Best practice in the delivery of personalised nutrition: is less more?

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18/11/15
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• Personalised nutrition could offer an effective way of producing healthy dietary-related behaviour change;
• Uncertainty as to whether receiving dietary health-related information has a positive or negative effect on dietary behaviour;
• Research required to determine effect of personalised nutrition intervention on psychological factors associated with behaviour change;

Is more, more? OR Is less more?
Qualitative - focus group discussion (N+22)

Questionnaire Development

Pilot Survey (n=50-100)

Proof of Principle (POP) baseline survey (N=320)

Pan European Survey (N=9000)

Post POP study follow-up and survey (n=?)

Comparison between the general population (Pan EU Survey) and those exposed to the benefits of PN (POP)
'You should want to do it yourself.' (Netherlands)

'Those who invest in themselves.'

'You do it tailored, as you want - you adapt it to your interests.'

'...I feel more comfortable when I have a doctor to tell me what to do, than do it myself.'
Research report

Factors influencing European consumer uptake of personalised nutrition. Results of a qualitative analysis

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A B S T R A C T

The aim of this research was to explore consumer perceptions of personalised nutrition and to compare these across three different levels of “medicalisation”: lifestyle assessment (no blood sampling); phenotypic assessment (blood sampling); genotypic assessment (blood and buccal sampling). The protocol was developed from two pilot focus groups conducted in the UK. Two focus groups (one comprising only “older” individuals between 30 and 60 years old, the other of adults 18–65 yrs of age) were run in the UK, Spain, the Netherlands, Poland, Portugal, Ireland, Greece and Germany (N = 26). The analysis (guided using grounded theory) suggested that personalised nutrition was perceived in terms of benefit to health and fitness and that convenience was an important driver of uptake. Negative attitudes were associated with internet delivery but not with personalised nutrition per se. Barriers to uptake were linked to broader technological issues associated with data protection, trust in regulator and service providers. Services that required a fee were expected to be of better quality and more secure. An efficacious, transparent and trustworthy regulatory framework for personalised nutrition is required to alleviate consumer concern. In addition, developing trust in service providers is important if such services to be successful.
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Post POP study follow-up and survey (n=?)

Pan European Survey (N=9000)
Questionnaire – volunteers aged 18-65 years (N=9381) in 9 EU countries

- Demographic profile
- Health Status
  - Dietary restrictions
- Personalised Nutrition:
  - Risk
  - Benefit
  - Preferences
  - Barriers
  - Trust
  - Goal orientation
  - Regulatory issues
  - Ethical issues
- Health Locus of Control (Gebhart, 2001)
- Eating Habit (Honkanen et al., 2005)
- Food Self-Efficacy (Schwarzer & Renner, 2000)
- Food Choice Questionnaire (Steptoe et al., 1995)
- Attitude (Adapted from Crites et al., 1994)
- Intention (Ajzen, 1991)
- Willingness to Pay
Figure 1 Standardized path coefficients Model vi in The Netherlands

Paths to Attitude
- Internal locus of control: [0.023, 0.063]
- Health commitment: [0.043, 0.087]
- Nutrition self-efficacy: [0.075, 0.115]
- Risk perception: [-0.121, -0.077]
- Benefit perception: [-0.623, 0.674]
- Perceived efficacy of control and regulation: [0.101, 0.145]

Paths to Intention
- Nutrition self-efficacy: [0.089, 0.133]
- Benefit perception: [0.223, 0.281]
- Attitude: [0.437, 0.499]

Psychological Determinants of Consumer Acceptance of Personalised Nutrition in 9 European Countries

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Abstract

Objective: To develop a model of the psychological factors which predict people’s intention to adopt personalised nutrition. Potential determinants of adoption included perceived risk and benefit, perceived self-efficacy, internal locus of control and health commitment.

Methods: A questionnaire, developed from exploratory study data and the existing theoretical literature, and including validated psychological scales was administered to N = 9381 participants from 9 European countries (Greece, Germany, Ireland, Poland, Portugal, Spain, the Netherlands, the UK, and Norway).

Results: Structural equation modelling indicated that the greater participants’ perceived benefits to be associated with personalised nutrition, the more positive their attitudes were towards personalised nutrition, and the greater their intention to adopt it. Higher levels of nutrition self-efficacy were related to more positive attitudes towards, and a greater expressed intention to adopt, personalised nutrition. Other constructs positively impacting attitudes towards personalised nutrition included more positive perceptions of the efficacy of regulatory control to protect consumers (e.g. information on personal data protection), higher self-reported internal health locus of control, and health commitment. Although higher perceived risk had a negative relationship with attitude and an inverse relationship with perceived benefit, its effects on attitude and intention to adopt personalised nutrition was less influential than perceived benefit. The model was stable across the different European countries, suggesting that psychological factors determining adoption of personalised nutrition have generic applicability across different European countries.

Conclusion: The results suggest that transparent provision of information about potential benefits, and protection of consumers’ personal data is important for adoption, delivery of public health benefits, and commercialisation of personalised nutrition.

Introduction

Poor nutrition contributes to the incidence of many diseases, see inter alia, [1–5]. It has been estimated that approximately 80% of cases of cardiac disease, stroke, type 2 diabetes, and 40% of cancers could be avoided through improved lifestyle, including those related to diet [6]. However, there may be substantial genetically determined variation between individuals in what constitutes an optimal diet with regard to health protection [7]. Nutrigenomics is the study of the effects of foods and food constituents on gene expression and health. Personalised nutrition, or personalised dietary advice, which can also be based on an individual’s genotype, can be translated into personalised dietary recommendations [8–9]. The advantage of nutrigenomics-based nutrition advice over and above that based on age, sex, body mass index (BMI), diet, physical activity and health status, is that genetic differences between individuals, which may interact with phenotype and covariate health impacts of dietary choices, are explicitly taken into account [10]. Various commercially internet based personalised nutrition and nutrigenomics based personalised dietary advice services are currently, and increasingly, available commercially [11], although consumer acceptance of
Qualitative - focus group discussion (N+22)

Questionnaire Development

Pilot Survey (n=50-100)

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Pan European Survey (N=9000)

Post POP study follow-up and survey (n=?)

Comparison between the general population (Pan EU Survey) and those exposed to the benefits of PN (POP)
Aim and Objectives

Aim:
- establish best practice in personalised nutrition for dietary behaviour change.

Objectives:
- determine the effect of non-personalised versus personalised dietary, phenotypic or genetic information on psychological constructs pertinent to behaviour change;
- compare the effect of the intensity of the above feedback on psychological constructs pertinent to behaviour change.
Level 0 – Standard Practice

- Public health (generic) advice based on healthy eating guidelines - no personalisation.
Level 1 – Diet and Anthropometry

- Demographic and Lifestyle;
- Family medical history;
- Anthropometry;
- Dietary practices and eating habits.
Demographic/lifestyle information plus:
– blood cholesterol;
– nutrient profile;
both assessed from a finger prick blood test.
Demographic, lifestyle and phenotypic information plus:

- Genetic assessment derived from a saliva sample.

Level 3 – Genotype
Intensity Levels

**Low Intensity**
- Personalised feedback three times during the intervention:
  - Baseline;
  - Month 3; and,
  - Month 6.

**High Intensity**
- Personalised feedback five times during the intervention:
  - Baseline;
  - Month 1;
  - Month 2;
  - Month 3; and,
  - Month 6.
### Table 1. Baseline characteristics of participants randomised into intervention and intensity feedback levels

<table>
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<th></th>
<th>All</th>
<th>Level 0</th>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>$P$ value $^a$</th>
<th>$P$ value $^b$</th>
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<td>n=387</td>
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<tr>
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<td>High</td>
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<tr>
<td>Age (y)</td>
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<td>39.8 (12.5)</td>
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<td>39.5 (13.1)</td>
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<td>39.1 (12.5)</td>
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<td>Male (%)</td>
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<td>42</td>
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<td>41</td>
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<td>Ethnicity ‡</td>
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<td>96</td>
<td>98</td>
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<td>BMI (kg/m²)</td>
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<td>26.3 (7.0)</td>
<td>25.0 (4.8)</td>
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<td>NSE ¹</td>
<td>3.23 (0.54)</td>
<td>3.20 (0.55)</td>
<td>3.27 (0.51)</td>
<td>3.22 (0.54)</td>
<td>3.18 (0.54)</td>
<td>3.25 (0.52)</td>
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<td>Internal HLoC</td>
<td>3.88 (0.68)</td>
<td>3.84 (0.70)</td>
<td>3.88 (0.64)</td>
<td>3.88 (0.62)</td>
<td>3.96 (0.73)</td>
<td>3.87 (0.69)</td>
<td>3.93 (0.67)</td>
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<tr>
<td>External HLoC</td>
<td>4.41 (0.57)</td>
<td>4.37 (0.57)</td>
<td>4.45 (0.54)</td>
<td>4.36 (0.57)</td>
<td>4.38 (0.59)</td>
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<td>Habit</td>
<td>3.30 (0.77)</td>
<td>3.30 (0.74)</td>
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<td>3.25 (0.78)</td>
<td>3.29 (0.81)</td>
<td>3.25 (0.81)</td>
<td>3.38 (0.75)</td>
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</table>

Data expressed as mean (SD) unless otherwise indicated. HLoC, Health Locus of Control; NSE, Nutrition Self-efficacy.
Statistical significance for comparison between $^a$ 4 treatment groups and $^b$ 7 treatment groups by one-way ANOVA or Chi-square as appropriate.

‡ % White.

¹ Data available for n=1568, Level 0: n= 373; Level 1: n=405, low: n=198, high: n=207; Level 2: n=395, low: n=191, high: n=204; Level 3: n=392, low: n=191, high: n=201.
Health Locus of Control (HLoC) (Gebhardt, 2001) - comprised of *internal* HLoC (health perceived in the control of the individual) and *external* HLoC (health perceived to be controlled by others or down to chance):

- High *external* locus of control - health less under own control - less likely to follow dietary advice;
- High *internal* loci of control – health more under own control - more likely to follow dietary advice.

• Does HLoC increase in response to personalised nutrition?
• Does intensity of feedback increase or reduce HLoC?
Nutrition Self-Efficacy (NSE) (Schwarzer & Renner, 2000) - Perceived ability to complete a specific task (Bandura, 1977) eg. Dietary behaviour change:

- Behaviour change most likely to occur if perceived self-efficacy high or increased in response to the intervention.
  - Does NSE increase in response to personalised nutrition?
  - Does the intensity of feedback increase or decrease nutrition self-efficacy?
• Social cognitive theory (SCT) holds that self-efficacy and perceived control are closely linked (Bandura, 1997);
• An individual with low self-efficacy and external HLoC, therefore, may respond less effectively to a dietary health intervention (Joost et al. 2007).
Self-Report Habit Index (SRHI) (Honkanen et al. 2005; Verplanken & Orbell, 2003) - refers to behaviours that are automatic or learned (Verplanken & Aarts, 1999):

• Habit could be important to sustained dietary health behaviour change;
  – Does habit strength increase in response to personalised nutrition?
  – Does the intensity of feedback increase or decrease habit strength?
Data analysis

- ANOVA compared the between the control (no personalised feedback) and treatment conditions – advice based on:
  - 1. diet and anthropometry;
  - 2. diet, anthropometry and phenotypic information (serum cholesterol, blood pressure etc.);
  - 3. diet, anthropometry, phenotypic and genetic information;

- and intensity – ie. frequency and depth of feedback (high/low).
Self-Report Habit Scale (S-RHS) treatment vs control post intervention

N=768

1. Diet/Anthropometry
2. Plus Phenotype
3. Plus Genotype
Total Sample

Pre-intervention
Post-intervention
Nutrition Self-Efficacy (NSE) treatment vs control post intervention

N=768

NSE

Pre-intervention
Post-intervention

0. Public Health Advice
1. Diet/Athropometry
2. Plus Phenotype
3. Plus Genotype
Total Sample
Health Locus of Control (NLoC) treatment vs control post intervention

N=768

External HLoC

- Pre-intervention
- Post-intervention
Health Locus of Control (HLoC) treatment vs control post intervention

<table>
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<th>N</th>
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<td>0. Public Health Advice</td>
<td>3.65</td>
<td>3.7</td>
<td>0.026</td>
<td>768</td>
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<td>1. Diet/Anthropometry</td>
<td>3.9</td>
<td>3.95</td>
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<tr>
<td>2. Plus Phenotype</td>
<td>4.0</td>
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<tr>
<td>3. Plus Genotype</td>
<td>3.95</td>
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<tr>
<td>Total Sample</td>
<td>3.85</td>
<td>3.9</td>
<td>0.026</td>
<td>768</td>
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</table>

P=0.026
Self-Report Habit Scale (S-RHS) post intervention and intensity level

Public Health Advice | Low Intensity | High Intensity | Total Sample
Pre-intervention | Post-intervention

P=0.047
Nutrition Self-Efficacy (NSE) post intervention and intensity level

<table>
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<th>Low Intensity</th>
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<td>3.6</td>
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Locus of Health Control (HLoC) post intervention and intensity level

External HLoC

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Pre-intervention vs Post-intervention
Health Locus of Control (HLoC) post intervention and intensity level

Internal HLOC

Pre-intervention
Post-intervention

Public Health Advice
Low Intensity
High Intensity
Total Sample
Conclusions

• **Self-Reported (Food) Habit:**
  – Lower in response to higher intensity feedback.

• **Internal Health Locus of Control (Hloc):**
  – Higher in those who received dietary plus phenotypic information (Level 2) compared to controls (level 0).
Is less more?

• Personalised dietary intervention should:
  – Provide lower intensity feedback to encourage habit;
  – Convey phenotypic (with dietary and anthropometric) information to encourage internal health locus of control.
Acknowledgements

This project has received funding from the European Union’s Seventh Framework Programme for research, technological development and demonstration under grant agreement n°265494.
An integrated analysis of opportunities and challenges for personalised nutrition.

Food4Me will consider all aspects of personalised nutrition; from investigating consumer understanding to producing technologies for implementation and investigating gene expression in response to diet.

Read more about the food4me project