

CONSUMER ACCEPTANCE OF GENETIC TESTING FOR PERSONALISED NUTRITION IN INDIA

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ABSTRACT

Rapid progress and developments are happening in the field of personal genomics and with increasing personalized nutrition services available on the market, but gene based personalised nutrition is not widely practiced or accepted in India. In recent times, it is quite evident that awareness and popularity about genetic testing for personalised nutrition is gaining momentum. Consumer attitudes and perceptions towards genetic testing to determine the risks of a predisposition to various diseases have already been examined by several studies, consumer acceptance of personalised nutrition have not been studied in the Indian population till date. Therefore, this study is aimed to examine consumer acceptance of personalised nutrigenetic testing in India. About 500 consumers who underwent the nutrigenetic tests were interviewed using a questionnaire. Forty eight percent of the participants were males and 52% were females. The mean age was 38.3 ± 14.9 years. Eighty five percent of participants who were diagnosed with type 2 diabetes reported being willing to follow the dietary recommendations based on their genetic makeup. The responses towards perceived advantages of receiving DNA based dietary advice were ease of understanding and specificity of the diet advice, which was the most frequently reported theme (57.5%), followed by more personalised and enjoyable (22.4%) and reduced costs due to disease prevention (20.1%). It can be concluded that individuals were optimistic and perceived many advantages of nutrigenetic testing. Individuals are able to perceive risks and benefits, but do not seem to fully understand the risks associated with privacy issues and ownership of personal genetic information. Our study supports that the population is optimistic and willing to adopt genetic tests for personalised nutrition recommendations.

Keywords: Genetic testing, Personalized nutrition, Consumer acceptance, risk vs benefit, Nutrigenetic testing.

1.1 Introduction

Recent advances in the area of genetics and genomics have greatly contributed to a deeper understanding of the gene- nutrient interactions which has led to the emergence of personalised nutrition concepts through nutrigenetics (Tai *et al*, 2007). Nutrigenetics takes into account the genetic variations (polymorphisms) and its influence on the dietary response. (El- Sohemy, 2007). Commercialised direct-to-genetic testing industry provides individuals with easy access to their own personal genetic information which includes their ability to metabolise nutrients & susceptibility to different diseases based on individual's DNA (Nielsen *et al*, 2012). It offers a more rational basis for giving personalised dietary advice for optimisation of health and prevention of disease outcomes.

One of the potential benefits of these genetic tests include gene- based dietary recommendations that are provided to prevent chronic diseases and more precise public health advice for individualised dietary intake and supplement use. Although the use of genotypic information in personalized nutrition offers considerable future

promise, it requires public acceptance and attitude to facilitate the uptake of these tests.

In recent years, some Indian genetic testing companies have created a niche market by providing Direct-to-consumer genetic tests for personalised nutrition. Several studies have been conducted to assess the attitudes and acceptance towards Direct-to-Consumer genetic tests among consumers in developed countries showing positive attitudes (Szakály, Z. *et al*, 2021) (Gollust SE *et al*, 2012) (Hardie EA, 2011) (Ronteltap A, 2007).

Several research studies were found to be conducted on assessing the consumer acceptance or attitudes towards nutrigenetic testing in western population. This study is first of its kind in India, based on the results of the previous research studies, this study will be an attempt to examine the factors influencing consumer acceptance of genetic testing for personalised nutrition in India.

1.2 Materials and Methods

1.2.1 Sampling method

Primary data collection was carried out by means of an in person interview method using the survey questionnaire. The data was collected from 500 individuals who had previously visited a wellness clinic in Coimbatore, India and underwent a personalised nutrigenetic test. An email communication was sent to all the individuals who had taken the genetic tests for nutrition in the clinic to know their interest and willingness to participate in the study (n = 1352), out of which 604 individuals consented to participate in the survey. Finally, data was collected from 500 individuals who provided the required information via the interview method.

1.2.2. Development of a survey questionnaire

Questionnaire was developed after analysing the results of the exploratory study and the existing theoretical literature was also considered. The questions assessing consumer acceptance were developed on the basis of Szakály *et al.* and Ronteltap *et al.* (2007), which determined the extent to which an individual's perceptions and attitudes increase the likelihood of acceptance of a genetically based personalized diet. Potential determinants of consumer acceptance included, attitudes & perceptions, motivation factor, individual's perceptions on sources and genetic information provider, confidence level and utility of DNA based dietary advice. The consumer acceptance of nutrigenetics test was assessed using 28 statements measured on 5-point Likert-scale, which was modified and adapted from Ronteltap *et al.* (2007). Additional information such as socio-demographic information, other information related to lifestyle data was also included as part of the questionnaire.

1.2.3 Mathematical and Statistical Evaluation

Statistical Analysis were exported from SurveyMonkey into Microsoft Excel (Microsoft, Redmonds, CA, USA), to be converted into calculation sheets before being imported into SAS v9.4 (SAS Institute, Cary, NC, USA). Regarding the open-ended questions, common themes were identified using NVivo software v10.2.0. Results were analyzed

as categorical variables. The χ^2 test was used to test for associations between categorical variables. Statistical significance was set at $p < 0.05$.

1.3 Results and Discussion

1.3.1 Study Population

This study aimed to better understand the current situation regarding consumer acceptance of personalised nutrigenetics testing amongst consumers in India.

Table.1 Characteristics of individuals who participated in the baseline survey

Characteristics	Sample Distribution (N = 500)	%	p^1
Gender			
Male	241	48.2	0.0001
Female	259	51.8	
Age			
18-29 years	84	16.8	0.0001
30-39 years	110	22	
40-49 years	123	24.6	
50-59 years	76	15.2	
60-69 years	52	10.4	
Above 70 years	55	11	
Educational Qualifications			
Graduation Degree	126	25.2	0.04
Post-graduation Degree	181	36.2	
Professional Degree	174	34.8	
Doctoral Degree	19	3.8	
Occupation			
House wife	58	11.6	0.0001
Business	167	33.4	
Private Job	126	25.2	
Government Job	51	10.2	

¹ Chi-square test was used to assess differences between subgroups

Characteristics of individuals who participated in the interview session are shown in Table 1. 48% of the participants were males and 52% were females. The mean age was 38.3 ± 14.9 years. The majority of the participants were from the age group between 40- 49 years. 36% of the study participants had a university post- graduation degree and 34.8% had a professional degree. Most of the participants had business as their occupation (33.4%) and 25.2% were working in private sectors.

1.3.2 Personal Medical History and current medical conditions

Significant associations were found between personal and/or familial medical history and the willingness to follow the personalised dietary recommendations. People were more inclined to follow a personalised diet based on their genetic makeup if they had diagnosed hypertension ($p = 0.02$), diagnosed type 2 diabetes ($p = 0.03$), and obesity

($p = 0.04$) and if they had diagnosed heart ailments ($p = 0.01$). In this study, a vast majority of participants reported to be willing to adopt a personalised diet that is based on genetic testing. Moreover, more than 85% of participants who were diagnosed with type 2 diabetes reported to be willing to follow the dietary recommendations based on their genetic makeup. This suggests that individuals identified having a medical condition may be more motivated to comply with dietary intervention.

1.3.3 Perceived advantages and disadvantages of nutrigenetic testing

The advantages and disadvantages perceived by the consumers about receiving personalized dietary advice based on genetic makeup are presented in Table 2. Respondents reported that ease of understanding and specificity of the diet advice was the most frequently reported perceived advantages of nutrigenetic testing (57.5%), followed by more personalised and enjoyable (22.4%) and reduced costs due to disease prevention (20.1%).

Table.2 Perceived Advantages and Disadvantages of Nutrigenetic Testing

Advantages	%	Disadvantages	%
Personalised nutrition is easier to understand and specific than general diet advice.	57.5	Personalized nutrition is much more time-consuming.	34.3
Genotype-based personalized nutrition advice is much Personalized & more enjoyable.	22.4	Personalised nutrition can add cost by advising to consume specific food.	45.7
Costs of diseases can be prevented by personalized nutrition.	20.1	Personalised nutrition advice is not feasible because it is difficult to prepare different foods for different family members.	20

Additionally, 23.5% of the study participants perceived no disadvantage to receiving DNA based dietary advice. While reporting about the disadvantages, “adds cost by advising to consume specific foods (45.7%) was the most frequently mentioned disadvantage followed by “personalised nutrition is much more time consuming” (34.3%) and non- feasibility and difficulty to prepare different foods for different family members (20%).

1.3.4 Confidence level of consumers

Table.3 Confidence Level of Consumers

I feel that genetic- based personalized nutrition	N	Percent
Has a lot of risks.	138	27.6
Has a lot of uncertainty around it.	65	13
Helps me to have full control of my health.	156	31.2
Could help me to prevent diseases.	141	28.2

As shown in Table 3, 31.2% of respondents feel confident that genetic test-based personalized nutrition helps them to have full control of their health and see it as an attractive option, while nearly 27.6% feel genetic based personalised nutrition has a lot of risks. Nearly 28.2% of them believe that it could help them prevent diseases.

1.3.5 Opinions of Sources for motivation factors to adopt personalised nutrition advice

In the survey used in the study, participants were asked to indicate the factors that motivated them to opt for personalised nutrition advice and the response options for this question listed with participants being instructed to select all that applied.

Table.4 Motivation to adopt personalised nutrition advice

Motivation Factor of consumers	Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly agree	Mean response \pm SD
Numerical Value	1	2	3	4	5	
1. Personalized nutrition makes me able to live longer in good health.	9	7	45	260	179	4.43 \pm 0.79
2. Personalized nutrition can help disease prevention.	5	18	6	186	285	4.17 \pm 1.05
3. If I weigh up the benefits and drawbacks of genetic-based personalized nutrition, I can see more benefits.	4	8	42	164	282	3.98 \pm 1.05

Three statements were included in the survey to assess motivation to adopt personalised nutrition advice based on genetic testing in order to determine their perceptions of these statements to understand the underlying motivation factors. The most commonly selected response among the 500 participants was 'personalised nutrition could help disease prevention' (57%), followed by 'can see more of benefits over drawbacks of genetic based personalised nutrition' (56.4) and 'personalised

nutrition makes me able to live longer in good health' (52%). The response options used in the questionnaire, 'personalised nutrition makes me able to live longer in good health' (Mean response \pm SD, 4.17 \pm 1.05), 'personalised nutrition can help disease prevention' (Mean response \pm SD, 4.43 \pm 0.79) and 'If I weigh up the benefits and drawbacks of genetic based personalised nutrition, I can see more of benefits ((Mean response \pm SD, 3.98 \pm 1.05). Trends in increases toward the positive end of the scale were observed for the statements.

1.4 Conclusion

It may be concluded that individuals with personal history of chronic disease have a heightened perceived susceptibility to disease and seem to have a positive outlook towards genetic based personalised nutrition. Majority of our study participants perceived many advantages to nutrigenetic testing (mainly health reasons). They are generally aware of the potential privacy issues of nutrigenetic testing, but do not seem to fully understand the risks associated with the ownership of personal genetic information. The findings further support that the study population is generally optimistic regarding the use of nutrigenetics in health care practice, preferably routed through health care professionals especially via registered dietitians.

Several risks have been identified in relation to the genetic testing for personalised nutrition by the consumers, which needs to be adequately addressed through effective communication to overcome individuals' fear while designing and implementing gene based personalised nutrition services. A realistic and pragmatic approach to ensure the consumers are motivated to engage these services. Awareness creation, public education, counselling regarding genetic testing for multifactorial diseases, personalised nutrition to optimise health and disease prevention are likely to help to improve uptake and acceptance of a nutrigenetic-based personalised nutrition services.

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Author Contributions

Janani Tamilvanan was responsible for the conception, writing, proofreading, editing of the article writing and tables/figure preparation. Kalpana CA is the corresponding author of this article and was involved in writing and reviewing.

Conflict of Interest

The author(s) declare(s) that there is no conflict of interest.

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