



The University of Bradford Institutional Repository

<http://bradscholars.brad.ac.uk>

This work is made available online in accordance with publisher policies. Please refer to the repository record for this item and our Policy Document available from the repository home page for further information.

To see the final version of this work please visit the publisher's website. Available access to the published online version may require a subscription.

Link to publisher's version: <http://eurpub.oxfordjournals.org/>

Citation: Fischer ARH, Berezowska A, van der Lans IA, Ronteltap A, Rankin A, Kuznesof S, Poinhos R, Stewart-Knox B and Frewer LJ (2016) Willingness to pay for personalised nutrition across Europe. *European Journal of Public Health*. Accepted for publication 2016.

Copyright statement: © 2016 Oxford University Press. Reproduced in accordance with the publisher's self-archiving policy.

This is a pre-copy-editing, author-produced PDF of an article accepted for publication in *European Journal of Public Health* following peer review. The definitive publisher-authenticated version, Fischer ARH, Berezowska A, van der Lans IA, Ronteltap A, Rankin A, Kuznesof S, Poinhos R, Stewart-Knox B and Frewer LJ (2016) Willingness to pay for personalised nutrition across Europe. *European Journal of Public Health*, is available online at: <http://eurpub.oxfordjournals.org/>

Willingness to pay for personalised nutrition across Europe

Arnout R.H. Fischer¹, Aleksandra Berezowska¹, Ivo A. van der Lans¹, Amber Ronteltap², Audrey Rankin³, Sharron Kuznesof⁴, Rui Poinhos⁵, Barbara Stewart-Knox⁶, Lynn J. Frewer⁴

1 Wageningen University, Marketing and Consumer Behaviour Group, The Netherlands
2 LEI Wageningen UR, The Netherlands
3 Ulster University, UK
4 Newcastle University, UK
5 Universidade do Porto, Portugal
6 University of Bradford, UK

Correspondence: Arnout R.H. Fischer, Hollandseweg 1, 6706KN Wageningen, the Netherlands, Tel: +31 317 483053, Fax: +31 317 484763; e-mail: arnout.fischer@wur.nl

Background: Personalised nutrition (PN) may promote public health. PN involves dietary advice based on individual characteristics of end users and can for example be based on lifestyle, blood and/or DNA profiling. Currently, PN is not refunded by most health insurance or health care plans. Improved public health is contingent on individual consumers being willing to pay for the service. **Methods:** A survey with a representative sample from the general population was conducted in eight European countries ($N = 8233$). Participants reported their willingness to pay (WTP) for PN based on lifestyle information, lifestyle and blood information, and lifestyle and DNA information. WTP was elicited by contingent valuation with the price of a standard, non-PN advice used as reference. **Results:** About 30% of participants reported being willing to pay more for PN than for non-PN advice. They were on average prepared to pay about 150% of the reference price of a standard, non-personalised advice, with some differences related to socio-demographic factors. **Conclusion:** There is a potential market for PN compared to non-PN advice, particularly among men on higher incomes. These findings raise questions to what extent personalized nutrition can be left to the market or should be incorporated into public health programs.

Introduction

Balanced nutrition is of paramount importance to public health. Today's foods are abundant and generally safe and of high quality. Nutrition does however also have more long term public health effects that tend to differ between individuals and countries in Europe.¹ Nutrition has different effects on individuals and food choices made in early life may impact health and quality of life decades from now.² With the ageing population and the growing impact of non-communicable health problems, long-term effects of healthier nutrition may have relevantly influence public health. Such long-term effects of nutrition that contribute to healthy ageing may differ between individuals. Potential public health improvement can only be achieved if individuals receive advice tailored to their personal nutritional needs, and if subsequently make the right food choices for their individual situation. Current advances in nutrition science and more specifically in nutrigenomics indicate that more specific information about an individual could be used to develop personalised nutrition (PN) advice that is tailored to individual needs.³ Increased personalisation requires more information about an individual, e.g. a blood sample to assess cholesterol levels, in order to suggest specific dietary recommendations. Genetic analysis can be applied to predict potential future nutritional needs, or to investigate how specific nutrients contribute to the healthiness of an individual's diet. PN advice is not only aimed at people that are already unhealthy or overweight. PN advice can contribute greatly to the prevention of health problems and even improve current health if no obvious health problems occur by providing suggestion for change in dietary behaviour based on nutritional needs of these individuals. Large scale adoption of PN advice by individuals can improve immediate and long term public health.

Nutrition advice aimed at curing nutrition related diseases is covered by most public health and health insurance systems. Currently, most health insurance companies or health service

providers, such as the UK NHS, or health care insurances in the Netherlands or Germany do not refund the cost of PN advice. PN advice is considered a preventive or health enhancement advice which at this moment in time is generally placed outside health care systems. Community support to high-risk populations is sometimes included, such as in diabetes prevention programs in the US;⁴ but individuals who are not part of a vulnerable group or patients are generally expected to organise nutrition advice themselves. Therefore, in the short term, adoption of PN depends on consumers' willingness to pay (WTP) for commercial PN advice. Various businesses across Europe have marketed PN as a viable opportunity, using a range of personalisation techniques and business models.⁵ The failure rate of these companies is however high, which may in part be because listed prices are more based on the incurred cost of more advanced personalisation methods than on a clear idea about *how much* consumers are willing to spend on PN advice at different levels of personalisation.⁶ Reasons why consumers may not be willing to pay more for PN advice requiring DNA or blood testing may be that consumers see potential privacy risks, or do not believe these additional, costly analyses will result in better advice.⁶

This article presents results from a survey that assessed people's WTP for PN based on three different levels of personal information: (i) lifestyle (food consumption and physical exercise pattern); (ii) lifestyle and phenotype (from analysis of a blood sample); lifestyle and genotype (from DNA testing using a saliva sample). To identify potential groups most likely to adopt PN advice, comparisons regarding WTP were made between countries, gender, age groups and income and education levels.

Methods

A survey was conducted in November and December 2012 with participants from eight EU countries (Greece, Spain, Germany, Ireland, Netherlands, UK, Poland and Norway). Samples were

Table 1 Average WTP per country per type of required personal information

Country	N	Reference price (local currency)	Average in % reference		
			Lifestyle	Lifestyle + Phenotype	Lifestyle + Genotype
Greece	1020	90€	70.24	75.81	76.64
Spain	1025	90€	65.84	68.77	71.21
Germany	1020	100€	53.38	54.32	54.62
Ireland	1020	110€	68.42	69.64	68.44
Netherlands	1020	100€	42.35	41.70	41.26
UK	1061	£80	44.24	47.53	46.65
Poland	1045	230 Zloty	64.50	68.67	70.99
Norway	1022	1100 Norse kroner	52.15	57.23	54.90

representative on gender, age and education level for the general population in their country and participants were members of existing panels of consumer research agencies who consented in receiving survey invitations. Data collection was part of a larger study on PN where more details about the procedure can be found.⁷ Data reported here have not been published previously.

WTP was measured as a two-step contingent valuation. Participants were first asked whether they would be willing to pay a price equal to that of standard, non-PN advice provided by a qualified dietitian. Those who reported a WTP of at least this reference price were provided with a continuous scale of which the lower end represented the reference price, and the higher end being five times the reference price. Participants who reported to be not willing to pay the reference price were provided with a scale that ranged from 0 to the reference price.

Based on an internet survey on the price of general dietary advices consisting of one intake session and a three month follow up advice in the Netherlands the reference price for PN was estimated at about 100€, which was then translated to reference prices for all participating countries using the Eurostat Comparative Price Level index of 2011.⁸ To check whether the calculated reference prices resembled dietary advice prices of the participating countries, the reference price of each country was compared to the price of a national Weight Watchers (Weight Watchers is an international company that offers various products and services to assist weight loss and maintenance.) dietary service. To allow comparability across countries, the reported WTPs were expressed as percentages of the reference prices. Each participant scored WTP for nutrition advice based on three, increasingly personal, levels of personal information: lifestyle (about daily diets and exercise); lifestyle and phenotype (with additional information from blood chemistry information); and, lifestyle and genotype (with additional information from DNA testing using a saliva sample). The order of WTP scoring was randomized.

WTP data were coded into three classes: (1) Nothing: Participants reporting a WTP below 1% of the reference (2) Low: Participants reporting a WTP below reference, but more than 0; (3) High: Participants reporting WTP higher than the reference price. In addition, age, gender, income [compared to the modal income of country of residence (Modal incomes at the time of data collection were: Germany: 25 000€; Spain: 22 000€; Greece: 20 000€; Ireland: 24 000€; Netherlands: 30 000€; United Kingdom: 22 000£; Poland: 50,000 Zloty; Norway: 322 000 kroner, Portuguese participants did not fill out this question.)], education (Low: 12 or fewer years of schooling, including kindergarten; Medium: 12–16 years education; High: degree level) were recorded. Of the 8233 participants, 919 did not disclose income. These participants were omitted from analyses that included income as determinant. Distributions of participants across the WTP classes were cross-tabulated and tested using χ^2 . In addition, factorial ANOVAs were conducted testing the main effects of the sociodemographic on WTP, for the Lower and Higher WTP class (For the Nothing WTP class, an ANOVA would be meaningless

Table 2 Distribution of WTP (as percentage of reference price) per personalisation level

	Lifestyle	Lifestyle + phenotype	Lifestyle + genotype
N	8233	8233	8233
Nothing	19.6%	19.1%	20.8%
Lower	51.5%	49.9%	48.4%
Mean (SD)	30.10 (21.40)	30.44 (21.66)	30.68 (21.83)
Median	25.56	26.10	27.27
Higher	29.0%	31.0%	30.7%
Mean (SD)	143.84 (62.53)	143.27 (61.14)	146.73 (63.64)
Median	120.00	119.00	122.23

since all participants in this class scored a WTP equal to 0) and each level of personal information.

Results

Sample description

A total of 8233 participants from the representative survey completed the questionnaire. Gender distribution was about equal (50.6% male). Twenty-two percent of participants were aged between 18 and 29 years; 23% between 30 and 39 years; 35% between 40 and 54 years; and 20% between 55 and 65 years. Twenty-nine percent reported low education level; 39% had completed medium level education; and, 32% had completed higher education. Income distribution peaked (as expected) around the modal income of each country, with 49.3% (3605) of those willing to disclose income information, earning between 0.5 and 1.5 times modal income.

General results

Average WTP as percentage of the reference price provided is reported in [Table 1](#).

A minority of the participants (about 30% see [Table 2](#)) showed a high WTP for PN advice. About half showed a low WTP. The remaining participants (about 20%; [Table 2](#)) reported not being willing to pay anything for PN advice. These percentages differed between the three levels of information (Friedman $\chi^2(2) = 106.98$, $N = 8233$, $P < 0.001$). For lifestyle-based nutrition advice, relatively fewer participants had a WTP above the reference price and more a WTP below the reference price. For lifestyle and phenotype information, more participants were willing to pay more, and fewer did not want to pay anything. For lifestyle and phenotype analysis and lifestyle and genotype analysis, relatively many participants were willing to pay nothing, while relatively few participants were willing to pay a lower than reference price ([Table 2](#)).

55

60

65

70

75

80

Table 3 Test statistics for effect of sociodemographics on WTP-class membership and mean WTP within the Low and the High WTP class. (Bold font indicates significant outcomes at $p < 0.05$)

	Lifestyle			Lifestyle and blood			Lifestyle and DNA		
	Class (nothing, low, high)	Low (n = 3609) (df _e = 3590)	High (n = 2269) (df _e = 2250)	Class (nothing, low, high)	Low (n = 3485) (df _e = 3466)	High (n = 2443) (df _e = 2424)	Class (nothing, low, high)	Low (n = 3393) (df _e = 3374)	High (n = 2415) (df _e = 2396)
Country (df _{1,2} = 14; df _f = 7)	$\chi^2 = 358.82, p < 0.001, V = 0.15$	$F = 14.02; p < 0.01$	$F = 5.86; p < 0.01$	$\chi^2 = 408.11, p < 0.001, V = 0.16$	$F = 11.32; p < 0.01$	$F = 3.92; p < 0.01$	$\chi^2 = 439.02, p < 0.001, V = 0.16$	$F = 2.46; p = 0.02$	$F = 1.56; p = 0.14$
Gender (df _{1,2} = 2; df _f = 1)	$\chi^2 = 29.23, p < 0.001, V = 0.06$	$F = 6.95; p < 0.01$	$F = 25.03; p < 0.01$	$\chi^2 = 29.18, p < 0.001, V = 0.06$	$F = 9.97; p < .01$	$F = 15.78; p < 0.01$	$\chi^2 = 28.31, p < 0.001, V = 0.06$	$F = 4.68; p = .03$	$F = 25.85; p < 0.001$
Age class (df _{1,2} = 6; df _f = 3)	$\chi^2 = 163.34, p < 0.001, V = 0.10$	$F = 36.54; p < 0.01$	$F = 1.01; p = .35$	$\chi^2 = 173.65, p < 0.001, V = 0.10$	$F = 41.41; p < 0.01$	$F = 1.80; p = .12$	$\chi^2 = 159.35, p < 0.001, V = 0.10$	$F = 34.07; p < 0.01$	$F = 0.77; p = .51$
Education level (df _{1,2} = 4; df _f = 2)	$\chi^2 = 61.81, p < 0.001, V = 0.06$	$F = 0.63; p = .53$	$F = 0.17; p = .84$	$\chi^2 = 75.02, p < 0.001, V = 0.07$	$F = 0.55; p = .58$	$F = 0.33; p = .72$	$\chi^2 = 51.54, p < 0.001, V = 0.06$	$F = 0.16; p = .86$	$F = 1.81; p = .17$
Income level (df _{1,2} = 10; df _f = 5)	$\chi^2 = 90.00, p < 0.001, V = 0.08$	$F = 5.97; p < 0.01$	$F = 5.77; p < 0.01$	$\chi^2 = 88.96, p < 0.001, V = 0.08$	$F = 5.94; p < 0.01$	$F = 7.04; p < 0.01$	$\chi^2 = 86.65, p < 0.001, V = 0.08$	$F = 4.66; p < 0.01$	$F = 7.66; p < 0.01$

The p value - following the test value (either F or Chi square) provides the exact p value - for both the bold and the non bold text.

a: Except for income $N = 7314$. Participants not willing or able to disclose income were not included.

Demographic differences

The effects of gender, age, income, education level and country showed several statistically significant differences in WTP class and mean WTP within the WTP class (Table 3 shows statistical tests; Figure 1 shows distribution and means).

Discussion

About a third of the participants reported WTP for PN higher than the reference price of standard, non-PN advice. Those participants were on average willing to pay a price of 40% and 50% of higher than the reference price. The additional price people were willing to pay for the more advanced forms (blood or DNA sample based) of personalisation (based on phenotype or genotype) was very small compared to what participants were willing to pay for lifestyle-only based PN advice. This aligns with previous research,⁹ where it was reported that people did not perceive additional benefits accruing from more medicalised personal data and suggests such advanced methods should be developed at little extra cost.

A sizable minority (20%) indicated that they are willing to pay nothing for PN, and about half of all participants indicated WTP for PN lower than for standard nutrition advice. While this may imply these participants reject the idea of PN altogether this is not necessarily the case. Current concerns about inadequate procedure to guarantee data privacy, lack of confidence in the efficacy of PN, or distrust in commercial service providers⁹ may have reduced WTP regardless of perceived acceptance of PN per se. Another group may have consisted of people who were potentially interested in adopting a PN advice but were opposed to paying for healthcare from their private funds because this is seen as a responsibility of the state.¹¹ There may have been a group of people for whom the personalized nutrition remained abstract and hypothetical and therefore indicated a low WTP, this may be particularly the case for a group of people not willing to pay for any nutrition service which may have reduced WTP for PN services (A much larger proportion (about 60%) of participants in a proof of principle trial in the same countries completed the same survey (7) and were willing to pay a higher price for a PN service than for a non-PN service (data not shown), indicating that motivation to engage with nutrition advice may be a central driver for adoption.)¹⁰. This relates to another potential limitation to the current study that in the used contingent valuation method participants did not make any actual monetary sacrifice.¹³ Future research is needed to investigate the reasons why WTP is so low, and under what conditions these people would participate in a PN program.

Analysis of differences based on demographic variables gives some insights into what participants are most likely to adopt a PN advice. There were some differences in WTP between countries. Participants from the Netherlands and the UK most often reported they did not want to pay anything or at least less than the reference. Participants in these countries either wanted to pay the least, but those with WTP more than the reference price were among those with the highest WTP. This may have to do with the availability of relatively inexpensive basic healthcare (Netherlands), or free of direct charge basic healthcare (UK), while additional, non-standard care is something for which inhabitants of these countries are accustomed to pay when they use it.

There were more males than females reporting a WTP of nothing. Males with low WTP reported lower WTP than female participants, males with a WTP higher than the reference value had a higher WTP than females. This suggests that male participants, once committed to pay more or less for PN than conventional nutrition advice, are more extreme in their deviation from standard nutrition advice WTP than females.

Participants in the highest income classes reported the highest WTP for PN. This suggests that commercial introduction of personalized nutrition services would benefit higher socioeconomic

5
10
15
20
25
30
35
40
45
50
55
60
65

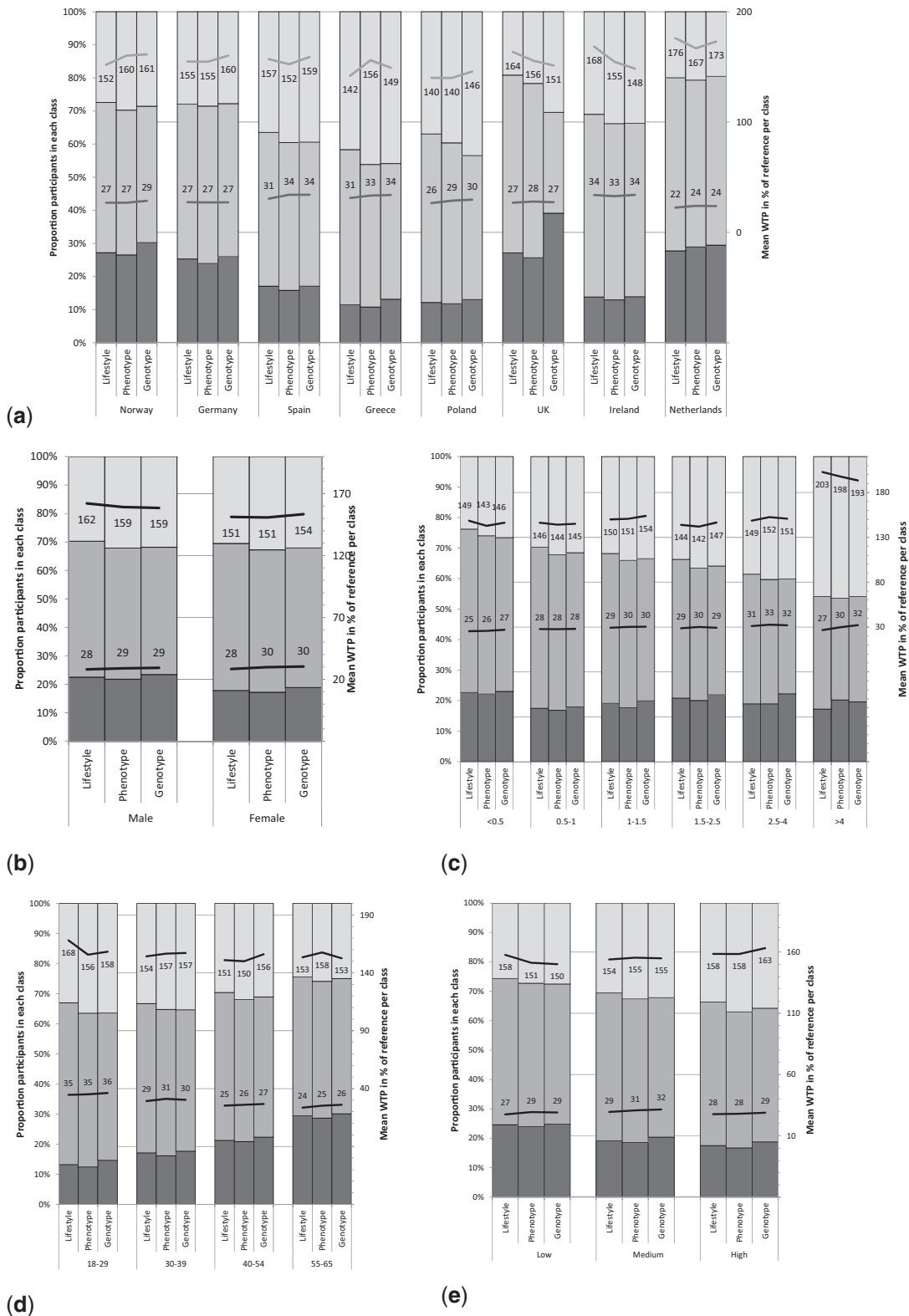


Figure 1 WTP for different levels of PN by (a) Country (b) Gender (c) Income (d) Age and (e) Education. Bars indicate proportion of participants willing to pay: Nothing (dark grey), Lower than reference (mid grey) and Higher than reference (light grey). Lines and numbers indicate mean WTP in percentage of the reference

classes most, while it is generally accepted that these groups in the population already have better health.¹² The higher WTP may in part be related to higher income classes having more awareness of health issues, but it may also relate to the availability of resources (money) to purchase nutrition services. This suggests that if availability of PN advice is regulated by commercial markets, these may explicitly target the higher social classes and incomes to maximize

profit; while PN advice to these population groups may have the least positive effect on public health. This raises important ethical questions to whether PN should also be accessible to lower income classes that may need it more than those with high income. Considering the low WTP of these income classes alternatives to commercial businesses seem more promising ways to have these groups benefit from PN advice for example PN advice provided

through employers or insurance companies. Alternatively, a hybrid form of commercial and public services could be considered, where basic PN services is covered by a national health program, while specific implementations such as comprehensive lifestyle advice and applications to monitor progress⁶ may be left to the market. The answer to this issue is beyond the scope of the current paper, and should be taken up at the level of policy discussion.

About one third of the population reports to be willing to pay more for PN than for a conventional nutrition service. This suggests that there may be a market for PN if it can be offered at no more than one and a half time the price of current nutrition advice services. While this suggests that PN may find a place in the European population if it is made available at limited additional cost compared to non-PN services, it might be more likely to be adopted by those who need it most if it is offered through existing health care systems.

Acknowledgements

This research was carried out within the context of Food4Me, which is the acronym of the EU FP7 project 'Personalised nutrition: an integrated analysis of opportunities and challenges' (Contract no. KBBE.2010.2.3-02, Project no.265494), <http://www.food4me.org/>.

Conflicts of interest: None declared.

Key points

- There is a potential market for personalised-nutrition advice in the EU.
- The majority of people is not willing to pay for personalised-nutrition advice.
- Willingness to pay for personalisation based on DNA sampling is not higher than for personalisation based on lifestyle or blood data.
- Large scale adoption of PN is likely to require inclusion in national health services.

References

- 1 Pomerleau J, McKee M, Lobstein T, et al. The burden of disease attributable to nutrition in Europe. *Public Health Nutr* 2003;6:453–61.
- 2 Crimmins EM. Physiological differences across populations reflecting early life and later life nutritional status and later life risk for chronic disease. *J Popul Ageing* 2015;8:51–69.
- 3 Gibney MJ, Walsh MC. The future direction of personalised nutrition: My diet, my phenotype, my genes. *Proc Nutr Soc* 2013;72:219–25.
- 4 Hurt TR, Seawell AH, O'Connor MC. Developing Effective Diabetes Programming for Black Men. *Glob Qual Nurs Res* 2015;2:2333393615610576.
- 5 Ronteltap A, Van Trijp H, Berezowska A, et al. Nutrigenomics-based personalised nutritional advice: In search of a business model? *Genes Nutr* 2013;8:153–63.
- 6 Berezowska A, Fischer ARH, Ronteltap A, et al. Understanding consumer evaluations of personalised nutrition services in terms of the privacy calculus: A qualitative study. *Public Health Genomics* 2014;17:127–40.
- 7 Poinhos R, Van Der Lans IA, Rankin A, et al. Psychological determinants of consumer acceptance of personalised nutrition in 9 European countries. *Plos One* 2014;9:
- 8 Eurostat. Comparative price levels, 2003–13 2013 [cited 2015 17-7]. Available from: [http://ec.europa.eu/eurostat/statistics-explained/index.php/File:Comparative_price_levels_2003%E2%80%9313_\(%C2%B9\)_final_consumption_by_private_households_including_indirect_taxes,_EU-28%3D100\)_YB15.png](http://ec.europa.eu/eurostat/statistics-explained/index.php/File:Comparative_price_levels_2003%E2%80%9313_(%C2%B9)_final_consumption_by_private_households_including_indirect_taxes,_EU-28%3D100)_YB15.png).
- 9 Berezowska A, Fischer ARH, Ronteltap A, Van der Lans IA, Van Trijp HCM. Consumer adoption of personalised nutrition services from the perspective of a risk-benefit trade-off. *Genes and Nutrition* 2015;10:42.
- 10 Panzone L, van der Lans I, Stewart-Knox B, et al. Effects of trial participation on beliefs, attitudes, and adoption intention regarding to adopt personalised nutrition: a propensity score matching approach.
- 11 Stewart-Knox B, Kuznesof S, Robinson J, et al. Factors influencing European consumer uptake of personalised nutrition. Results of a qualitative analysis. *Appetite* 2013;66:67–74.
- 12 Cohen AK, Rai M, Rehkopf DH, et al. Educational attainment and obesity: A systematic review. *Obes Rev* 2013;14:989–1005.
- 13 Miller KM, Hofstetter R, Krohmer H, et al. How should consumers' willingness to pay be measured? an empirical comparison of state-of-the-art approaches. *J Market Res* 2011;48:172–84.