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**Factors Influencing European Consumer Uptake of Personalised Nutrition:
Results of a Qualitative Analysis.**

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Running Head: Factors Influencing Uptake of Personalised Nutrition

33 **Abstract**

34 The aim of this research was to explore consumer perceptions of personalised nutrition
35 and to compare these across three different levels of “medicalization”: lifestyle
36 assessment (no blood sampling); phenotypic assessment (blood sampling); genomic
37 assessment (blood and bucal sampling). The protocol was developed from 2 pilot focus
38 groups conducted in the UK. Two focus groups (one comprising only “older” individuals
39 between 30-60 years old, the other of adults 18-65 years of age) were run in the UK,
40 Spain, the Netherlands, Poland, Portugal, Ireland, Greece and Germany (N=16). The
41 analysis (guided using grounded theory) suggested that personalised nutrition was
42 perceived in terms of benefit to health and fitness and that convenience was an
43 important driver of uptake. Negative attitudes were associated with internet delivery
44 but not with personalised nutrition *per se*. Barriers to uptake were linked to broader
45 technological issues associated with data protection, trust in regulator and service
46 providers. Services that required a fee were expected to be of better quality and more
47 secure. An efficacious, transparent and trustworthy regulatory framework for
48 personalised nutrition is required to alleviate consumer concern. In addition, developing
49 trust in service providers is important if such services to be successful.

50 **Keywords** Personalised nutrition; Nutrigenomics; Consumer; Qualitative; Barriers;
51 Acceptance; Focus group; Food4Me.

52 **Introduction**

53 There is evidence that healthy dietary choices may contribute to a substantial reduction
54 in disease incidence (Nishida et al., 2004) and it has been estimated that
55 approximately 80% of cases of cardiac disease, stroke, type 2 diabetes, and 40% of
56 cancers could be avoided through improved lifestyle choices, including those related to
57 diet (WHO 2011). There may be considerable variation between individuals in what

constitutes an optimal diet and, to some extent, these differences may be genetically determined (Madden et al., 2011).

Currently, nutritionists and dietitians personalise nutritional advice based on age, sex, body mass index (BMI), diet, physical activity and clinical picture (Boland, 2008). Such a strategy does not take account of genetic differences which may interact with phenotype and co-determine health impacts of dietary choices. A possible health promotion strategy may be to employ personalised nutrition (PN), which takes account of genetic differences between individuals, including how certain genes affect the risk of diet-related diseases (Kaput & Rodriguez, 2004) and various (primarily internet based) services are currently being offered commercially (Ronteltap et al., 2012).

Societal responses to the application of various technologies in the food sector have tended to attract greater controversy compared to applications of the same technology in medicine or some other non-food areas (Frewer et al., 2011). Societal negativity has frequently been driven by risk perceptions, such that technologies that are perceived to be risky, unnatural and uncontrollable are more likely to be rejected by the public (Fischhoff et al., 1978; Slovic, 1992). Many empirical investigations have focused on consumer perceptions about food technologies (Bredahl, 2001; Miles & Frewer, 2001; Sparks & Shepherd, 1994), where consumer rejection of applications is typically high. In the case of PN and nutrigenomics (the study of how different foods may interact with specific genes to increase the risk of common chronic diseases), consumers may perceive the application to be more closely linked to medicine than to food, and thus tolerate greater perceived risk and unnaturalness, as the benefits may also be perceived to be greater (Ronteltap et al., 2008; Ronteltap et al., 2007). Individual reactions to innovations in the food sector may be more favourable if associated with

84 tangible and personally relevant health benefits (Costa-Font & Mossialos, 2007;
85 Schenk et al., 2008). Stewart-Knox et al. (2008) surveyed more than 6000 consumers
86 about their attitudes to nutrigenomics across six European countries, and found that
87 individuals who were aware that they had health problems associated with the
88 metabolic syndrome appeared particularly favourable toward nutrigenomics-based
89 interventions. Similarly, Pin (2009) reports that if personalised nutrition was perceived
90 to benefit individuals, the consequences were perceived as more desirable which was
91 associated with strengthened intentions about taking a test and adopting a diet. From
92 this, it may be predicted that the more benefits (or risks) a person perceives to be
93 potentially derived from adoption of PN, the more positive (or negative) they will feel
94 about adopting it. In addition, cultural and social aspects of food and food choices vary
95 (Lennernäs et al., 1997), and may influence adoption of PN (Pin & Gutteling, 2008; Pin
96 et al., 2008). An important element of consumer/citizen acceptance of potentially
97 controversial technologies is that of trust, which may vary across different socio-
98 historical contexts (Frewer et al., 2011). Trust may refer to the governance and
99 regulatory systems put into place to optimise consumer protection (Van Kleef et al.,
100 2006), or to information providers delivering information about PN, as well as to those
101 organisations and businesses delivering services. Various researchers have examined
102 the impact of different types of citizen/consumer trust associated with technological
103 innovation, as well as its impact on other potentially influential determinants of
104 technology acceptance (*inter alia* van Kleef et al., 2006, Slovic et al., 2005). Trust in
105 information sources and opinion leaders may be particularly influential under
106 circumstances where attitudes are as yet inchoate, in particular in relation to the
107 formation of shared values (Fischer et al., in press). Generally, trust in scientific
108 governance has increased across Europe in recent years (Gaskell et al., 2011). In the
109 case of PN, trust in regulators, governance structures more generally, and service
110 providers may influence acceptance, particularly in relation to genetic testing, where
111 data storage and protection emerge as particularly salient issues (Castle & Ries, 2007).

Ethical, social and data protection questions associated with PN must be addressed (Rimbach & Minihane, 2009) in the context of direct-to-consumer genetic testing (Hogarth et al., 2008).. Various psychological and contextual barriers to uptake of PN may be identified (Ronteltap et al., 2009). For example, higher levels of perceived self-efficacy and control (Armitage & Conner, 1999), or regulatory focus (Sengupta & Zhou, 2007), may influence uptake. Concerns about privacy and data security may be relevant (Castle & Ries, 2007) and this may become more salient as the level of biometric data required for PN “assessment” is increased.

The aim of the research was to explore European citizens’ perspectives, attitudes, opinions, concerns and beliefs in relation to PN, as well as identify consumer priorities and preferences regarding provision of PN information and services.

Methods

Focus groups were used for generating data on the basis of their capacity to provide insights into participants’ perceptions of, and attitudinal consistency associated with, substantive issues that arise from both individual contributions and interactive exchanges (Barbour, 2007). The use of focus group methodology facilitated exploratory analysis in the hitherto not well understood area of public opinion towards PN.

Data exploring European consumers’ attitudes and opinions towards PN were collected in eight European countries: Ireland, University College Dublin (IE); United Kingdom, University of Reading (UK); Spain, University of Navarra (ES); Greece, Harokopio University Athens (GR); The Netherlands, Wageningen University (NL); Germany, Technical University Munich (DE); Poland, National Food and Nutrition Institute (PL);

and Portugal, University of Porto (PT). (As a different sampling profile for the focus group recruitment was used in Norway, these data will be reported separately). Country codes are adopted from ISO 3166. Ethical approval for the research was obtained by each participating institution.

Focus Group Protocol

To ensure internal consistency in the research approach across the eight contributing countries, a standardised focus group protocol (including focus group composition) was developed by a core of qualitatively experienced researchers from Ulster, Newcastle, Wageningen and Porto. Following ethical approval, two pilot focus groups were conducted in Newcastle during September 2011 in English, and the results used to further refine the protocol. Pilot data were not further used in the main analysis to ensure all data had been collected using an identical protocol. About one month prior to the focus groups being held (October 2011), a two day training course was provided to harmonise focus group moderation in participating centres. The research protocols were translated from English into the national languages of the centres responsible for the data collection and back-translated to ensure consistency in methodology was applied across all the centres.

Participants

One hundred and twenty six participants were recruited using social research agencies (UK, Spain, the Netherlands, Poland and Portugal) or through distributed flyers and/or posters displayed in public *fora* (Ireland, Greece and Germany). Two focus groups were conducted in each country. Each focus group comprised 6-10 free living, urban dwelling participants of a mix of sex and occupations within the groups. Individuals who were not healthy (according to their own definition) were excluded. Vulnerable

individuals, health professionals with an interest in food or diet, individuals with a background in genomics, nutrigenomics or personalised medicine, individuals who had previously taken part in research related to PN, or those who were regular focus group attendees were excluded. In each centre, one group comprised a mixed age profile (18-65), and one group comprised “older” individuals (30-65), to allow age or cohort specific issues to be investigated. Participant profiles were verified using a questionnaire administered to record sex, age, marital status, household size, number of dependents, and information about occupation, before the focus groups commenced (Table 1).

There were no significant differences in the distribution of sex ($X^2=0.40$, $df=7$, $p=1.00$) or age group ($X^2=38.85$, $df=35$, $p=0.30$; Monte Carlo approximation). Marital status did differ across countries, with Germany and Greece having more, and the Netherlands and Poland fewer, single individuals than expected ($X^2=14.98$, $df=7$, $p=0.03$; Monte Carlo approximation).

.....
Insert Table 1 here.
.....

Procedure

Following ethical approval, the main data collection phase occurred during November 2011, following the protocol to ensure a uniform procedure across all centres. Focus groups were held at convenient, neutral and private locations. Upon arrival, the participants were given a financial reimbursement of £30/€30 to cover time and travel expenses. Informed consent was obtained and the profile questionnaire administered. The discussions followed the protocol outlined in a semi-structured discussion guide (Table 2). The topic list included a general introduction/ warm up session focussing on the participants’ interest in health and food (based on 2 open-ended questions included at the end of the profile questionnaire). Following this, participants’ awareness and

spontaneous understanding of PN were explored. Participants were then asked to reflect upon the following definition “PN is healthy eating advice that is tailored to suit an individual based on their own personal health status, lifestyle and/or genetics”. The discussion moved onto three PN scenarios that sequentially introduced increasing levels of medicalization. No other information was provided.

.....
Insert Table 2 here
.....

Scenario 1 related to the provision of ‘*lifestyle*’ related data in which participants were asked to imagine and comment on a scenario where they wanted to change their diet to improve health through an on-line provider who requested the following information: name and e-mail address, gender, age, height, weight, food allergies and intolerance, own medical history, eating habits and physical activity levels.

Scenario 2 related to the provision of ‘*phenotypic*’ data in which participants were asked to provide supplementary data to Scenario 1 that included a home kit to collect information regarding waist and hip measurements and nutrient level from a finger prick blood test. The participants were shown an instruction leaflet on a prompt board describing how to take the blood samples (providing five blood spots on a card, which, once dry, was packaged and posted to the service provider).

Scenario 3 related to the provision of ‘*genotypic*’ data where in addition to the information supplied in scenario 1 and the blood spots in scenario 2, participants were asked to provide genetic information which could be obtained via a home kit using a cotton bud to collect buccal cells from the inside of the cheek. Information on the collection and packaging of this information was presented as above.

218

219 Ethical, legal and social issues that had not been spontaneously mentioned during the
220 focus groups were then prompted or clarified. Finally, the discussion focussed on the
221 future of PN services. Participants were then thanked and debriefed. The focus groups
222 each lasted approximately 1.5 hours, were audio-recorded, subsequently transcribed
223 *verbatim*, anonymised and (where appropriate) translated into English for analysis.

224 *Data Analysis*

225 The analysis followed a thematic approach (Gibbs, 2007). Preliminary data analysis
226 was conducted by four analysts from the universities of Ulster and Newcastle. First, the
227 analysts independently read, manually coded and annotated all 16 transcripts. The
228 coding followed an inductive approach best suited to the exploratory nature of the
229 research questions (Strauss & Corbin, 1998). Based on annotations and key codes,
230 response? patterns or themes were identified within and across the transcripts to form
231 an initial coding scheme (Denzin & Lincoln, 1994). The themes were discussed and a
232 thematic framework developed, which was further refined by multiple analysts
233 independently coding small passages of text and then comparing and discussing
234 coding decisions. After several iterative refinements, a sufficiently robust coding
235 scheme was established, indicated by agreement in the coding of small passages by
236 multiple analysts reaching acceptable inter-coder reliability (Cohen's kappa=0.67;
237 Landis and Koch, 1977). Subsequently, all 16 transcripts were coded in detail by a
238 single analyst using NVivo9 (QSR International Pty.). A thematic analysis of the coded
239 transcripts was conducted by analysts from Ulster and Newcastle Universities.

240

241 **Results**

242 *Sample Description*

Demographic composition was similar across focus groups and countries (Table 1). The average proportion of males to females was 46/54% the majority of whom (66.5 %) were married. The average proportion in each age category for focus group 1: 18-25 yrs = 21%; 26-30 yrs = 9.5%; 31-39 yrs = 20%; 40-49 yrs = 21%; 50-59 yrs = 18%; 60-65 yrs = 13%; and, for focus group 2 (older): 18-25 yrs = 0%; 26-30 yrs = 2%; 31-39 yrs = 24%; 40-49 yrs = 31%; 50-59 yrs = 22.5%; 60-65 yrs = 16%. The percentage of households who had children in focus group 1: 60%; 25%; 72%; 50%; 63%; 100%; 57%; 43%; and, for focus group two: 60%; 38%; 50%; 87%; 50%; 86%; 57%; 67%.

The results are presented in sections relating to the awareness and characterisations of PN; categories of potential PN users; discourses underpinning a PN service; and, specific concepts relating to the online delivery of a PN service. The themes reported arose in all countries included in the research.

Awareness and Characterisation of PN

Participants' expectations of the types of information required to support PN advice largely mirrored lifestyle assessment data (scenario 1). Awareness of PN that includes phenotypic (scenario 2) and genotypic data (scenario 3) was low by comparison. Although this suggests that people may require educative explanations of PN at higher levels of medicalization, the term 'personalised nutrition' appeared to have an intuitive logic:

'...it's designed to work within your lifestyle, to keep you at an optimum weight, [...] keep your body functioning properly. At the end of the day it's kind of designed around you rather than a generalisation.' (UK). Participants likened a PN service to existing forms of individualised advice related to food, diet, and lifestyle, e.g. 'personal coaches', 'nutrition counsellor or trainer' and 'nutrition consultant'. Conceptually, PN was perceived as being beneficial with a variety of potential users.

269

270 **Potential PN Users**

271 Three categories of potential PN user were inductively derived from the data and
272 classified according to primary motivating factors for using PN: 1) Health management
273 (disease prevention, particularly where there was genetic foreshadowing of chronic
274 illness, or the alleviation of symptoms associated with pre-existing health conditions):

275 *'I think that diet is not only for being slim, diet is health, because there's a lot of*
276 *lean people with very high cholesterol ... or intolerance to certain foods...'* (ES).

277 Weight reduction to improve health outcomes (rather than improve appearance) was
278 characteristic of this category. 2) Personal appearance – through changing or
279 perfecting body morphology via weight loss, weight gain or for aesthetic reasons such
280 as body building. 3) Athletic performance - to improve fitness and competitive
281 performance of 'committed athletes' such as marathon runners or cyclists.

282 *'I think it would be athletes..., maybe because they're ... not necessarily*
283 *wanting to lose weight but just to optimise how your [...] body's running ...'* (UK)

284 Motivations for PN use were, therefore, broader and more nuanced than health alone
285 and were recognised to be dependent on personal commitment to dietary change. A
286 lack of will power was recognised as a barrier to PN.

287 *'It still comes down to willpower as well, the individual. You can have the best diet*
288 *going but if you haven't got the willpower to stick to it'* (UK)

289 *'...you can arrange your life accordingly, but it takes a lot of will power to do that'*
290 (GR)

291

Participants identified further factors which might act as barriers to PN dietary changes including a dislike of recommended foods, reduced food choices and making multiple meals for different household members.

Personal Nutrition Service Discourses

Analysis of participant interpretations of a PN service revealed three thematic discourses associated with the concept of 'personal'. These include the relationships between 1) personal nutrition and personal contact; 2) personal contact and professional contact; and, 3) personal and private. These discourses underpin an understanding of attitudes to the on-line delivery of a PN service.

Personal nutrition = personal contact

Personal nutrition was suggestive of personal contact and the requirement for personal contact increased with successive levels of medicalisation. Face-to-face contact implied practical and emotional benefits. At a practical level, it denoted a perceived efficiency in assessing individual health status. This was revealed when participants compared the passive, on-line provision of health-related information to that provided by a health professional whose tacit knowledge and expertise could result in spontaneous and reactive interactions:

'...it can't be...tailored for me because that much information can't be in a questionnaire, I guess. What's balancing when you meet someone face-to-face for 15 minutes and who gets to know me, no questionnaire can compensate for this...' (DE)

315 *'For me it's important that there's the presence of a professional who examines*
316 *me...because face to face is important, to see one's symptoms, and all that...'*
317 (ES)

318 Medical expertise was also considered important for assisting with or supervising the
319 effective taking of blood and saliva samples, particularly where people doubted their
320 own competency or self-efficacy:

321 *'To be honest I think that doing these tests this way isn't very feasible...I think it*
322 *had to be a professional to do them....'* (PT)

323 *'I'm not an expert and I would give wrong results'.* (GR)

324 Personal contact provided emotional support, encouragement and the motivation to
325 follow a PN dietary plan. Such activities, that reduced the risk of failure, were also
326 interpreted as 'care':

327 *'someone to check...such as an instructor who takes care of us'* (PL)

328 *'...a confirmation of like, am I doing OK?'* (NL)

329 ***Personal contact = professional contact***

330 Personal contact was associated with appropriately qualified medical or nutrition
331 professionals. 'Professionals' were associated with perceptions of trust in the taking of
332 bio-samples and their handling and processing.

333 *'...if you give it to a general practitioner, then you know where it's going'* (NL)

334 *'...the nearest clinic it would be possible to take the test without worry about who*
335 *does it and where'* (PL)

336

337 ***Personal = private and protected***

An issue which emerged in the PN discourses centred on keeping personal data private and protected. Some participants expressed concerns related to the invasion of privacy and data security which increased with PN level. The linking of personal with biological data was of particular concern:

‘... information that is really personal, like DNA, [...] – as long as it doesn’t escape’ (DE)

‘If there’s no connection with surname ... phone number [...] I think I would prefer not to put all that there’ (PL)

A key personal strategy to protecting privacy was participant anonymity. This included a reluctance to supply names and addresses with personal data from lifestyle to genotypic. Concerns about privacy and data protection were accentuated when associated with an on-line PN service delivery format.

On-line PN Service Delivery: Perceived Risks and Benefits

During initial PN discussions, participants assumed that PN services would be provided through existing health service provision.

‘I think that it will have to be in the healthcare sector’ (IE)

‘so maybe either the National Health Fund could run it ... right?’ (PL)

This assumption provided a counterpoint to the perceived characteristics of on-line commercial PN service providers (Table 3). Perceived lack of self-efficacy in providing blood and buccal samples, and data protection, was amplified when participants considered an on-line method of PN service delivery. Trust was a defining concept underpinning concerns associated with the extended PN service chain, relating to, for example, the credibility and expertise of PN service staff; accountability and transparency in data management; and, the transport of bio-samples. Perceived

benefits associated with an on-line PN service related to privacy and relationship building.

Credibility of On-Line PN Staff

It was considered important that the PN provider website displayed their professional qualifications and credentials in order for on-line providers to be perceived as legitimate or credible;

‘.....[...]how, how accurate are they, how robust are they, you know what level of expertise is there, [...]there’s no qualification behind what you’re reading....’ ‘I suppose it would depend who I was dealing with and who was the name behind it. You don’t know who these people are [...]anybody can set up a website...’
(UK)

‘The first thing I’d so is to have information about whose behind all this.’ (ES)

Personal Contact - a Perceived Need

Although some participants expressed a preference for anonymity, it was deemed important that professionals were ‘easily’ available to provide assistance, even if they were not contacted. The framing of personal contact in terms of ‘difficult’ and ‘easy’ are indicative of the potential barriers and facilitators to interacting on-line:

‘It would be difficult to see how it be personalised if it is just an electronic relationship’ (IE)

‘I think that might be more difficult, because you’re talking to a machine. And get answers on that and communicating like that, is harder for me, than when I’m talking directly to someone if you have a problem....’ (NL)

387

388 *Continuity of Care and Relationship Building*

389 Continuity of care was considered essential in a PN service. Participants expressed a
390 preference for advice and support to be delivered by the same professional. A critical
391 issue appeared to be relationship building within the on-line environment. In relation to
392 this, participants suggested extending communication interactions through a variety of
393 on-line media and dedicated telephone lines:

394 *'... your personal assistant...to watch you during your participation in this*
395 *program...to have the same person...to know that I'm talking to my doctor' (GR)*

396 *'or some info line that you can ring up...'(PL)*

397 *Test Anxiety and Feedback Support*

398 Irrespective of whether in person or through other means, support was considered
399 essential to overcoming barriers relating to competency and self-efficacy associated
400 with the taking of blood and cheek cell samples at higher levels of PN medicalisation.
401 There was an expectation that high levels of support would accompany feedback to
402 reduce anxiety relating to phenotypic and genotypic results:

403 *'A place where there is an address and a telephone number that you can*
404 *investigate' (NL)*

405 *'There should be something... when you realize, after your own experimental*
406 *period, I can deal with this or not. Or with this and this aspect I can deal or not'*
407 *(DE)*

408

409 *Accountability in Data Management*

410 A commercially based delivery system was perceived to carry specific risks to users.
411 Foremost was the notion that the website would sell personal data for commercial gain,
412 or that personal data could be fraudulently 'hacked'.

413 *'you simply don't know about what happens with your data' (DE)*

414 *'for example, impersonated or someone hacked in' (PL)*

415

416 *Anonymity*

417 A perceived advantage of on-line PN service delivery was that the process, if properly
418 regulated, had the potential to afford greater privacy than that delivered off-line:

419 *'If you get on the internet you don't have to, like make yourself known' (NL)*

420 *'Because you want to keep something personal... (GR)*

421 Some discussants implied that they may be more likely to use on-line PN if the process
422 were anonymised:

423 *'Is it anonymous (PT)*

424 *'I might do it, if it would be like, anonymous, if you don't have to register...' (DE)*

425

426 *Transparency and Trustworthiness of Handling Bio-Samples*

427 The perceived inadequacy and lack of trust in postal services to reliably handle and
428 deliver biological samples effectively, safely and securely emerged as an issue in all
429 focus groups. Some of these concerns were experientially based.

430 *'when it goes by post, no one's going to carry it like an egg, it could get broken,*
431 *damaged, whatever' (PL)*

432 *'just the other day there was this story about mailmen not delivering like half of*
433 *the mail or ...it ends up in the ditch or in a container'* (NL)

434 Strategies to allay concerns about the transfer of samples (at genotype and phenotype
435 levels) included registered mail and courier services

436

437 *Paying for PN*

438 Participants related price to the quality of commercial PN services. Payment for PN
439 was associated with a greater likelihood of achieving the benefits sought, data
440 protection measures being in place, and increased probability of qualified individuals
441 being employed at the service end. Payment for the service provided a form of
442 validation, symbolised the quality of provision and provided a contractual and thus legal
443 right to redress:

444 *'... if it's cheap, we also think it will not be good...'* (SP)

445 *'... if you do not pay, then you have services of doubtful quality'* (GR)

446 Willingness to pay was related to benefit perceptions. Those who were unwilling to pay
447 tended not to perceive any added value of PN above those services provided by a GP.

448 *'If it is really about your health, then yes...I think it's a good idea to pay for it'* (NL)

449 *'Health was not for sale'* (PL)

450 However, genetic test results were deemed worthy of payment by others .

451 *'I'd be prepared to pay a bit more (genotype level)...'* (IE).

452 *'for this kind of stuff you have to pay because otherwise it wouldn't be trustworthy*
453 *at all'* (NL)

454

455

Insert Table 3 here

Discussion

There was little evidence of consumer rejection of the concept of PN *per se*. Negative perceptions appeared to be linked to the process of engagement with the technology, e.g. relating to storage of data, or trustworthiness or expertise of commercial companies. Consumer negativity towards food technologies is associated with greater perceptions of unnaturalness, catastrophic potential and involuntary exposure. In the case of PN, consumers are not, at least in the context of the present study, being asked to consume “unnatural” or novel foods, in particular those developed using novel technologies, but rather are asked to select, from those foods currently available, those which are the most appropriate for their individual or genetic profiles. While the use of human DNA to identify appropriate nutritional profiles may be regarded as a technological advance, it may be perceived as a medical application and, therefore, more “necessary”. In terms of involuntary exposure, adoption of PN is perceived as a matter of personal choice. There was no evidence of concerns regarding potentially catastrophic effects, where many people are negatively affected by the occurrence of an event. It is difficult to identify potentially catastrophic impacts of PN other than those associated with the loss of large quantities of personal data, which could be misused if they fell into the wrong hands. Discussants provided concrete expression of the potential benefits of genetic testing in general, and of PN in particular, for individual and public health. Future research may consider whether such benefits are traded off against perceived risk at the technological delivery interface. Similar results have been reported elsewhere (Ronteltap et al., 2009, genetic testing in both Rose et al., 2005; Bates et al., 2005; Catz et al., 2005, Skirton et al., 2006).

However, related to risk perception is the concept of “optimistic bias”, where an individual judges that negative events are less likely to affect the person making the

judgement in comparison to the risks experienced by an average member of society (Miles & Scaife, 2003; Weinstein, 1989). Discussants identified individuals who might benefit from PN (for example, those wanting to improve health or athletic importance, or reduce weight), who were also at risk from unhealthy eating practices. There was less evidence to suggest that discussants themselves would adopt PN, as it was perceived to apply to others who were at “greater risk”. This might operate as a barrier to improved public health through PN in the future, unless communication about benefits can be targeted to those individuals with potential to benefit specifically from its application.

A potentially influential issue which emerged from the data related to trust (see also Saba & Messina, 2003; Williams & Hammitt, 2001). Under circumstances where knowledge about an issue is limited, people tend to rely more strongly on risk managers to protect consumer health (Siegrist & Cvetkovich, 2000). Discussants tended to be more comfortable with nutrigenomics being provided by health professionals, in particular those working in the public sector, who are not motivated by financial gain. Van Kleef et al. (2006) have suggested that trust is increased if the “responsible authorities” engage in effective risk management activities which prioritise consumer protection over and above the economic interests of particular institutions or industries. Identification of a “named individual” to provide nutrigenomics advice, who is perceived to be interested in health rather than motivated by financial incentives, with associated authentication and/or certification, appears also to increase trust in the service.

Ethical issues raised did not appear to differ from those associated with genetic technologies generally. Most concerns appeared to focus on anonymisation of stored

personal data (in particular relating to genetic information) and potential misuse of such data by companies or through fraudulent acquisition. Developing ethically appropriate and societally acceptable guidelines for medical applications of genetic technologies (Knoppers & Chadwick, 2005) will allay ethical concerns about the development and application of nutrigenomics. Concerns about data security might be alleviated by displaying evidence that the service is authentic and providing a guarantee of data protection. Implementing consumer protection regulation about data protection, and communication with end-users about the implementation of such regulations, may build confidence in the governance framework associated with medical genetic technologies in general and PN in particular. Consumer confidence may be further enhanced if providers ensure that personal details and biological data are stored separately. In line with this, 'medicalization' of PN increased discussant concern, because of concerns about genetic privacy but also because of the requirement to self-sample blood and cheek cells. As this kind of sampling becomes more commonplace with advances in medical technologies, some of these concerns may dissipate. However, additional support, either on-line or by telephone, might reduce existing concerns regarding sampling. Discussants mentioned that the provision of a 24 hour support service (either by a telephone hotline or via the internet) would facilitate adherence and maintenance of PN recommendations, although the financial implications for service delivery would need to be assessed. Individual differences were identified regarding in the extent to which discussants thought that total anonymity, remote contact with identifiable health professionals, or face-to face contact with health professionals would be preferable, suggesting that different levels of contact may be required to be built in to PN services by service providers. Payment for services may further consumer confidence and enhance perceived control over the quality of the PN service provided. It was also suggested that, having paid for such a service, consumers may be more likely to provide honest information. At the same time, expensive fees would act as a barrier to uptake. The amount which people would be willing to pay for PN could be dependent

on factors such as household income and whether the service can be provided through existing health providers funded by taxation or insurance and this will be investigated in future research.

The potential convenience of being able to use the service at any time via the internet was also raised as a positive aspect of the service, although there may be individual differences in the extent to which this is regarded as a potential benefit. To maximise motivation and compliance, PN programmes should be integrated with the individuals' lifestyle and tailored to their specific motivations and efficacy.

From these data, it has not been possible to draw comparisons between the different EU states included in the study. Although it may be considered a strength to have data from different countries (and identifying as, in this case, agreement in all but attitudes linked to different national infrastructures), the low number of individuals recruited in each country (about 15-20 participants) results in difficulties in making direct comparisons between countries. It is arguable that the exploratory approach adopted here is invaluable in identifying key determinants of attitude. The analysis of differences between European countries will allow potential socio-cultural influences on dietary choices and socio-historical differences in regulatory systems to be identified.

The results are assumed to be derived from a sample of individuals with relatively low awareness of PN. The results might have been different in a sample with higher awareness of PN that included more knowledge about the use of phenotypic and genotypic data in PN delivery, and so the conclusion cannot be assumed to apply to the whole population. A further limitation of this research is that the methodology adopted (mixed focus groups) fails to assess the potential impact that education may have on knowledge about, and perceptions of perceptions of PN. This issue will be systematically assessed in the quantitative phase of the research.

564

565 **Conclusions**

566 European consumers appear to construe PN in terms of benefit to individual and public
567 health. Perceived risks are more closely linked to general concerns about privacy and
568 data security, and are not directly linked to PN. The development of an efficacious,
569 transparent, and trustworthy regulatory framework for human genetic technologies,
570 underpinned by the need to optimise human health and consumer protection, may
571 alleviate concerns. Developing trust in service providers is important, in particular
572 within the commercial sector. One possible barrier to adoption may be optimistic bias,
573 suggesting that communication should target those who potentially may benefit from
574 adopting PN, but who do not perceive that it will benefit them. This might include
575 younger consumers, as well as those without existing medical conditions. Promotion
576 might also focus on benefits for health and fitness, whilst simultaneously stressing the
577 convenience of the online service. Advice should be tailored to align with people's
578 lifestyles and preferences, including those related to food choices, motivational factors
579 and service delivery preferences. Cost may also determine uptake of PN. Cross-
580 cultural and demographic determinants of attitudes towards PN will be investigated in
581 future research.

582

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714 determinants.

Table 1: Sample description of participants across the focus groups

Country	<u>UK</u>		<u>Ireland</u>		<u>Greece</u>		<u>Netherlands</u>		<u>Spain</u>		<u>Poland</u>		<u>Portugal</u>		<u>Germany</u>	
Focus group	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
	n(%)	n(%)	n(%)	n(%)	n(%)	n(%)	n(%)	n(%)	n(%)	n(%)	n(%)	n(%)	n(%)	n(%)	n(%)	n(%)
	10	10	8	10	7	8	8	8	8	8	7	7	7	7	7	6
Male	5	5	3	5	3	4	4	3	4	4	3	3	3	3	4	2
	(50%)	(50%)	(38%)	(50%)	(43%)	(50%)	(50%)	(38%)	(50%)	(50%)	(43%)	(43%)	(43%)	(43%)	(57%)	(33%)
Female	5	5	5	5	4	4	4	5	4	4	4	4	4	4	3	4
	(50%)	(50%)	(63%)	(50%)	(57%)	(50%)	(50%)	(63%)	(50%)	(50%)	(57%)	(57%)	(57%)	(57%)	(43%)	(67%)
18-25 yrs	3	0	1	0	4	0	1	0	0	0	1	0	1	0	2	0
	(30%)	(0%)	(13%)	(0%)	(57%)	(0%)	(13%)	(0%)	(0%)	(0%)	(14%)	(0%)	(14%)	(0%)	(29%)	(0%)
26-30 yrs	2	0	0	0	1	0	0	0	0	0	1	0	1	0	1	1
	(20%)	(0%)	(0%)	(0%)	(14%)	(0%)	(0%)	(0%)	(0%)	(0%)	(14%)	(0%)	(14%)	(0%)	(14%)	(17%)
31-39 yrs	2	4	2	1	0	3	1	1	1	1	2	2	1	2	3	1
	(20%)	(40%)	(25%)	(10%)	(0%)	(38%)	(13%)	(13%)	(13%)	(13%)	(29%)	(29%)	(14%)	(29%)	(43%)	(17%)
40-49 yrs	2	2	1	3	0	1	3	2	3	3	1	2	2	3	1	3
	(20%)	(20%)	(13%)	(30%)	(0%)	(13%)	(38%)	(25%)	(38%)	(38%)	(14%)	(29%)	(29%)	(43%)	(14%)	(50%)
50-59 yrs	1	3	3	4	1	3	1	1	2	1	1	2	2	0	0	1
	(10%)	(30%)	(38%)	(40%)	(14%)	(38%)	(13%)	(13%)	(25%)	(13%)	(14%)	(29%)	(29%)	(0%)	(0%)	(17%)
60-65 yrs	0	1	1	0	1	1	2	4	2	3	1	1	1	0	0	0
	(0%)	(10%)	(13%)	(0%)	(14%)	(13%)	(25%)	(50%)	(25%)	(38%)	(14%)	(14%)	(14%)	(0%)	(0%)	(0%)
Married	5	9	7	5	1	5	6	7	5	6	6	6	5	6	2	3
	(50%)	(90%)	(88%)	(50%)	(14%)	(63%)	(75%)	(88%)	(63%)	(75%)	(86%)	(86%)	(71%)	(86%)	(29%)	(50%)
Single	5	1	1	3	6	3	2	1	3	2	1	1	2	1	5	3
	(50%)	(10%)	(13%)	(30%)	(86%)	(38%)	(25%)	(13%)	(38%)	(25%)	(14%)	(14%)	(29%)	(14%)	(71%)	(50%)

Children	12	11	5	8	10	6	11	14	9	8	12	7	6	6	6	5
	(60%)	(60%)	(25%)	(38%)	(72%)	(50%)	(50%)	(87%)	(63%)	(50%)	(100%)	(86%)	(57%)	(57%)	(43%)	(67%)

Table 2: Focus Group Topic Schedule

Topic	Schedule
<i>Introduction</i>	We'd like to begin the discussion by asking you how much attention you pay to your health? We'd also like to know how interested you are in food?
<i>Awareness and Understanding</i>	Has anyone heard of the term PN? We are interested to know what you understand by the term PN?
<i>PN Definition Provided</i>	'PN is healthy eating advice that is tailored to suit an individual based on their own personal health status, lifestyle and/or genetics'.
<i>PN Scenarios</i>	1. Lifestyle Data: sex; age; height; weight, food allergies and intolerance; medical history; eating habits; and physical activity levels. 2. Phenotypic Testing: Blood sample for nutrient levels (finger prick test), waist and hip circumference. 3. Genotypic Testing: DNA sample (via saliva from cheek swab).
<i>Ethical Issues</i>	We are interested in knowing if you have any issues to raise or concerns about how the information from the above scenarios might be used and stored? We are interested in knowing if you have any issues to raise or concerns about how your personal feedback is given or delivered to you? We are interested in knowing if you have any issues to raise or concerns about how the feedback information might be used by those seeking this service?'
<i>Finish</i>	Do you think this could be a successful service? Why? What would make it successful?

Table 3: Differences in PN Service Provision

	PN via Existing Healthcare Provider	PN via Commercial On-line Provider
Personal contact	<ul style="list-style-type: none"> - Pre-existing relationship - Face to face contact - Perceived accountability 	<ul style="list-style-type: none"> - Relationship building required - Opportunities to use multiple sources of social media to connect with PN provider - Potential lack of accountability
Professional contact	<ul style="list-style-type: none"> - Professional expertise is known/inferred, credible and trusted - Opportunity to use medical expertise/supervision 	<ul style="list-style-type: none"> - Expertise in unknown, lacking in credibility and therefore not trusted. - Self-efficacy required in taking biological samples - Price and service quality
Privacy	<ul style="list-style-type: none"> - No privacy, but pre-existing expertise with personal information and biological samples e.g. logistics associated with biological samples, data management 	<ul style="list-style-type: none"> - Possibility for anonymity - Perceived conflicts with commercial objectives and data protection - Perceived lack of transparency across service delivery supply chain - Reliance on unreliable/untrustworthy postal service for movement of biological samples