

## **Nutrigenetic testing for personalized nutrition – an evaluation of public perceptions, attitudes and concerns in a population of French Canadians**

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**Running title:** Nutrigenetic testing – evaluation of public perceptions.

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1 **Abstract**

2 **Background/aims:** This study aimed to evaluate attitudes, perceptions and concerns  
3 about nutrigenetic testing for personalized nutrition in the general population of the  
4 province of Quebec, in Canada.

5 **Methods:** A total of 1425 individuals from the province of Quebec fully completed a 37-  
6 question online survey on nutrigenetics and were included in analyses. Chi-square tests  
7 were used to test for associations between categorical variables.

8 **Results:** The majority of participants (93.3%) considered dietitians as the best  
9 professionals to give personalized dietary advice based on nutrigenetic testing. The  
10 main reported advantage for nutrigenetic testing was “health” (23.5%), followed by  
11 “disease prevention” (22.2%). Among disadvantages, “no disadvantage” (24.4%),  
12 followed by “diet restriction” (12.9%) were mostly reported. The two major concerns  
13 raised were the accessibility to genetic testing by telemarketing companies and  
14 spammers (51.8%), and solicitation by companies using the personal genetic data to sell  
15 products (48.6%).

16 **Conclusions:** French Canadians generally have a positive attitude towards  
17 nutrigenetics and find many benefits to its use. They rose up possible confidentiality  
18 issues associated with the management or property of genetic test results. However  
19 education about confidentiality issues is still considerably needed. These findings overall  
20 suggest that the population is interested by a more extensive use of nutrigenetics in  
21 health management.

22

## 23 **Introduction**

24 Nutrigenetics and nutrigenomics explore the interactions between food and genes, and  
25 how these interactions can influence one's health and risk to develop chronic nutrition-  
26 related diseases [1-3]. Despite that the science of nutrigenetics/nutrigenomics has  
27 greatly evolved since its emergence in the late 90's, and has now sufficiently progressed  
28 to bring a wide variety of genetic tests to predict the individual response to nutrients  
29 and/or nutritional interventions, nutrigenetic technologies have still rarely been used in  
30 health care practice [4-6]. Besides their recent commercialization by companies  
31 specialized in nutrigenetic tests, sometimes in collaboration with registered dietitians, a  
32 very small proportion of registered dietitians actually use nutrigenetics in their practice to  
33 provide personalized nutritional recommendations to their patients, and often do not  
34 consider themselves sufficiently trained to adequately use it [4,5]. Despite the infrequent  
35 use of nutrigenetic testing by registered dietitians, many companies offer genetic tests  
36 directly to consumers, thus making the technology very accessible, and the genetic  
37 testing market as a whole has been steadily increasing in recent years [6,7].

38 Nutrigenetic technologies appear to be well accepted in European and North-American  
39 countries, including Canada [8-11]. Nielsen *et al.* studied public perceptions of  
40 personalized nutrition based on genetic testing among Canadians and observed that  
41 participants' interest in nutrigenetics increased when participants received dietary advice  
42 based on their genetic profile in comparison with participants who received dietary  
43 advice without genetic information [12,13]. Attitudes of Canadian consumers towards  
44 nutrigenomics

45 were also studied by Morin *et al.* in focus groups in five Canadian cities, namely Halifax,  
46 Montreal, Toronto, Edmonton, and Vancouver, and concluded that consumers perceived  
47 benefits of nutrigenomics outweighed the risks [14].

48 However, cultural differences between populations might affect the way people perceive  
49 nutrigenetics. Hence, our research group recently surveyed a population of French  
50 Canadians living in the province of Quebec to assess their current knowledge and level  
51 of interest in nutrigenetics. In order to bridge the substantial gap between research and  
52 clinical practice regarding nutrigenetics, and to facilitate its integration in professional  
53 practice, attitudes, beliefs, perceptions and fears of consumers towards nutrigenetics  
54 must be comprehensively assessed. We therefore aimed, in the present study, to draw a  
55 global portrait of the current situation of nutrigenetics in Quebec by evaluating  
56 apprehensions, perceptions and attitudes of nutrigenetic testing for personalized  
57 nutrition of the population of Quebecers.

58

## 59 **Methods**

### 60 *Recruitment*

61 A total of 2238 individuals aged of 18 years old or older living in the province of Quebec,  
62 in Canada, were recruited via Facebook and the Laval University list of employees and  
63 students and surveyed from March 10, 2015 to April 28, 2015. Participants had to have  
64 access to a computer with an Internet connection and to be able to answer the  
65 questionnaire written in French. To reduce the risk that someone completes the survey  
66 more than once, the IP address of the computer used to complete the survey was  
67 checked. A total of 1535 individuals completed the survey, from which 110 were  
68 thereafter excluded for missing information. A total of 1425 participants, including 252  
69 men and 1173 women were kept for statistical analysis. The Ethics Committee on  
70 Research Involving Human Subjects of Laval University approved this project.

### 71 *Questionnaire development*

72 SurveyMonkey Gold with enhanced security (<http://www.surveymonkey.com>), an online  
73 survey development cloud-based software, was used to build the questionnaire. Twenty  
74 unrelated individuals pre-tested the questionnaire to estimate the necessary time to  
75 complete it, to verify the clarity of the questions and to evaluate the relevance of the  
76 proposed answers. The survey comprised a total of 37 questions. Thirty-three of them  
77 were closed-ended and four were open-ended. Most of the closed-ended questions  
78 were multichotomic with one or multiple possible answers, so that the respondent could  
79 choose more than one answer.

80 A brief definition of nutrigenetics was given at the beginning of the survey. A total of 14  
81 questions for quota sampling were found at the beginning (ex. citizenship, age, etc.),  
82 and at the end of the questionnaire (ex. personal and familial health history, gender,  
83 ethnicity, etc.). Questions about citizenship, province/territory and age were  
84 discriminatory to ensure that respondents were Canadian citizens living in the province  
85 of Quebec, and were 18 years old or older. Seven items evaluated perceptions, attitudes  
86 and concerns of participants, which were used to address the objective of the present  
87 study. Five items evaluated genetic literacy and knowledge of participants on  
88 nutrigenetics, six evaluated participants' interest and willingness to undergo nutrigenetic  
89 testing, and five evaluated intentions to follow dietary advice based on genetic testing.  
90 These last 16 items were mainly addressed in another paper by our research group [15].

91 *Statistical analysis.*

92 Results were exported from SurveyMonkey into Microsoft Excel (Microsoft, Redmonds,  
93 CA, USA) to be converted into calculation sheets, before being imported into SAS, v9.4  
94 (SAS Institute, Cary, NC, USA). In open-ended questions, common themes were  
95 identified using NVivo software v10.2.0. Results were analyzed as categorical variables.  
96 Chi-square tests were used to test for associations between categorical variables.  
97 Statistical significance was set at  $p < 0.05$ .

98

## 99 **Results**

### 100 *Study population*

101 Characteristics of subjects are presented in **Table 1**. Participants had a mean age of  
102  $38.3 \pm 14.9$  years. A proportion of 49.4% of participants had completed undergraduate or  
103 graduate university studies, and 14.6% had a college degree. A total of 25.2% of  
104 participants had an annual household income equal or superior to \$100 000/year. The  
105 vast majority were Caucasians (96.7%) and were not familiar with the term  
106 “nutrigenetics” (82.7%). Five participants had already undergone genetic testing.

### 107 *Preference for Health Care Professional*

108 When asked to which health care professional(s) should be referred an individual  
109 wishing to receive nutritional recommendations adapted to his genetic profile, 93.3% of  
110 participants identified registered dietitian as a good choice. Doctor/family physicians  
111 were identified by 39.7% of participants, followed by geneticists (39.2%) and genetic  
112 counsellors (28.6%). Naturopaths, nurses and pharmacists were identified by 11.9%,  
113 10.3% and 8.2% of participants, respectively.

### 114 *Perceived Advantages and Disadvantages of Nutrigenetic Testing*

115 **Table 2** shows the principal advantages and disadvantages given by study participants  
116 from receiving personalized dietary advices based on genetic makeup. Briefly, when  
117 asked about the perceived advantages of receiving DNA-based dietary advice, “health”  
118 was the most frequently reported theme (23.5%), followed by “disease prevention”  
119 (22.2%), “personalized dietary advice based on genetic makeup” (22.0%), “improving  
120 diet” (9.1%), “food classified as being good or bad” (7.7%), “weight control” (6.9%), and

121 “feeling better” (5.4%). Additionally, 24.4% of respondents perceived no disadvantage  
122 for receiving DNA-based dietary advice. The item “diet-related restrictions” was the most  
123 frequently mentioned disadvantage (12.9%) followed by “worry/fear/anxiety” (8.1%), “the  
124 loss of pleasurable eating practices” (5.5%), and “the risk to develop food obsession”  
125 (5.0%).

126 A proportion of 90.7% (n=1292) of participants reported to be ready to follow a  
127 personalized diet based on the results of a nutrigenetic test, as reported in a previous  
128 paper [15]. The remaining 9.3% (n=133) were questioned about the reasons for not  
129 being inclined to follow personalized dietary advice based on genetic makeup.  
130 Restrictions associated with the diet (25.6%) (e.g. “I do not like having restrictions.”), the  
131 fact that they do not want to follow any diet (12.8%) (e.g. “I do not like diets [...] Having a  
132 food structure bores me and I will not follow a diet for the rest of my life.”), that they  
133 already have a suitable diet (9.8%) (e.g. “I already have a balanced diet”), the pleasure  
134 of eating (10.5%) (e.g. “It could take away the pleasure of eating.”), the absence of  
135 health problems and illness (8.3%) (e.g. “I do not have any particular disease. I do not  
136 think I need to follow a special diet.”), the complexity to follow a diet based on DNA  
137 dietary advice (6.8%) (e.g. “It must be complicated to eat in restaurants.”), the personal  
138 food preferences (6.0%) (e.g. “The fear of having to cut my favourite food. I am very  
139 picky on the food side, so it would be difficult for me to go on a diet.”), and the negative  
140 impact of diet on psychological aspects such as self-control and guilt (6.0%) (e.g. “I do  
141 not want to have to personally control what I think [...] Knowing my genetic profile would  
142 make me feel guilty if I do not follow the nutritional recommendations, and I would know



143 that I have a direct effect on my health. I just do not want to know.”) were among the  
144 answers most often quoted by the participants in qualitative analyses (data not shown).

#### 145 *General Concerns about Nutrigenetic Testing*

146 As shown in **Figure 1**, the accessibility to personal genetic data by telemarketing  
147 companies and spammers, and the solicitation by companies using personal genetic  
148 data to sell products/supplements adapted to the genetic profile of individuals being  
149 tested were the two main concerns (51.8% and 48.6%, respectively; % of study  
150 participants that answered, “Very concerned”). Participants were generally not  
151 concerned about the scientific advancement in the field of nutrigenetics, the destruction  
152 of their DNA samples by the genetic testing company once results are reported to the  
153 customer, and the accessibility to personal genetic data by the genetic testing company.  
154 The price and the high cost of the technology were not among the major concerns with  
155 regard to the limits most commonly reported. A proportion of 55.8% of participants were  
156 ready to pay less than \$100 CAD, 22.46% of the participants were ready to pay between  
157 \$100-199 CAD, and 4.6% were ready to pay between \$200-299 CAD to obtain DNA-  
158 based dietary advice. In an ordinal model for multinomial data adjusted for sex, annual  
159 income was significantly associated with willingness to pay for DNA-based personalized  
160 nutrition ( $p < 0.0001$ ), where individuals with an income  $\geq \$80\,000$ /year were more likely to  
161 be willing to pay \$200 or more ( $p \leq 0.015$ ) for nutrigenetic testing.

162 When asked if they would share their nutrigenetic test results, 82.0% declared that they  
163 will share them with their life partner, but only 51.4% intended to share the results with  
164 their children. With regard to other relatives, most people were ready to share their  
165 results with parents or with their brothers and sisters (68.4% and 68.1%, respectively).

166 Percentages were higher with health care providers; 87.3% of participants intended to  
167 share their nutrigenetic test results with a family physician and 88.1% with a registered  
168 dietitian.

169

## 170 **Discussion**

171 This survey aimed to assess public perceptions and general concerns regarding  
172 nutrigenetic testing for personalized nutrition in a population of French Canadians from  
173 the province of Quebec, in Canada. In this study, advantages and disadvantages of  
174 nutrigenetic testing were documented as well.

### 175 *Study Population*

176 The study sample was mainly composed of Caucasian women, often presenting high  
177 socioeconomic status and level of education. The majority was under 40 years of age,  
178 and all were French Canadians living in the province of Quebec. Because of the  
179 homogeneity of the study sample, generalizability of the results could be limited. Part of  
180 this homogeneity can be explained by the recruitment methods. Participants were partly  
181 recruited via the Laval University list of employees and students, explaining high levels  
182 of education, and it is likely that more women returned the questionnaire than men..

### 183 *Preference for Health Care Professional*

184 Almost all participants preferred dietitians for providing DNA-based personalized dietary  
185 advice. This observation is rather consistent with other studies on the subject. In a  
186 Canadian study by Nielsen DE *et al.*, 56% of participants answered “registered dietitian”  
187 when asked which health care professional, including registered dietitians, medical  
188 doctors, registered nurses, naturopaths or other, they felt would offer them the best  
189 personalized nutrition recommendation [12]. Similarly to the present study, medical  
190 doctor was reported as the second-best source (27%) for personalized nutrition  
191 recommendation [12]. However, in that study, health care professionals were not

192 perceived as being the best source for personal genetic information [12]. A total of 47%  
193 of participants reported “university research lab” as the best source, followed by “health  
194 care professional” (41%), and finally “direct-to-consumer genetic testing company”  
195 (12%) [12]. Conversely, Póinhos R *et al.* documented, in a large survey of 9381  
196 individuals across nine European countries, that family doctors/general practitioners  
197 were deemed the best service providers for personalized nutrition in all countries except  
198 in Poland, where registered dietitians were preferred [16]. Family doctors were also the  
199 most trusted providers for personalized nutrition information in all nine countries studied  
200 [16]. In Norway and Poland, trust in registered dietitians for providing personalized  
201 nutrition information did not significantly differ from family doctors [16]. It should be  
202 mentioned that, in France and Germany, the minimum level of training to become a  
203 registered dietitian requires less than a bachelor’s degree unlike in Canada, the United  
204 States and several other European countries [17]. These differences in educational  
205 levels may partly explain the discordances of public opinions between different countries  
206 and studies. These observations demonstrate that registered dietitians and physicians  
207 are generally well trusted for giving personalized nutritional recommendations from  
208 genetic testing, including in Quebec. Nonetheless, this high level of trust from the public  
209 towards family doctors is rather surprising considering that dietitians receive much more  
210 nutritional training during undergraduate studies than family doctors, and actually have a  
211 much higher level of expertise in nutritional counselling [18-21].

### 212 *Perceived Advantages and Disadvantages of Nutrigenetic Testing*

213 Health benefits were reportedly the most frequent perceived advantage in the present  
214 study. Consistently, our group previously observed that participants with personal and/or

215 familial health issues history were more willing to undergo a genetic testing [15]. These  
216 results are consistent with the work of Rankin *et al.*, who showed that “health benefits”  
217 was positively associated with attitude towards and intention to adopt personalized  
218 nutrition [22]. In the same study, they demonstrated that attitude towards and intention to  
219 adopt personalized nutrition were positively influenced by several other determinants of  
220 food choice, including “weight control”, “ethical concern” and “mood” [22]. Unexpectedly,  
221 “weight control” was among the less reported advantages for receiving personalized  
222 dietary advice in the present study. Similar findings were reported in a study by Morin *et*  
223 *al.*, in which participants indicated, among others, “better diet, disease prevention and  
224 overall healthier habits” as benefits of nutrigenomics testing [14]. Participants generally  
225 deemed that benefits of nutrigenomics outweighed risks, as opposed to health care  
226 professionals, who had a more conservative thinking [14].

#### 227 *General Concerns about Nutrigenetic Testing*

228 Morin *et al.*, also reported several risks perceived by the public regarding nutrigenomic  
229 testing. Insufficient scientific evidence to support nutrigenomics testing, misinterpretation  
230 of the results by the public, psychological risks, confidentiality aspects, and high costs  
231 were raised [14]. Rankin *et al.* reported “price” as negatively associated with attitude  
232 towards and intention to adopt personalized nutrition [22]. In the present study, most of  
233 participants would pay less than \$100 for dietary recommendations based on their  
234 genetic profile. These results show that, in this population, price also appears to be a  
235 limiting factor. A substantial proportion of participants had a high socio-economic status.  
236 Considering that annual income was significantly associated with willingness to pay for  
237 personalized dietary recommendations based on genetic profile, price would probably

238 have constituted an even more important barrier to genetic testing and personalized  
239 nutrition if the survey was conducted in a population with lower incomes. Fisher *et al.*  
240 reported that about 30% of participants, particularly men with high incomes, would be  
241 willing to pay more for personalized dietary advice than non-personalized dietary advice  
242 [23]. Participants were, on average, willing to pay 150% of the standard price for non-  
243 personalized nutrition advice [23]. Henneman *et al.* showed that men were more prone  
244 to genetic testing as well [24]. In the present study, willingness to pay for DNA-based  
245 personalized nutrition was not different between men and women.

246 Accessibility to genetic information was reported as an important preoccupation in some  
247 cases. Similar concerns were widely reported in other studies. It was documented that  
248 privacy risk was an important determinant of consumers' intention to use  
249 recommendation systems to obtain personalized nutrition advice [25]. Apprehensions  
250 about genetic risk profiling were reported in about half of participants (all physicians) of a  
251 recent study by Haga *et al.*, where 50% of participants expressed concerns about health  
252 insurance discrimination and 43% about confidentiality regarding genetic testing [26].  
253 Authors also found with participants from the public that agreed or strongly agreed with  
254 the possibility that results of genetic tests could affect their capacity to get health  
255 insurance (51.3%) or a job (15.7%) [27]. In other studies, employment and insurance  
256 taking were matters of concerns for participants as well [9,27-29]. These observations  
257 clearly demonstrate a certain public's awareness of the ethical issue of confidentiality.  
258 However, the majority of participants were comfortable with sharing nutrigenetics  
259 information within the family. Similarly, it was previously observed that almost half of  
260 participants (49%) of a study believed that the information from genetic tests belongs to

261 the whole family [30]. In a survey by Haga *et al.*, 89.7% of participants agreed or  
262 strongly agreed with the share of results of their genetic test with their family members,  
263 and only 22.7% agreed or strongly agreed that the family does not need to know the  
264 results [27]. Similar findings were reported in another study, in which almost every  
265 participant considered that genetic information was familial, not merely individual [31].  
266 Interestingly, Heaton TG *et al.* observed that individuals are more willing to give away  
267 personal information from genetic testing to an at-risk relative of a disease when the  
268 disease is preventable (mostly) and serious [32]. Authors state that information about  
269 genetic testing is very dependent on disease characteristics [32]. Moreover, Nielsen *et*  
270 *al.* reported that participants who received personalized dietary advice based on  
271 participants' genotype shared more their information with a family member compared to  
272 the control group (dietary recommendations with no genetic information) [12].

273 Participants were also little concerned by the accessibility and destruction of DNA  
274 samples by the genetic testing company, and the regulation of the industry of genetic  
275 testing. There is currently very little legislation surrounding the provision of evidence-  
276 based nutrition information and nutrigenetic testing, and customers may not be aware of  
277 it [33,34]. Also, there are still some debates on the strength of scientific evidence  
278 supporting the marketing of nutrigenetics and its use in health care practice [33,35].

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281

**282 Conclusion**

283 Overall, the present study showed that individuals perceive many advantages from  
284 nutrigenetic testing, mainly for health, and are comfortable with the disclosure of genetic  
285 information with relatives. They, however, remain generally aware of the potential  
286 privacy issues of nutrigenetic testing, although they do not seem to fully understand the  
287 risks associated with ownership of personal genetic information. These findings further  
288 support that the population is generally optimistic regarding the use of nutrigenetics in  
289 health care practice via registered dietitians.

290



291 **Declarations and special requirements**

292 *Investigations Involving Human Subjects*

293 Written informed consent was obtained from all subjects for the publication of this report.

294 The Ethics Committee on Research Involving Human Subjects of Laval University

295 approved this project (2014-292 / 24-02-2015). Authors' signatures:

296

297 *Statement for Authors Submitting Original Research or Case Reports*

298 The enclosed manuscript "Nutrigenetic testing for personalized nutrition – an evaluation

299 of public perceptions, attitudes and concerns in a population of French Canadians" has

300 been approved by me as well as by the responsible authorities at the institute where the

301 work has been carried out. I certify that none of the material in this manuscript has been

302 published previously in any form and that none of this material is currently under

303 consideration for publication elsewhere. This includes symposia and proceedings of

304 meetings and preliminary publications of any kind except an abstract of 400 words or

305 less. Authors' signatures:

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307

308

309 **Declarations**

310 *Competing interests*

311 Authors have no conflict of interest to declare.

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316 BVM and HC wrote the paper and performed statistical analysis; JR, VG, SD and MCV  
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**Table 1. Characteristics of participants**

	<b>Men*</b>	<b>Women*</b>	<b>Total*</b>
<b>Gender</b>	252 (17.7)	1173 (82.3)	1425 (100.0)
<b>Age (years)**</b>			
18-29	60 (23.9)	477 (40.7)	537 (37.7)
30-39	34 (13.6)	283 (24.1)	317 (22.3)
40-49	47 (18.7)	150 (12.8)	197 (13.8)
50-59	52 (20.7)	143 (12.2)	195 (13.7)
60 and up	58 (23.1)	120 (10.2)	178 (12.5)
<b>Matrimonial status</b>			
Single (including divorced, separated and widowed)	89 (6.3)	506 (30.0)	595 (41.8)
Married or Common law	162 (11.4)	651 (45.7)	813 (57.1)
No answer	1 (0.07)	16 (1.1)	17 (1.2)
<b>Ethnicity</b>			
Caucasian	244 (96.8)	1134 (96.7)	1378 (96.7)
Others	8 (3.2)	39 (3.3)	47 (3.3)
<b>Level of education</b>			
High School			
Not completed	3 (0.2)	12 (0.8)	15 (1.1)
Completed	2 (0.1)	25 (1.8)	27 (1.9)
Vocational training	11 (0.8)	63 (4.4)	74 (5.2)
College			
Not completed	6 (0.4)	43 (3.0)	49 (3.4)
Completed	29 (2.0)	179 (12.6)	208 (14.6)
University			
Not completed	46 (3.2)	302 (21.2)	348 (24.4)
Completed	155 (10.9)	549 (38.5)	704 (49.4)
<b>Annual household income (\$ CAD/year)</b>			
≤ 39 999	35 (13.9)	243 (20.7)	278 (19.5)
40 000 - 59 999	26 (10.3)	185 (15.8)	211 (14.8)
60 000 - 79 999	33 (13.1)	140 (11.9)	173 (12.1)
80 000 - 99 999	30 (11.9)	168 (14.3)	198 (13.9)
100 000 and up	96 (38.1)	263 (22.4)	359 (25.2)
No answer	32 (12.7)	174 (14.8)	206 (14.5)
<b>Geographical distribution</b>			
Quebec City	187 (74.2)	594 (50.6)	781 (54.8)
Montreal	7 (2.3)	66 (5.6)	73 (5.1)
Elsewhere in the province of Quebec	58 (23.0)	513 (43.7)	571 (40.1)

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\*Number (%).

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\*\*One participant had missing data for age.

**Table 2. Perceived advantages and disadvantages for nutrigenetic testing**

<b>Advantages</b>		<b>Disadvantages</b>	
Statement	%*	Statement	%*
Health	23.5	No disadvantage	24.4
Disease prevention	22.2	Diet restrictions	12.9
Personalized dietary advices based on genetic makeup	22.0	Worry/Fear/Anxiety	8.1
Improving diet	9.1	Loss of pleasure of eating	5.5
Dichotomy between good and bad food	7.7	To develop food obsession	5.0
Weight control	6.9	No knowledge about potential disadvantages	4.8
Feeling better	5.4	Changes in food habits	4.7
To understand the impact of food on health	4.1	Food intake complexity	3.9
Awareness of current health status	3.8	Costs	3.9
Awareness of own situation	3.5	Awareness of current health status	3.8
Having better results (glycæmic controls, physical activity, weight loss, etc.)	3.0	To only rely on the nutrigenetic test results	3.8
Motivation	1.4	Guilt	3.2
Allergies/Intolerances	1.3	The diet does not necessary apply to all people or family members	2.9
Avoiding bad behaviours that could increase the risk	1.1	Unestablished relevance of dietary advices based on genetic makeup	2.0
Better digestive health	1.1	The predictive value of nutrigenetic testing is unknown	1.9
Promote personalized healthy lifestyle habits	1.1	Difficulty/Inability to follow the dietary advices	1.6
Informed decision	1.1	Higher risks of nutritional deficiencies	1.6
Reliable source of information	0.8	Feeling obligated	1.6
Self-confidence	0.8	Population misunderstanding	1.5
Does not know	0.8	Insurability	1.4

Data are from qualitative analyses. Common themes were identified using NVivo software v10.2.0.

\*Percentage of participants who reported this advantage and/or disadvantage

**Figure 1. Level of concern in regard to principal limits commonly reported in the field of nutrigenetics**





