marital status, children, education, smoking status etc.), were also collected and blood pressure, weight and height of the subjects were measured (Seca® 764, Sigma Medical Co, Athens, Greece) at the end of the meeting. Completed questionnaires were collected, recorded in an electronic database and statistically analyzed. In Phase 2, 15 days after the questionnaires were initially distributed, a 45-minute lecture on healthy eating and mediterranean diet was held followed by discussion and distribution of printed material with practical proposals for adoption of healthier eating habits. Overall, the whole session lasted approximately two hours. A week later a second meeting took place (Phase 3) in order to discuss and clarify issues derived from the conclusions of the initial analysis. Specifically, knowledge gaps and restrictive factors for the adoption of healthier nutritional

choices were further discussed. The intervention was completed 22 days later (Phase 4) when the participants were asked to fill in the questionnaires again. In the last phase (5th), a final meeting took place to present and discuss the results, and for individual counseling by the research team.

Statistical analysis

Analysis of variance (ANOVA) was used to reveal statistically significant differences among various subgroups. Due to the small sample, Spearman rho test was used to examine correlations of the quantitative variables while the paired signed Wilcoxon test was used to compare average values of continuous variables for each category of nominal variables in the intervention group (before and after). A p-value of <0.05 was considered statistically significant. Statistical processing and data analysis were performed using commercial software (SPSS version 16.0, SPSS Inc., 2007).

Results

General characteristics of the study population

From the 29 workers who initially responded positively, 20 workers (67%) attended all phases and completed the WHP program (Table 1). Losses were mainly due to absences on the days of intervention, or inability or failure to return the study questionnaires in time. Between the final and initial groups there were no significant differences in any of the variables.

Analysis of the knowledge questionnaire, returned by the 29 workers who initially responded, showed a lack of knowledge of food composition in saturated fat, fibers, and salt, of the origin of fatty acids (monosaturated, polysaturated and saturated) and of the sources of antioxidant vitamins. Education level correlated significantly with the partial score, i.e. the higher the education level the higher the scores.

Analysis of the habits questionnaire showed that dietary habits included medium to large consumption of fatty foods. However, the score of the workers corresponding to the avoidance of fried foods was pretty high, reaching almost the excellent level. No significant correlations were found between variables under study and the two first subscales (replacement of fatty foods and meat modification). Men, people living with others, and those without children had a tendency to avoid the more fatty substances. Meanwhile, women consumed less fried foods.

Post-intervention analysis was done in the 20 workers who had participated in all phases. Table 2 shows the demographic and individual characteristics of these workers. Women and blue collar workers accounted for 90% and 95%, respectively, a fact that limits the possibility of revealing significant effects of these variables (sex and job title) on the results of the intervention.

As expected, there were significant correlations between the sections (scales) of the two questionnaires prior to, and following, the intervention. By contrast, between the different questionnaires, scales were less and weakly correlated with the exemption of the group of the avoidance of fatty substances. Very high Cronbach alpha score (above 0,80) shows satisfactory reliability of all subscales of both questionnaires. Table 3 presents the scores per category (section) of nutritional knowledge prior to, and following, the intervention in the 20 workers. Significant improvement was seen in the sections of "*dietary recommendations*", in "*basic food ingredients*" and in the total score. Prior to intervention, non-smokers had higher (better) scores concerning the subscales of the "*basic food ingredients*" (41.0 vs 33.1, p=0.08) and the "*selection of healthier foods*" (6.2 vs 4.8, p=0.06) but these differences did not reach statistical significance. Following the intervention, non-smokers improved more in the "*selection of healthier foods*" (6.8 vs 5.2, p=0.04).

Table 4 presents the dietary habit scores prior to, and following, the intervention. The mean score was improved in the categories of "*replacement of fatty foods*", "*meat modification*", "*consumption of food and vegetables*", "*avoidance of fatty substances*" and in the total score but the difference was far from significant. On the contrary in the habit of "*avoidance of fried foods*", the score was significantly worse, a paradox that might be explained by the very high initial score (tendency towards regression to the mean).

Workers with a normal BMI exhibited better habits compared with overweight and obese subjects in terms of "*meat modification*" (4.6 vs 12.7, p=0.002). Non-smokers had lower scores compared with smokers in "*fat avoidance*" (12.6 vs 15.0, p=0.06) and in "*avoidance of fried food*" (6.5 vs 7.7, p=0.05).

Discussion

In the present study, a short-term intervention regarding eating knowledge and habits was implemented in a worksite. Knowledge

Table 3. Score comparison of population distribution per knowledge category prior to and following the intervention (n=20).

Knowledge category	Max score	Prior to the intervention			Following the intervention			Paired difference		
		Median	Mean	SD	Median	Mean	SD	Mean	95% CI	p-value
Dietary recommendations	11	7	7.13	1.81	8	8.00	1.76	-0.88	-1.68 -0.07	0.035
Basic food ingredients	69	39	37.45	9.99	48	44.05	12.01	-6.60	-11.85 -1.35	0.016
Selection of healthier foods	10	6	5.55	1.70	6	6.10	1.74	-0.55	-1.33 0.23	0.157
Diet – health relationship	20	14	12.50	4.80	15	13.20	4.456	-0.70	-2.92 1.52	0.518
Total score	110	66	62.63	15.40	77	71.35	16.39	-8.73	-15.55 -1.90	0.015

Table 4. Comparison of dietary habits score per dietary habit category prior to and following the intervention (n=20).

Dietary habits	Max score	Prior to the intervention			Following the intervention			Paired difference		
		Median	Mean	SD	Median	Mean	SD	Mean	95% CI	p-value
Replacement of fatty foods	28	21	20.11	7.35	18	19.15	6.77	0.97	-2.45 4.39	0.560
Meat modification	12	5.50	6.88	3.85	6	6.60	2.41	0.28	-1.14 1.69	0.690
Avoidance of fried foods	16	6	6.12	1.44	7	7.03	1.30	-0.92	-1.56 -0.27	0.008
Food and vegetables consumption	12	8.50	7.92	2.33	8.50	7.67	2.47	0.25	-0.61 1.11	0.549
Avoidance of fatty substances	20	13	13.54	2.95	13	13.08	4.20	0.46	-1.39 2.31	0.610
Total score	88	11.44	10.84	2.31	11.79	10.45	2.60	0.39	-0.62 1.40	0.470

A lower score on this assessment indicates improved/more healthy eating habits.

was significantly improved following this intervention, while no significant improvement was achieved concerning dietary habits. The paradox regarding the fact that average consumption of fried, browned or breaded food ("avoidance of fried food") increased following the intervention could be partially attributed to the very high (excellent) initial score combined with the fact that some national holidays (where meat consumption is imposed by Greek orthodox religion) also coincided with the program.

The finding that knowledge gain did not lead to habit modification may be explained by the short duration of the program and the complexity that characterizes the conscious or unconscious choices of adults. Health promotion programs in workplaces have shown to be cost-effective, especially for long-term interventions[20,21]. As already discussed emphasis was given in promoting healthy eating choices and habits as well as in overcoming the relevant barriers. The fact that the Diet-Health relationship, showed the least significant change following the intervention may be attributed to the minimal interest of employees to control health risks In our study, a number of factors, i.e. education level, job title, family situation and smoking status was shown to be related to the level of nutrition knowledge and dietary habits. However, the small number of participants prevented these correlations to be concurrently analyzed in multivariate analysis. Other factors known to influence dietary behavior including socio-economic factors, stress and organizational factors (increased work demands, low skills motivation, overtime employment) were not analyzed in our study[22,23] but in our setting, the population was highly homogeneous and most of these factors are not anticipated to have a significant discriminatory impact. However, recent findings show that these interventions can be easily incorporated into the daily working routine programs, and if combined with stress management programs, may result in better outcomes[24,25].

Limitations of this study arise from the small sample size and the short duration of the program. The good general health (healthy worker effect) of participants might also have diminished their scope for demonstrating improvements while self-reporting bias seemed to have negligible effect. It would be recommended in future research in similar settings to use additional back-up measures, such as 24 hour recall diaries, in order to enhance the validity of the data. For organizational reasons, we did not attempt to allocate a control group by randomization. On the other hand, the homogeneity of the population concerning socio-economic aspects, the supportive environment, and the good relationships between colleagues are considered to minimize confounding of the different factors.

Short-term interventions may produce substantial improvement in knowledge but not necessarily accompanied by changes in unhealthy eating habits. These types of programs are not far from those commonly encountered in every day practice but do not seem to be effective in changing unhealthy eating habits. Participation by the employees in defining their needs and priorities; planning long-term interventions, and incorporating self-empowerment and stress management techniques might be necessary for cost-effective worksite health promotion programs to succeed in reducing unhealthy eating habits.

Author contributions

Conception and design of the study: DT, YT and ECA; Questionnaire validation and data collection: DT, DP and ER; Intervention team: DT, ER and ECA; Data analysis: DP and ECA; Draft writing: DP, ER and ECA; Co-ordination: YT and ECA; Guarantor of the study: ECA.

Competing interests

No competing interests were disclosed.

Grant information

During the study, DT was supported by a scholarship from Onassis Foundation while pursuing his MSc in Health Promotion and Education at the Medical School of Athens University in Athens.

The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

Acknowledgements

We are grateful to all the employees for their participation.

References

1. World Health Organization. **Obesity and overweight.** 2013.
Reference Source
2. Grundy SM, Pasternak R, Greenland P, *et al.*: **Assessment of cardiovascular risk by use of multiple-risk-factor assessment equations: a statement for healthcare professionals from the American Heart Association and the American College of Cardiology.** *Circulation.* 1999; **100**(13): 1481–1492.
PubMed Abstract | Publisher Full Text
3. Dietz WH, Franks AL, Marks JS: **The obesity problem.** *N Engl J Med.* 1998; **338**(16): 1156–1158.
PubMed Abstract | Publisher Full Text
4. Dixon JB: **The effect of obesity on health outcomes.** *Mol Cell Endocrinol.* 2010; **16**(2): 104–108.
PubMed Abstract | Publisher Full Text
5. Roditis M, Parlapani E, Tzotzas T, *et al.*: **Epidemiology and predisponding factors of Obesity in Greece: from the second World war until today.** *J Pediat Endocrinol Metabol.* 2009; **22**(5): 389–406.
PubMed Abstract | Publisher Full Text
6. Katsarou A, Tyrovolas S, Psaltopoulou T, *et al.*: **Socio-economic status, place of residence and dietary habits among the elderly: the Mediterranean islands study.** *Public Health Nutr.* 2010; **13**(10): 1614–1621.
PubMed Abstract | Publisher Full Text
7. Pitsavos C, Panagiotakos DB, Chrysochoou C, *et al.*: **Epidemiology of cardiovascular risk factors in Greece: aims, design and baseline characteristics of the ATTICA study.** *BMC Public Health.* 2003; **3**: 32.
PubMed Abstract | Publisher Full Text | Free Full Text
8. Nishitani N, Sakakibara H, Akiyama I: **Eating behaviour related to obesity and job stress in male Japanese workers.** *Nutrition.* 2009; **25**(1): 45–50.
PubMed Abstract | Publisher Full Text
9. Ni Mhurchu C, Aston LM, Jebb SA: **Effects of worksite health promotion interventions on employee diets: a systematic review.** *BMC Public Health.* 2010; **10**: 62.
PubMed Abstract | Publisher Full Text | Free Full Text
10. Leighton F, Polic G, Strobel P, *et al.*: **Health impact of Mediterranean diets in food at work.** *Public Health Nutr.* 2009; **12**(9A): 1635–1643.
PubMed Abstract | Publisher Full Text
11. Robroek SJ, van Lenthe FG, van Empelen P, *et al.*: **Determinants of participation in worksite health promotion programmes: a systematic review.** *Int J Behav Nutr Phys Act.* 2009; **6**: 26.
PubMed Abstract | Publisher Full Text | Free Full Text
12. Parmenter K, Wardle J: **Development of a general nutrition knowledge questionnaire for adults.** *Eur J Clin Nutr.* 1999; **53**(4): 298–308.
PubMed Abstract | Publisher Full Text
13. Kristal AR, Shattuck AL, Henry HJ: **Patterns of dietary behavior associated with selecting diets low in fat reliability and validity of a behavioral approach to dietary assessment.** *J Am Diet Assoc.* 1990; **90**(2): 214–220.
PubMed Abstract
14. Kristal AR, Beresford SA, Lazovich D: **Assessing change in diet-intervention research.** *Am J Clin Nutr.* 1994; **59**(1 Suppl): 185S–189S.
PubMed Abstract
15. Glasgow R, Perry JD, Toobert DJ, *et al.*: **Brief assessments of dietary behavior in field settings.** *Addict Behav.* 1996; **21**(2): 239–247.
PubMed Abstract | Publisher Full Text
16. Shannon J, Kristal AR, Curry SJ, *et al.*: **Application of a behavioral approach to measuring dietary change: the fat- and fiber-related diet behavior questionnaire.** *Cancer Epidemiol Biomarkers Prev.* 1997; **6**(5): 355–361.
PubMed Abstract
17. Darviri C, Fouka G, Gnardellis C, *et al.*: **Determinants of self-rated health in a representative sample of a rural population: a cross-sectional study in Greece.** *Int J Environ Res Public Health.* 2012; **9**(3): 943–54.
PubMed Abstract | Publisher Full Text | Free Full Text
18. Rosenstock IM, Strecher VJ, Becker MH: **Social learning theory and the health belief model.** *Health Educ Q.* 1988; **15**(2): 175–183.
PubMed Abstract | Publisher Full Text
19. Glanz K, Patterson RE, Kristal AR, *et al.*: **Stages of change in adopting healthy diets: fat fiber, and correlates of nutrient intake.** *Health Educ Q.* 1994; **21**(4): 499–519.
PubMed Abstract | Publisher Full Text
20. Atlantis E, Chow CM, Kibry A, *et al.*: **An effective exercise-based intervention for improving mental health and quality of life measurers: a randomized controlled trial.** *Prev Med.* 2004; **39**(2): 424–434.
PubMed Abstract | Publisher Full Text
21. Goetzel RZ, Ozminkowski RJ: **What's holding you back: why should (or shouldn't) employers invest in health promotion programs for their workers?** *N C Med J.* 2006; **67**(6): 428–430.
PubMed Abstract
22. Wamala SP, Wolk A, Schenck-Gustafsson K, *et al.*: **Lipid profile and socioeconomic status in healthy middle aged women in Sweden.** *J Epidemiol Community Health.* 1997; **51**(4): 400–407.
PubMed Abstract | Publisher Full Text | Free Full Text
23. Kouvonen A, Kivimäki M, Cox SJ, *et al.*: **Relationship between work stress and body mass index among 45,810 female and male employees.** *Psychosom Med.* 2005; **67**: 577–583.
PubMed Abstract | Publisher Full Text
24. Christaki E, Kokkinos A, Costarelli V, *et al.*: **Stress management can facilitate weight loss in Greek overweight and obese women: a pilot study.** *J Hum Nutr Diet.* 2013; **26**(Suppl 1): 132–9.
PubMed Abstract | Publisher Full Text
25. Alexopoulos EC, Zisi M, Manola G, *et al.*: **Short-term effects of a randomized controlled worksite relaxation intervention in Greece.** *Ann Agric Environ Med.* 2014; **21**(2): (in press).

European Journal of Clinical Nutrition (1999) 53, 298–308

http://www.stockton-press.co.uk/ejcn

Development of a general nutrition knowledge questionnaire for adults

K Parmenter[1] and J Wardle[1]*

[1]*ICRF Health Behaviour Unit, University College London*

Objective: This paper describes the development of a reliable and valid questionnaire to provide a comprehensive measure of the nutritional knowledge of UK adults. The instrument will help to identify areas of weakness in people's understanding of healthy eating and will also provide useful data for examining the relationship between nutrition knowledge and dietary behaviour which, up until now, has been far from clear.
Design: Items were generated paying particular attention to content validity. The initial version of the questionnaire was piloted and assessed on psychometric criteria. Items which did not reach acceptable validity were excluded, and the final 50 item version was administered to two groups differing in nutritional expertise on two occasions to assess the construct validity and test-retest reliability.
Setting: The questionnaire was developed in 1994 in the UK.
Subjects: Three hundred and ninety-one members of the general public, recruited via their places of work, completed the questionnaire at the piloting stage. The final version was administered to 168 dietetics and computer science students following a university lecture.
Results: The internal consistency of each section was high (Cronbach's alpha $= 0.70-0.97$) and the test-retest reliability was also well above the minimum requirement of 0.7. Nutrition experts scored significantly better than computer experts [$F(1167) = 200.5, P < 0.001$], suggesting good construct validity.
Conclusions: The findings demonstrate that the instrument meets psychometric criteria for reliability and construct validity. It should provide a useful scale with which to reassess the relationship between knowledge and dietary behaviour.
Sponsorship: The study was funded by a grant from the Biotechnology and Biological Sciences Research Council.
Descriptors: nutrition knowledge; psychometrics; diet; questionnaire

Introduction

Since the 1950s the link between diet and chronic diseases such as cancer and cardiovascular disorders has been increasingly well recognised world-wide (WHO, 1990). In the UK, attempts to improve the nation's health through dietary change have tended to centre around education. Underlying this approach is the assumption that providing people with the information necessary to choose healthy foods will ultimately lead to an improvement in diet. According to this view, given accurate information about what they should be eating and the implications for their health if they eat the 'wrong' foods, people will change their diets appropriately. Organisations like the Health Education Authority in the UK produce extensive literature aimed at informing people about appropriate dietary behaviour. Their most recent leaflet, entitled '*Eight Guidelines for a Healthy Diet*' (HEA, 1997) includes advice to eat more starchy foods, plenty of fruit and vegetables and to cut down on fatty and sugary foods, as well as information about what these foods are, explanations of the kinds of health benefits of following the guidelines and practical tips and recipes to help people make the recommended dietary changes.

Despite the intuitive appeal of education as a means of improving diet, many studies in this area have failed to find significant associations between nutritional knowledge and dietary behaviour (Axelson *et al*, 1985). If these conclusions are correct and knowledge really has little or no impact on dietary behaviour, then the implications for campaigns to improve people's diet are important. It could be that resources used for public education programmes are being wasted if knowledge does not, in fact, have a major influence on behaviour.

One alternative explanation for the inconsistent associations between knowledge and dietary behaviour, is that knowledge could be being poorly assessed. Psychometrics, the science of measuring or scaling psychological attributes, has defined a set of criteria for a valid test (Kline, 1993). The items should sample the full domain of the attribute in question and be phrased simply and unambiguously (content validity). Individual items should (usually) not be so easy that almost everyone completes them, nor so difficult that very few complete them. Individual items within a scale or subscale should be well correlated to the total subscale score (internal reliability). Scores should remain stable when the test is completed twice over a reasonable time period, that is long enough for precise answers to be forgotten, short enough to minimise real change in the measured attribute (test-retest reliability).

*Correspondence: Professor J Wardle, ICRF Health Behaviour Unit, Department of Epidemiology & Public Health, University College London, 2–16 Torrington Place, London WC1E 6BT.
Received 7 July 1998; revised 14 October 1998; accepted 17 November 1998

Table 1 Psychometric validation of existing nutrition knowledge questionnaires

Authors (*year*)	*Target population*	*Scope*	*Psychometric measures*
Anderson *et al* (1988)	Medical in-patients	General nutrition knowledge	Content validity
Bergman *et al* (1992)	Adult women	Caffeine knowledge	KR = 0.6 for reliability
McDougall (1998)	Teenagers	General nutrition knowledge	Content validity Test-retest reliability
Resnicow *et al* (1997)	Adults	Fat, fibre & cholesterol	Construct validity
Sapp & Jensen (1997)	Adults	Diet and health knowledge	Construct validity < 0.7
Shepherd & Towler (1992)	Adults	General nutrition knowledge	Construct validity
Stafleu *et al* (1996)	Adults (Dutch)	General nutrition knowledge	Content validity Construct validity Test-retest reliability
Steenhuis *et al* (1996)	Adults (Dutch)	Knowledge relating to fat	Test-retest reliability $r = 0.85$

Finally, when administered to samples known, on other grounds, to vary on the attribute in question, for example, by virtue of specialist training, the scores should be significantly different (construct validity). Apart from content validity, which is assessed qualitatively, all these are statistically measureable and there are standard cut-off values for reliability and validity, beyond which items or scales become unacceptable.

Nutrition questionnaires developed to date generally have limitations in one or more of these areas (see Table 1 for a summary). Either they lack the kind of psychometric validation described above, or they cover only a limited area of nutrition knowledge. For example, Towler & Shepherd's (1990) questionnaire is shown to have good construct validity and internal reliability, but the authors say little about how the items were generated and the content validity is therefore questionable. It is, for example, hard to see how an item which asks about the hormones involved in hunger would be related to dietary behaviour. There are no questions about diet-disease links, and although knowledge about the nutrient content of foods is thoroughly tested, there is no systematic questioning about dietary recommendations.

By contrast, Anderson *et al* (1988)) used a questionnaire with good content validity and a sound rationale. Items tested familiarity with nutrition terms, knowledge about current dietary recommendations, and the practical applications of these recommendations. However, the instrument was not subjected to rigorous psychometric validation, so nothing can be said about the construct validity or test-retest reliability, and the internal consistency is shown to be poor. This is also true of McDougall's (1998) study, although her questionnaire has good content validity. However, construct validity was not assessed and the test-retest reliability was measured at an interval of only a day, so although it was found to be high, it is not possible to know whether the measure would be stable over a longer period of time. As the questionnaire is specifically designed for use with teenagers, it might not be suitable for use with an adult sample.

Other studies have used reliable instruments on adult samples, but have concentrated on a particular aspect of nutrition, for example, fat (Steenhuis *et al*, 1996) or fat, fibre and cholesterol (Resnicow *et al*, 1997). These, although useful, would not, therefore, be appropriate for use in measuring the overall nutrition knowledge of a population.

A large-scale study in the USA (Sapp & Jensen, 1997) assessed the reliability and validity of the nutrition knowledge measures used in the Diet and Health Knowledge surveys carried out between 1989 and 1991. Using extensive psychometric evaluation, the authors found that the nutrition knowledge questionnaire did not meet standards for reliability, highlighting the need for a more reliable instrument. They did, however, find that the questionnaire used to test awareness of the relationship between diet and health has acceptable reliability as well as good construct validity.

Further encouragement that it is possible to develop instruments which meet psychometric criteria comes from a study in the Netherlands. Stafleu *et al* (1996) used an adaptation of a questionnaire based on Dutch dietary guidelines. Reliability and validity were both found to be high. Again, the scope of the questionnaire is narrowed, to cover only fat and cholesterol, so it could not be used to assess overall nutrition knowledge. As well as this, because of cultural variations in eating habits and precise dietary recommendations, an instrument developed in the Netherlands would not necessarily be valid for a UK population. Although general recommendations are typically similar across different westernised countries, specific questionnaires might need adapting to take account of cultural variations in diet.

Given the problems of measuring nutrition knowledge and the ambiguity of the findings to date, it is perhaps premature to dismiss the link between knowledge and behaviour without first trying to develop a reliable and valid instrument with which to test a broad range of nutrition knowledge of adults. The aim of this study, therefore, is to develop and validate such a questionnaire which can then be used to look again at the relationship between nutritional knowledge and dietary behaviour.

Methods

Developing the questionnaire item pool

On the basis of this review of current material containing dietary advice and the literature linking diet with disease, it was decided to divide the questionnaire into five main sections: the understanding of terms (such as fibre and cholesterol); awareness of dietary recommendations (in leaflets like the one described earlier); knowledge of food sources related to the advice, that is, which foods contain which nutrients; using the information to make dietary choices (practical food choice); and awareness of diet-disease associations. Using these broad categories, an item pool of 1201 was generated. Some items were taken from existing questionnaires while others were generated from the literature with expert advice from dieticians where necessary. It is believed that this process served to

maximise the content validity of the questionnaire, that is, that the items selected were representative of the whole area of knowledge being measured.

Using this pool of items, two reviews were carried out by a panel of four psychologists and four dieticians to select the best in terms of clarity of the questions, accuracy of the dietary knowledge being tapped, and interpretability. This process reduced the number of items to 102. The preliminary instrument was then ready for piloting in a general population sample.

A number of demographic questions were included in the survey to characterise respondents. A literature search of existing questions was carried out and 12 items chosen from a pool of 58. These asked about sex, age, marital status, ethnic origin (categories taken from the UK 1991 Census), number of children, children under 18 y living at home, educational level, nutrition-related qualifications, occupation and partner's occupation (classified according to the Standard Occupational Classification system), employment status and details of any special diets.

Subjects and method of distribution for the preliminary questionnaire

Nine hundred questionnaires were distributed to a variety of organisations for their employees with the request that they complete and return them (in a pre-paid envelope) and add any comments that might occur to them. Hierarchical organisations were canvassed, in the hope of reaching people from a range of socio-economic backgrounds. Of the 900 questionnaires, 43.3% were completed and returned, although given that distribution was left to the recruited organisations, this is probably an underestimate of the actual response rate. The majority of respondents were women (72.1%), aged between 18 and 44 y (72.4%), white (95.4%) and had non-manual occupations (82.4%). The demographic characteristics are shown in Table 2.

Table 2 Sample characteristics ($n = 391$)

	n	%
Gender		
Male	109	27.9
Female	282	72.1
Age		
Under 18	29	7.4
18–24	92	23.5
25–34	116	29.7
35–44	75	19.2
45–54	45	11.5
55–64	18	4.6
65–74	12	3.1
75 and over	4	1.0
Socio-economic status		
Non-manual	253	82.4
Manual	54	17.6
Ethnic origin		
White	373	95.4
Other	18	4.6
Marital status		
Single	162	41.4
Married/cohabiting	198	50.7
Divorced/widowed	31	7.9
Employment status		
Employed full time	189	48.3
Employed part time	63	16.1
Other	139	35.6

Analyses and results

The results were analysed both quantitatively (for item difficulty, item discrimination and internal consistency) and qualitatively (which involved looking at comments made by respondents).

Item difficulty

According to Kline (1993) items are not useful if they are answered correctly by more than 80% or fewer than 20% of respondents. These indices were adjusted upwards slightly as the pilot sample was skewed towards characteristics which have previously been associated with higher than average nutrition knowledge (Crawford & Baghurst, 1990; Levy *et al*, 1993). Items were therefore rejected over 90% or under 30% of respondents answered them correctly. Of the items which did not meet these criteria, about a quarter were retained on the grounds of content validity, that is they were considered to be testing an essential aspect of nutrition knowledge not covered elsewhere in the questionnaire.

Item discrimination

The ability of each individual item to discriminate between people with different levels of knowledge was measured by correlating the score on each item with the overall test score. An item-to-total-score correlation of 0.2 has been cited as the cut-off point below which items should be discarded (Kline, 1986; Streiner & Norman, 1992). This was adhered to except in circumstances where an item was considered particularly important in terms of content validity.

Internal consistency

This was measured separately for the different sections, each of which was tapping a different area of knowledge. The minimum requirement for internal consistency has been recommended as 0.7 (Kline, 1993). It was calculated for each section as follows (using Cronbach's alpha): understanding of terms: 0.69; dietary recommendations: 0.76; sources of nutrients: 0.8; choosing everyday foods: 0.66; diet-disease relationships: 0.79.

Respondents' comments

Some changes to wording were made in response to comments written on the questionnaires, in order to reduce ambiguity and maximise the clarity of the questions.

On the basis of the analysis described above, the number of items was reduced to 50. The first section (the understanding of terms) was removed completely as so few items met statistical criteria while others were judged to be too scientific and not relevant to behaviour. The final survey was presented as a four page booklet. (Questions are shown in Appendix 1. Copies of the questionnaire booklet are available from authors on request).

Evaluation of validity and reliability of the final scale

The next step was to test construct validity (Streiner & Norman, 1992; Kline, 1993) of the final version by administering it to two groups known to differ in their nutrition knowledge. Test-retest reliability had to be verified to make sure that the results produced were consistent over time (Streiner & Norman, 1992; Nunnally, 1978). Internal consistency was also reassessed for the final version of the

questionnaire. Minimum requirements for test-retest reliability and internal consistency were 0.7 (Kline, 1993).

Subjects and methods

Participants in this study were final year undergraduate students, studying either dietetics or computer sciences. This ensured that one group had a greater knowledge of nutrition, while other variables such as age and socio-economic status were fairly similar for both groups. Questionnaires were administered at the end of lectures on two separate occasions, with an interval of two weeks between them. Two weeks was expected to be long enough for participants to have forgotten their original responses, but not sufficiently long for much real change in nutrition knowledge to have taken place. Participants were not aware of the intended second administration at the time of the first. Dates of birth were used to match the two sets of questionnaires.

The responses from the first administration were used to assess construct validity and internal consistency. The two sets of responses were used to measure test-retest reliability.

Results

At both sessions, compliance was good with almost all students present completing the measure, 168 participants completed the questionnaire at least once, 74 dietetic students and 94 computer science students, 105 of these completed the questionnaire twice (53 dietetic and 52 computer science students). There was a significant gender difference between the two groups, with 90% of the dieticians being female and 84% of computer scientists being male. Differences in age and ethnic origin between the two groups were not significant. The demographic characteristics of the two groups are shown in Table 3.

Table 3 Gender, age and ethnic origin of the two student samples ($n = 168$)

	Dietetic students ($n = 74$)		*Computer students* ($n = 94$)	
Characteristic	*n*	%	*n*	%
Gender				
Male	7	9.5	79	84.0
Female	67	90.5	15	16.0
Age				
18–24	55	74.3	53	56.4
25–34	17	23.0	34	36.2
35–44	2	2.7	7	7.4
Ethnic origin				
White	57	77.0	66	70.2
Other	17	23.0	28	29.8

Construct validity

Table 4 shows that the dietetics students scored consistently higher than the computer science students on all sections of the questionnaire ($P < 0.001$).

Given the different gender balance of the two groups, gender was controlled for in an analysis of covariance but this had little effect on the results. The questionnaire therefore met the criterion for construct validity.

Internal reliability

The reliability of each section was established using Cronbach's alpha. Correlations ranged from 0.7–0.97 (see Table 5).

Test-retest reliability

Pearson's correlation was used to assess test-retest reliability on the scores of the 105 respondents who completed the questionnaire twice. As shown in Table 5, the reliability for each of the sections was very high, ranging from 0.8–0.97 and the overall reliability was 0.98.

Discussion

Studies aiming to assess the relationship between nutrition knowledge and dietary behaviour in the UK have often been criticised on the grounds of uncertain validity and reliability of the instruments used to measure nutritional knowledge (see, for example, Axelson *et al*, 1985; Shepherd and Towler, 1992; Anderson *et al*, 1988). The aim of the present study was to develop a psychometrically reliable and valid questionnaire covering all aspects of practical nutrition knowledge which could be used in future studies to look at the relationship between nutrition knowledge, demographic characteristics and dietary behaviour.

Significant differences between the scores of the dietetic students (nutritional experts within the university environment) and the computer scientists (who had no specialist knowledge of nutrition) indicate that the questionnaire had a satisfactory construct validity, even when taking into the account the skewed gender characteristics of the two groups. The dietetic students scored higher on all sections

Table 5 Internal and test-retest reliability ($n = 168$)

Knowledge section	*Internal reliability (Cronbach's alpha)*	*Test-retest reliability*
Dietary recommendations	0.70	0.80
Sources of nutrients	0.95	0.94
Choosing everyday foods	0.76	0.87
Diet-disease relationship	0.94	0.97
Total	0.97	0.98

Table 4 Differences in knowledge scores between dietetic and computer science students

	Dietetic students ($n = 74$)		*Computer science students* ($n = 94$)		
Knowledge section (*max score*)	*Mean*	*s.d.*	*Mean*	*s.d.*	*F* (1,167)
1. Dietary recommendations (11)	10.2	1.1	7.4	1.6	82.0*
2. Sources of nutrients (69)	62.2	5.0	40.4	11.6	134.6*
3. Choosing everyday foods (10)	9.1	1.1	5.9	2.1	81.4*
4. Diet-disease relationships (20)	17.3	2.3	6.2	3.1	321.3*
Total (110)	98.8	8.1	60.1	16.1	200.5*

*$P < 0.001$.

of the questionnaire, and showed a particularly marked superiority with regard to knowledge about the links between diet and disease (section 4—see Table 4).

The reliability of the final instrument was high. A few items which lacked consistency with the rest of the questionnaire were retained for the sake of content validity, but the internal reliability remained high. The test-retest reliability was also very good.

As well as achieving statistical significance in terms of validity and reliability, the initial process by which the items were generated ensured that all aspects of the subject area were covered, and thus the content validity, though not statistically measurable, was undoubtedly high.

The questionnaire covers current dietary recommendations, sources of nutrients, everyday food choices and diet-disease relationships. These four areas underlie the main aspects relating knowledge to dietary behaviour:

- do people know what current expert dietary recommendations are?
- do they know which foods provide the nutrients referred to in the recommendations?
- can they choose between different foods to identify the healthiest ones?
- do they know what the health implications of eating or failing to eat particular foods are?

This represents a more comprehensive assessment of nutrition knowledge than has generally been achieved. Given that dietary behaviour is so complex, any attempts to understand it in terms of nutrition knowledge must begin with a clear understanding of knowledge. Students have tended either to concentrate on a specific area of knowledge like fat or cholesterol, or have covered a wide variety of knowledge but have not been sufficiently systematic to gain a true understanding of what people know. This, together with the general lack of psychometric validation of measures, may explain the variability of the results of studies looking at the knowledge-behaviour relationship in the area of nutrition.

Conclusion

This questionnaire (see Appendix 1) should provide a useful tool in research on food choice and permit a clearer understanding of the relationship between knowledge and behaviour than has previously been possible. Thanks to its broad coverage in terms of content, it should also be a useful tool for identifying gaps in the public's nutrition knowledge and in evaluating the success of health education campaigns.

Acknowledgements—This research was supported by a grant from the Biotechnology and Biological Sciences Research Council. Acknowledgements to Jo Waller for her contribution to the writing up of the study.

References

Anderson AS, Umapathy D, Palumbo L & Pearson DWM (1988): Nutrition knowledge assessed in a group of medical in-patients. *J. Hum. Nutr. Diet.* **1**, 39—46.

Axelson ML, Federline TL & Birnberg D (1985): A meta-analysis of food and nutrition related research. *J. Nutr. Educ.* **17**, 51—54.

Bergman EA, Erickson ML & Boyungs JC (1992): Caffeine knowledge, attitudes and consumption in adult women. *J. Nutr. Educ.* **24**, 179—184.

Crawford DA & Baghurst KI (1990): Diet and health: a national survey of beliefs, behaviours and barriers to change in the community. *Austr. J. Nutr. Diet.* **47**, 97—104.

Health Education Authority (1997): *Eight Guidelines for a Healthy Diet*. London: Health Education Authority.

Kline P (1986): *A Handbook of Test Construction*. London: Methuen.

Kline P (1993): *The Handbook of Psychological Testing*: London, Routledge.

Levy AS, Fein SB & Stephenson M (1993): Nutrition knowledge levels about dietary fats and cholesterol 1983—1988. *J. Nutr. Educ.* **25**, 60—66.

McDougall P (1998): Teenagers and nutrition: assessing levels of knowledge. *Health Visitor* **71**, 62—64.

Nunnally JC (1978): *Psychometric Theory*. 2nd edn. New York: McGraw-Hill.

Resnicow K, Hearn M, Delano RK, Conklin T, Orlandi MA & Wynder EL (1997): Development of a nutrition knowledge scale for elementary school students: toward a national surveillance system. *J. Nutr. Educ.* **28**, 156—164.

Sapp SG & Jensen HH (1997): The reliability and validity of nutrition knowledge and diet-health awareness tests developed from 1989—1991 diet and knowledge surveys. *J. Nutr. Educ.* **29**, 63—72.

Shepherd R & Towler G (1992): Nutrition knowledge, attitudes and fat intake: application of the theory of reasoned action. *J. Hum. Nutr. Diet.* **5**, 387—397.

Stafleu A, Van Staveren WA, De Graaf C & Burema J (1996): Nutrition knowledge and attitudes towards high-fat foods and low-fat alternatives in three generations of women. *Eur. J. Clin. Nutr.* **50**, 33—41.

Steenhuis IHM, Brug J, Van Assema P & Imbos Tj (1996): The validation of a test to measure knowledge about the fat content of food products. *Nutr. and Health* **10**, 331—339.

Streiner DL & Norman GR (1992): *Health Measurement Scales: A Practical Guide to Their Development and Use*. Oxford: Oxford University Press.

Towler G & Shepherd R (1990): Development of a nutritional knowledge questionnaire. *J. Hum. Nutr. Diet.* **3**, 255—264.

WHO (1990): *Diet, Nutrition and the Prevention of Chronic Diseases*. WHO Technical Report Series 797. Geneva: WHO.

Appendix 1

Nutrition survey

This is a survey, *not* a test. Your answers will help identify which dietary advice people find confusing.

1. It is important that you complete it by yourself.
2. Your answers will remain anonymous.
3. If you do not know the answer, mark 'not sure' rather than guess.

The first few items are about what advice you think experts are giving us

1 Do you think health experts recommend that people should be eating more, the same amount, or less of these foods? *(tick one box per food)*

	More	Same	Less	Not sure
Vegetables	☐	☐	☐	☐
Sugary foods	☐	☐	☐	☐
Meat	☐	☐	☐	☐
Starchy foods	☐	☐	☐	☐
Fatty foods	☐	☐	☐	☐
High fibre foods	☐	☐	☐	☐
Fruit	☐	☐	☐	☐
Salty foods	☐	☐	☐	☐

2 How many servings of fruit and vegetables a day do you think experts are advising people to eat? (One serving could be, for example, an apple or a handful of chopped carrots)

. . . . . .

3 Which fat do experts say is most important for people to cut down on? *(tick one)*

(a) monounsaturated fat ☐
(b) polyunsaturated fat ☐
(c) saturated fat ☐
(d) not sure ☐

4 What version of dairy foods do experts say people should eat? *(tick one)*

(a) full fat ☐
(b) lower fat ☐
(c) mixture of full fat and lower fat ☐
(d) neither, dairy foods should be cut out ☐
(e) not sure ☐

Experts classify foods into groups. We are interested to see whether people are aware of what foods are in these groups

1 Do you think these are *high or low in added sugar*? *(tick one box per food)*

	High	Low	Not sure
Bananas	☐	☐	☐
Unflavoured yoghurt	☐	☐	☐
Ice-cream	☐	☐	☐
Orange squash	☐	☐	☐
Tomato ketchup	☐	☐	☐
Tinned fruit in natural juice	☐	☐	☐

2 Do you think these are *high or low in fat*? *(tick one box per food)*

	High	Low	Not sure
Pasta (without sauce)	☐	☐	☐
Low fat spread	☐	☐	☐
Baked beans	☐	☐	☐
Luncheon meat	☐	☐	☐
Honey	☐	☐	☐
Scotch egg	☐	☐	☐
Nuts	☐	☐	☐
Bread	☐	☐	☐
Cottage cheese	☐	☐	☐
Polyunsaturated margarine	☐	☐	☐

3 Do you think experts put these in the *starchy foods* group? *(tick one box per food)*

	Yes	No	Not sure
Cheese	☐	☐	☐
Pasta	☐	☐	☐
Butter	☐	☐	☐
Nuts	☐	☐	☐
Rice	☐	☐	☐
Porridge	☐	☐	☐

4 Do you think these are *high or low in salt*? *(tick one box per food)*

	High	Low	Not sure
Sausages	☐	☐	☐
Pasta	☐	☐	☐
Kippers	☐	☐	☐
Red meat	☐	☐	☐
Frozen vegetables	☐	☐	☐
Cheese	☐	☐	☐

5 Do you think these are *high or low in protein*? *(tick one box per food)*

	High	Low	Not sure
Chicken	☐	☐	☐
Cheese	☐	☐	☐
Fruit	☐	☐	☐
Baked beans	☐	☐	☐
Butter	☐	☐	☐
Cream	☐	☐	☐

6 Do you think these are *high or low in fibre/roughage*? *(tick one box per food)*

	High	Low	Not sure
Cornflakes	☐	☐	☐
Bananas	☐	☐	☐
Eggs	☐	☐	☐
Red Meat	☐	☐	☐
Broccoli	☐	☐	☐
Nuts	☐	☐	☐
Fish	☐	☐	☐
Baked potatoes with skins	☐	☐	☐
Chicken	☐	☐	☐
Baked beans	☐	☐	☐

7 Do you think these fatty foods are *high or low in saturated fat*? *(tick one box per food)*

High	Low	Not sure	
Mackerel	☐	☐	☐
Whole milk	☐	☐	☐
Olive oil	☐	☐	☐
Red meat	☐	☐	☐
Sunflower margarine	☐	☐	☐
Chocolate	☐	☐	☐

8 Some foods contain a lot of fat but no cholesterol.

(a) agree ☐
(b) disagree ☐
(c) not sure ☐

9 Do you think experts call these *a healthy alternative to red meat*? *(tick one box per food)*

Yes	No	Not sure	
Liver pate	☐	☐	☐
Luncheon meat	☐	☐	☐
Baked beans	☐	☐	☐
Nuts	☐	☐	☐
Low fat cheese	☐	☐	☐
Quiche	☐	☐	☐

10 A glass of unsweetened fruit juice counts as a helping of fruit.

(a) agree ☐
(b) disagree ☐
(c) not sure ☐

11 Saturated fats are mainly found in:*(tick one)*

(a) vegetable oils ☐
(b) dairy products ☐
(c) both (a) and (b) ☐
(d) not sure ☐

12 Brown sugar is a healthy alternative to white sugar.

(a) agree ☐
(b) disagree ☐
(c) not sure ☐

13 There is more protein in a glass of whole milk than in a glass of skimmed milk.

(a) agree ☐
(b) disagree ☐
(c) not sure ☐

14 Polyunsaturated margarine contains less fat than butter.

(a) agree ☐
(b) disagree ☐
(c) not sure ☐

15 Which of these breads contain the most vitamins and minerals? *(tick one)*

(a) white ☐
(b) brown ☐
(c) wholegrain ☐
(d) not sure ☐

16 Which do you think is higher in calories: butter or regular margarine? *(tick one)*

(a) butter ☐
(b) regular margarine ☐
(c) both the same ☐
(d) not sure ☐

17 A type of oil which contains mostly monounsaturated fat is: *(tick one)*

(a) coconut oil ☐
(b) sunflower oil ☐
(c) olive oil ☐
(d) palm oil ☐
(e) not sure ☐

18 There is more calcium in a glass of whole milk than a glass of skimmed milk.

(a) agree ☐
(b) disagree ☐
(c) not sure ☐

19 Which *one* of the following has the most calories for the same weight? *(tick one)*

(a) sugar ☐
(b) starchy foods ☐
(c) fibre/roughage ☐
(d) fat ☐
(e) not sure ☐

20 Harder fats contain more: *(tick one)*

(a) monounsaturates ☐
(b) polyunsaturates ☐
(c) saturates ☐
(d) not sure ☐

21 Polyunsaturated fats are mainly found in: *(tick one)*

(a) vegetable oils ☐
(b) dairy products ☐
(c) both (a) and (b) ☐
(d) not sure ☐

The next few items are about choosing foods

Please answer what is being asked and not whether you like or dislike the food!

For example, suppose you were asked . . . . . .

'If a person wanted to cut down on fat, which cheese would be best to eat?'

(a) cheddar cheese
(b) camembert
(c) cream cheese
(d) cottage cheese

If you didn't *like* cottage cheese, but knew it was the right answer, you would still tick cottage cheese.

1 Which would be the best choice for a low fat, high fibre snack? *(tick one)*

(a) diet strawberry yoghurt ☐
(b) raisins ☐
(c) muesli bar ☐
(d) wholemeal crackers and cheddar cheese ☐

2 Which would be the best choice for a low fat, high fibre light meal? *(tick one)*

(a) grilled chicken ☐
(b) cheese on wholemeal toast ☐
(c) beans on wholemeal toast ☐
(d) quiche ☐

3 Which kind of sandwich do you think is healthier? *(tick one)*

(a) two *thick* slices of bread with a *thin* slice of cheddar cheese filling ☐
(b) two *thin* slices of bread with a *thick* slice of cheddar cheese filling ☐

4 Many people eat spaghetti bolognese (pasta with a tomato and meat sauce). Which do you think is healthier? *(tick one)*

(a) a *large amount* of pasta with a *little* sauce on top ☐
(b) a *small amount* of pasta with a *lot* of sauce on top ☐

5 If a person wanted to reduce the amount of fat in their diet, which would be the best choice? *(tick one)*

(a) steak, grilled ☐
(b) sausages, grilled ☐
(c) turkey, grilled ☐
(d) pork chop, grilled ☐

6 If a person wanted to reduce the amount of fat in their diet, but didn't want to give up chips, which one would be the best choice? *(tick one)*

(a) thick cut chips ☐
(b) thin cut chips ☐
(c) crinkle cut chips ☐

7 If a person felt like something sweet, but was trying to cut down on sugar, which would be the best choice? *(tick one)*

(a) honey on toast ☐
(b) a cereal snack bar ☐
(c) plain Digestive biscuit ☐
(d) banana with plain yoghurt ☐

8 Which of these would be the healthiest pudding? *(tick one)*

(a) baked apple ☐
(b) strawberry yoghurt ☐
(c) wholemeal crackers and cheddar cheese ☐
(d) carrot cake with cream cheese topping ☐

9 Which cheese would be the best choice as a lower fat option? *(tick one)*

(a) plain cream cheese ☐
(b) Edam ☐
(c) cheddar ☐
(d) Stilton ☐

10 If a person wanted to reduce the amount of salt in their diet, which would be the best choice? *(tick one)*

(a) ready made frozen shepherd's pie ☐
(b) gammon with pineapple ☐
(c) mushroom omelette ☐
(d) stir fry vegetables with soy sauce ☐

This section is about health problems or diseases

1 Are you aware of any major health problems or diseases that are related to a *low intake of fruit and vegetables*?

(a) yes ☐
(b) no ☐
(c) not sure ☐

If yes, what diseases or health problems do you think are related to a low intake of fruit and vegetables?

. . . . . .
. . . . . .
. . . . . .

2 Are you aware of any major health problems or diseases that are related to a *low intake of fibre*?

(a) yes ☐
(b) no ☐
(c) not sure ☐

If yes, what diseases or health problems do you think are related to sugar?

. . . . . .
. . . . . .
. . . . . .

3 Are you aware of any major health problems or diseases that are related to *how much sugar* people eat?

(a) yes ☐
(b) no ☐
(c) not sure ☐

If yes, what diseases or health problems do you think are related to sugar?

. . . . . .
. . . . . .
. . . . . .

4 Are you aware of any major health problems or diseases that are related to *how much salt* or sodium people eat?

(a) yes ☐
(b) no ☐
(c) not sure ☐

If yes, what diseases or health problems do you think are related to salt?

. . . . . .
. . . . . .
. . . . . .

5 Are you aware of any major health problems or diseases that are related to the *amount of fat* people eat?

(a) yes ☐
(b) no ☐
(c) not sure ☐

If yes, what diseases or health problems do you think are related to fat?

. . . . . .
. . . . . .
. . . . . .

6 Do you think these help to reduce the chances of getting certain kinds of cancer? *(answer each one)*

	Yes	No	Not sure
eating more fibre	☐	☐	☐
eating less sugar	☐	☐	☐
eating less fruit	☐	☐	☐
eating less salt	☐	☐	☐
eating more fruit and vegetables	☐	☐	☐
eating less preservatives/additives	☐	☐	☐

7 Do you think these help prevent heart disease? *(answer each one)*

	Yes	No	Not sure
eating more fibre	☐	☐	☐
eating less saturated fat	☐	☐	☐
eating less salt	☐	☐	☐
eating more fruit and vegetables	☐	☐	☐
eating less preservatives/additives	☐	☐	☐

8 Which *one* of these is more likely to raise people's blood cholesterol level? *(tick one)*

(a) antioxidants ☐
(b) polyunsaturated fats ☐
(c) saturated fats ☐
(d) cholesterol in the diet ☐
(e) not sure ☐

9 Have you heard of *antioxidant* vitamins?

(a) yes ☐
(b) no ☐

10 If YES to question 9, do you think these are *antioxidant* vitamins? *(answer each one)*

	Yes	No	Not sure
Vitamin A	☐	☐	☐
B Complex Vitamins	☐	☐	☐
Vitamin C	☐	☐	☐
Vitamin D	☐	☐	☐
Vitamin E	☐	☐	☐
Vitamin K	☐	☐	☐

Finally, we would like to ask you a few questions about yourself

1 Are you male or female?

(a) Male ☐
(b) Female ☐

2 How old are you?

(a) less than 18 ☐
(b) 18–24 ☐
(c) 25–34 ☐
(d) 35–44 ☐
(e) 45–54 ☐
(f) 55–64 ☐
(g) 65–74 ☐
(h) more than 75 ☐

3 Are you:

(a) single ☐
(b) married ☐
(c) living as married ☐
(d) separated ☐
(e) divorced ☐
(f) widowed ☐

4 What is your ethnic origin?

(a) White ☐
(b) Black Caribbean ☐
(c) Black African ☐
(d) Black other ☐
(e) Indian ☐
(f) Pakistani ☐
(g) Bangladeshi ☐
(h) Chinese ☐
(i) Asian – other ☐
Please specify:
.....
j) Any other ethnic group ☐
Please specify:
.....

5 Do you have any children?

(a) No ☐
(b) 1 ☐
(c) 2 ☐
(d) 3 ☐
(e) 4 ☐
(f) more than 4 ☐

6 Do you have any children, under 18 years, living with you?

(a) Yes ☐
(b) No ☐

7 What is the highest level of education you have completed?

(a) primary school ☐
(b) secondary school ☐
(c) O levels/GCSEs ☐
(d) A levels ☐
(e) Technical or trade certificate ☐
(f) Diploma ☐
(g) Degree ☐
(g) Post-graduate degree ☐

8 Do you have any health or nutrition related qualifications?

(a) Yes ☐
Please specify:
.....
(b) No ☐

9 What is your job? *If you are not working now, what is your usual job? (please be specific).*

.....

.....

10 If you have a partner, what is his/her job? *If he/she is not working now, what is his/her usual job? (please be specific):*

. . . . . .

. . . . . .

11 Are you currently:

(a) employed full time ☐
(b) employed part time ☐
(c) unemployed ☐
(d) full time homemaker ☐
(e) retired ☐
(f) student ☐
(g) disabled or too ill to work ☐

12 Are you on a special diet?

(a) Yes ☐
Please specify:
. . . . . .
(b) No ☐

THE END

Thank you very much for your time.

If there are any comments you would like to make about this questionnaire, please do so below, they would be very welcome.

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

Fat-Related Diet Habits Questionnaire
I. Interviewer Administered Format

Please consider your food choices over the past MONTH
In the past month…

			Usually	Often	Some-times	Rarely or Never	REF
1.	Did you eat chicken?						
	1 YES →	When you ate chicken					
	2 NO	1a. How often was it fried?					
	3 NA/REF	(READ 1 – 4)	1	2	3	4	ref
		1b. How often did you remove the skin? (READ 1 – 4)	1	2	3	4	ref
2.	Did you eat red meat such as beef, pork or lamb?						
	1 YES →	When you ate red meat					
	2 NO	2a. How often did you trim all the visible fat? (READ RESPONSES IF NECESSARY)	1	2	3	4	ref
	3 NA/REF						
3.	Did you eat ground meat?						
	1 YES →	When you ate ground meat					
	2 NO	3a. How often was it extra lean?	1	2	3	4	ref
	3 NA/REF						
4.	Did you eat fish?						
	1 YES →	When you ate fish					
	2 NO	4a. How often was it fried?	1	2	3	4	ref
	3 NA/REF						
5.	Did you have at least one vegetarian dinner or main meal – that is, without meat, fish, eggs or cheese?						
	1 YES →	5a. How often did you have a					
	2 NO	vegetarian dinner?	1	2	3	4	ref
	3 NA/REF						
6.	Did you eat spaghetti or noodles?						
	1 YES →	When you ate spaghetti or noodles					
	2 NO	6a. Were they plain, or with a red					
	3 NA/REF	or tomato sauce without meat?	1	2	3	4	ref
7.	Did you eat cooked vegetables?						
	1 YES →	When you ate cooked vegetables					
	2 NO	7a. How often did you add butter,					
	3 NA/REF	margarine or other fat?	1	2	3	4	ref
		7b. How often were they fried?	1	2	3	4	ref

In the past month…

			Usually	Often	Some-times	Rarely or Never	REF
8.	Did you eat potatoes? 1 YES → When you ate potatoes 2 NO 8a. How often were they fried, like 3 NA/REF French fries or hash browns?		1	2	3	4	ref
9.	Did you eat baked or boiled potatoes? 1 YES → When you ate baked or boiled 2 NO potatoes 3 NA/REF 9a. How often did you eat them without any butter, margarine or sour cream?		1	2	3	4	ref
10.	Did you eat green salads? 1 YES → When you ate green salads 2 NO 10a. How often did you use no 3 NA/REF dressing?		1	2	3	4	ref
	10b. How often did you use low-fat or non-fat dressing?		1	2	3	4	ref
11.	Did you eat bread, rolls or muffins? 1 YES → When you ate bread, rolls or muffins 2 NO 11a. How often did you eat them 3 NA/REF without butter or margarine?		1	2	3	4	ref
12.	Did you drink milk or use milk on cereal? 1 YES → When you had milk 2 NO 12a. How often was it 1% or nonfat 3 NA/REF milk?		1	2	3	4	ref
13.	Did you eat cheese, including on sandwiches or in cooking? 1 YES → When you ate cheese 2 NO 13a. How often was it specially-made 3 NA/REF low-fat cheese??		1	2	3	4	ref
14.	Did you eat dessert? 1 YES → When you ate dessert 2 NO 14a. How often did you eat only 3 NA/REF fruit?		1	2	3	4	ref

In the past month…

		Usually	Often	Some-times	Rarely or Never	REF
15.	Did you eat home-baked cookies, cakes or pies? 1 YES → When you ate home-baked cookies, cakes or pies 2 NO 3 NA/REF 15a. How often were they made with less butter, margarine or oil than the recipe called for?	1	2	3	4	ref
16.	Did you eat frozen desserts like ice cream or sherbet? 1 YES → When you ate frozen desserts 2 NO 3 NA/REF 16a. How often did you choose frozen yogurt, sherbet or low-fat or non-fat ice cream?	1	2	3	4	ref
17.	Did you eat snacks between meals? 1 YES → When you ate snacks between meals 2 NO 3 NA/REF 17a. How often did you eat raw vegetables or fresh fruit?	1	2	3	4	ref
18.	Did you sauté or pan fry any foods? 1 YES → When you sautéed or pan fried foods 2 NO 3 NA/REF 18a. How often did you use Pam® or other non-stick spray instead of oil, margarine or butter?	1	2	3	4	ref
19.	Did you use mayonnaise or mayonnaise-type spread? 1 YES → When you used mayonnaise or mayonnaise type spread 2 NO 3 NA/REF 19a. How often did you choose low-fat or nonfat types?	1	2	3	4	ref
20.	Did you eat breakfast? 1 YES → When you ate breakfast 2 NO 3 NA/REF 20a. How often did you have fresh fruit?	1	2	3	4	ref
21.	Did you eat lunch? 1 YES → When you ate lunch 2 NO 3 NA/REF 21a. How often did you have one or more vegetables, not including potatoes or salad?	1	2	3	4	ref
22.	At dinner (or your main meal), how often did you have two or more vegetables, not including potatoes or salad?	1	2	3	4	ref

Fat-Related Diet Habits Questionnaire
II. Example of Self-Administered Format

MEAT, FISH AND MAIN DISHES

IN THE PAST 3 MONTHS...				Usually or Always	Often	Sometimes	Rarely or Never
1. Did you eat fish?							
No ☐	Yes ☐	→ When you ate fish, how often was it:					
		(*answer both*)	a. broiled, baked or poached?	1	2	3	4
			b. fried?	1	2	3	4
2. Did you eat chicken?							
No ☐	Yes ☐	→ When you ate chicken, how often did you:					
			a. have it broiled, or baked?	1	2	3	4
		(*answer all three*)	b. fried?	1	2	3	4
			c. take off the skin?	1	2	3	4
3. Did you eat spaghetti or noodles?							
No ☐	Yes ☐	→ When you ate spaghetti or noodles, how often did you eat them plain or with a tomato sauce without meat?		1	2	3	4
4. Did you eat red meat (beef, pork, lamb)?							
No ☐	Yes ☐	→ When you ate red meat, how often did you trim all the visible fat?		1	2	3	4

Fat-Related Diet Habits Questionnaire Eating Pattern Score Sheet

	QUESTION	RESPONSE
Factor 1 (Substitution)		
	10_b	_____
	12_a	_____
	13_a	_____
	15_a	_____
	16_a	_____
	18_a	_____
	19_a	_____
	Total	_____ + number answered = Factor 1 score _____
Factor 2 (Modify meat)		
	1_b	_____
	2_a	_____
	3_a	_____
	Total	_____ + number answered = Factor 2 score _____
Factor 3 (Avoid frying)		
	1_a*	_____
	4_a*	_____
	7_b*	_____
	8_a*	_____
	Total	_____ + number answered = Factor 3 score _____
Factor 4 (Replacement)		
	5_a	_____
	14_a	_____
	17_a	_____
	Total	_____ + number answered = Factor 4 score _____
Factor 5 (Avoid fat)		
	6_a	_____
	7_a*	_____
	9_a	_____
	10_a	_____
	11_a	_____
	Total	_____ + number answered = Factor 5 score _____

Summary score $\frac{\sum \text{Factors}}{5} =$ _____

*Reverse order scoring (done as follows: 1=4, 2=3, 3=2, 4=1). For example, a recorded score of 1 will be noted as a 4 on this score sheet, a 2 will be scored as a 3, and so on.
Items 14, 17, 20, 21, and 22 are used for vegetable-related dietary patterns. See: Satia JA, et al, Nutrition, *18:* 247-54, 2002, for more information.

References:

1. Kristal AR, Shattuck AL, and Henry HJ. Patterns of dietary behavior associated with selecting diets low in fat: reliability and validity of a behavioral approach to dietary assessment. J Am Diet Assoc 1990;90:214-20.

2. Kristal AR, White E, Shattuck AL, et al. Long-term maintenance of a low-fat diet: durability of fat-related dietary habits in the Women's Health Trial. J Am Diet Assoc 1992;92:553-9.

3. Kristal AR, Beresford SA, and Lazovich D. Assessing change in diet-intervention research. Am J Clin Nutr 1994;59:185S-9S.

4. Glasgow R, Perry JD, Toobert DJ, and Hollis JF. Brief assessments of dietary behavior in field settings. Addict Behav 1996;21:239-47.

5. Shannon J, Kristal AR, Curry SJ, and Beresford SA. Application of a behavioral approach to measuring dietary change: the fat- and fiber-related diet behavior questionnaire. Cancer Epidemiol Biomarkers Prev 1997;6:355-61.

6. Kristal AR, Shattuck AL, and Patterson RE. Differences in fat-related dietary patterns between black, Hispanic, and white women: Results from the Women's Health Trial Feasibility Study in Minority Populations. Public Health Nutr 1999;2:273-6.

7. Kristal AR, Curry SJ, Shattuck AL, Feng Z, and Li S. A randomized trial of a tailored, self-help dietary intervention: The Puget Sound Eating Patterns Study. Prev Med 2000;31:380-9.

Open Peer Review

Current Referee Status: ✓ ✓

Version 2

Referee Report 06 June 2014

doi:10.5256/f1000research.3993.r5020

Marjorie Freedman
Nutrition, Food Science, and Packaging, San José State University, San José, CA, USA

I have read this submission. I believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

Competing Interests: No competing interests were disclosed.

Referee Report 22 April 2014

doi:10.5256/f1000research.3993.r4049

John Mooney
School of Health and Related Research, University of Sheffield, Sheffield, UK

I confirm that satisfactory revisions have been made, thanks.

I have read this submission. I believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

Competing Interests: No competing interests were disclosed.

Version 1

Referee Report 18 February 2014

doi:10.5256/f1000research.2497.r3399

Marjorie Freedman[1], **Ashlee Gossard**[2]
[1] Nutrition, Food Science, and Packaging, San José State University, San José, CA, USA
[2] San José State University, San José, CA, USA

Thank you for the opportunity to review this paper. I have recently traveled to Greece and love traditional Greek food. It was distressing to read about low numbers of Greeks following a traditional Mediterranean diet, which has many health benefits. The authors are to be commended for undertaking this study in a worksite setting, aimed to lower fat intake. Overall, this research project represents a simple, non-invasive, low-cost method of attempting to improve health behaviors among a work force. It is unfortunate that the lack of evidence of significant change in actual health behavior is also typical of many such small-scale, short-term projects. The authors attempted to link change in knowledge with change in behavior. However, the literature is clear that change in knowledge alone is not sufficient to change behavior. The use of the Health Belief Model was presumably chosen to enhance motivation to change behaviors (even though over 60% of the population was at a normal weight, despite a “medium to large consumption of fatty foods.”). However, there was limited information presented in this paper as to how the constructs of the HBM were integrated into the classes presented to the employees. Did participants perceive any risks? Did they perceive susceptibility to a particular disease or to weight gain? This needs further explanation.

Additional issues that need to be addressed are as follows:

1. The Supplemental files (Q1 and Q2) are presented inversely from their description in text. The text indicates that the Knowledge questionnaire is File Q1, when it is in fact Q2, and the reverse is true for the Diet Habits questionnaire (actually Q1, listed as Q2 in text). [minor technicality]

2. Q1, Diet Habits, indicates that some portions of this questionnaire were administered by an interviewer, while other portions were self-administered by participants. However, in text no mention is made of interviewer participation in the questionnaire, indicating only that participants received explanation in the Phase I session how to complete the form; greater clarification of procedure is required here. Furthermore, social pressures and positive presentation bias during personal interviews with a study administrator could have resulted in participants misrepresenting (toward a "healthy" direction) the quantities and frequencies of the foods they consumed. Particularly if the pre-intervention diet habit assessment was done via personal interview while the post-intervention was done via self-completed questionnaire, changes in dietary habits post-intervention may not have been accurately captured. This could also possibly explain the apparent increase in consumption of fried foods post-intervention.

3. The diet habits questionnaire also asks participants about their food intake over the past month (~30 days) or 3 months; however, barely 30 days elapsed between the first day of intervention (Phase 2 - day 16) and the post-intervention questionnaire (Phase 4, day 45). If dietary changes are to be captured, either a shorter-term assessment (i.e. asking about intake over the past 2 weeks) or a greater delay between intervention and post-assessment should be considered.

4. The authors note that some participants took vacations during the intervention/assessment period. Given the typical deviations from "normal" dietary habits that many people enjoy on vacation, and the recency (within the past month) of the diet habits questionnaire, this factor may function as a greater confounding variable in the observed lack of change in diet habits than the authors acknowledge.

5. The 45-minute primary intervention lecture (Phase 2) was based on the Health Belief model, and it is the authors' claim that the HBM (which links beliefs and perceptions about health behaviors/risks to an individual's personal level of risk and his/her ability to control that risk through healthier behaviors) is an effective way to approach behavior change. However, Section 4 of the Knowledge questionnaire, which addresses the Diet-Health relationship, showed the least significant change

following the intervention. Therefore, either the intervention lectures did not adequately target this subsection of knowledge, or else the participants were resistant to learning in this area for other reasons. The Discussion section, addressing the lack of observed behavior change, would be strengthened by acknowledging that the supposedly most critical piece of effecting behavior change was apparently not adequately targeted by the intervention, as evidenced by the lack of change in knowledge in this area. In addition, 61% of participants were normal weight. Thus, it is unclear why the authors chose the Health Belief Model, and how the intervention was tailored to address perceived risk, perceived susceptibility, perceived barriers or perceived benefits.

6. [another technicality/clarification] Table 4 (comparison of dietary habits) would be improved with a caption or footnote clarifying that a *lower* score on this assessment indicates *improved/more healthy* eating habits.

We have read this submission. We believe that we have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however we have significant reservations, as outlined above.

Competing Interests: No competing interests were disclosed.

Referee Report 23 October 2013

doi:10.5256/f1000research.2497.r1969

John Mooney
School of Health and Related Research, University of Sheffield, Sheffield, UK

Many thanks for the opportunity to review this paper. Tanagra and colleagues present a concise, interesting and well discussed piece of research on their attempts to improve dietary practices in the workplace, using a 'health belief model' approach to improving awareness in the first instance of the main components of a healthy diet and food items which it is advisable to consume more sparingly (e.g. fried food). I particularly liked the focus for the most part on blue collar occupational groups and the relative homogeneity of the target population. This holds promise for being able to target higher risk occupational groups that are known to be less receptive to health promotion type interventions.

It is relatively well established among advocates of public health interventions, however, that changing actual behaviour is a much greater challenge than improving awareness of risk factors, particularly around diet and eating practices. While the contrast between the improved knowledge and no real benefit in behaviour is certainly of interest in this well controlled setting, it is not a terribly surprising or novel finding in its own right. As the authors themselves also point out, this is a study population which already has a relatively healthy diet, so their scope for encouraging and achieving improvements is necessarily limited. The narrow sample characteristics of the sub-group participating in the post-intervention follow-up (90% women) also restricts any meaningful inferences around the influence of gender and occupational group (a fact also acknowledged by the authors).

My most significant misgiving about the article in its present form however surrounds the established limitations of the 'health belief model' as applied to preventative public health interventions:

"*The HBM is more descriptive than explanatory, and does not suggest a strategy for changing health-related actions. In preventive health behaviors, early studies showed that perceived susceptibility,*

benefits, and barriers were consistently associated with the desired health behavior; perceived severity was less often associated with the desired health behavior. The individual constructs are useful, depending on the health outcome of interest, but for the most effective use of the model it should be integrated with other models that account for the environmental context and suggest strategies for change."

[Extract from Boston University MPH content around 'Limitations of the Health Belief Model'; http://sph.bu.edu/otlt/MPH-Modules/SB/SB721-Models/SB721-Models2.html].

The call for looking at the environmental context in particular suggests a potential missed opportunity within the current study to examine the characteristics and quality of food catering within the workplace itself.

Overall, as stated at the outset, I think this is an elegant and well-presented piece of research which certainly deserves to be published, but ideally needs some additional discussion around some of its methodological drawbacks. While the authors have acknowledged the short duration and sample size issues, there could be more discussion of desirability bias in self-reporting and 'healthy-worker' effects, the latter of which almost certainly will have diminished their scope for demonstrating improvements. Those relatively minor issues aside, there does need to be a fuller consideration of the limitations of the health belief model and the slightly confusing absence of any details on the types of catering and foods available within the workplace itself. In terms of specific essential revisions, I would suggest:

1. Demographic characteristics (Table 2): the addition of a section within 'individual characteristics' on how this population compares with the general Greek population on BMI and smoking etc.

2. Acknowledgement of the drawbacks of HBM and some description of the catering opportunities within the workplace itself, and if there are aspects of availability which could be improved to compliment the educational measures.

3. Some additional discussion around the drawbacks of self reporting and to what extent other back-up measures, such as 24 hour recall diaries, had been considered to enhance and substantiate the quality of the data gathered.

I have read this submission. I believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

Competing Interests: No competing interests were disclosed.