**Egyptian Journal of Nutrition**
Offiwcial journal of the Egyptian Nutrition Society
**Print ISSN**: 1687-1235
**Online ISSN**: 2090-2514
Vol. 39 (3): 94 – 106 (2024)
https://ejn.journals.ekb.eg/

# Awareness and Perception of Students Towards Nutrigenomics for Personalized Nutrition

Dare Ademiluyi [1]*, Ibiyemi Olayiwola[1], Ayobami Ojo-adalumo [2], and Boluwatife Oyewumi[1].

1; Nutrition and Dietetics Department, Federal University of Agriculture, Abeokuta. Ogun state, Nigeria.

2; Nutrition and Dietetics Department, Federal Medical Center, Idi Aba, Abeokuta, Ogun state, Nigeria.

*Corresponding email: ademiluyidare@gmail.com Phone No: +2347033169105

## ABSTRACT

Background: Nutrigenomics, a science at the intersection of genetics and nutrition, explores how dietary components influence gene expression and provide insights into personalized approaches for disease prevention. The study aims to evaluate the awareness and perceptions of nutrigenomics among undergraduate students, identify factors influencing awareness, and assess the relationship between genetic knowledge and attitudes toward nutrigenomics for personalized nutrition at the Federal University of Agriculture Abeokuta. Methodology: A multi-stage (4) cross-sectional survey was conducted among 400 full-time undergraduate students selected through multistage sampling at the Federal University of Agriculture Abeokuta. Data was collected using a structured questionnaire comprising sections on demographics, perceptions of nutrigenomics, factors influencing awareness, and general genetic knowledge. Statistical analyses, including descriptive statistics, independent t-tests, ANOVA, and Pearson correlation coefficients, were performed using SPSS version 25. Result: The study found that 60% of participants were aware of nutrigenomics, although their general genetic knowledge was moderate (average score of 57%). Students majoring in biological sciences and those who had taken genetics courses demonstrated higher knowledge scores. Positive perceptions of nutrigenomics were prevalent, particularly regarding its potential in disease prevention. However, concerns about the cost and accessibility of nutrigenomics testing were significant. The study revealed a non-significant negative correlation between genetic knowledge and positive attitudes towards nutrigenomics. Conclusion: The findings highlight the need for enhanced genetics education at the college level, particularly in non-biological science disciplines. Targeted educational interventions and cost-effective approaches are recommended to maximize the potential of nutrigenomics in personalized nutrition.
Abstract should be accurate, self-contained, and readable. It should describe the purpose of study, methodology, summary of findings/results, conclusion. Abstract should be unstructured, i.e. should not contain sections or subheadings. Abstract must not exceed 300 word.

**Keywords:** ;Nutrigenomics, Personalized Nutrition, Genetic Knowledge, Undergraduate Students, Disease Prevention.

***Received:1-9-2024*** ***Accepted: 3-10-2024*** ***Published: 9-2024***

# INTRODUCTION

Nutrigenomics, an emerging science, explores how dietary components and metabolites influence gene expression and interact with the genome, establishing a connection between food-related factors and genetic responses. Understanding these interactions is key to regulating metabolic processes associated with age-related disease risk factors such as obesity, cardiovascular disease, and inflammation **(Park *et al*., 2017).**

Diet and genomes interact. Nutrition has the most important life-long environmental impact on human health. While nutrigenetics addresses how an individual's genetic makeup predisposes for dietary susceptibility, nutrigenomics asks how nutrition influences the expression of the genome. Human history has evolved through genetic adaptations to diets, shaping the human genetic profile and influencing diverse traits. Local adaptations to region-specific dietary components may have been a critical force shaping the human genome, driving population differentiation, and laying the genetic foundation for human diversity **(Ye and Gu, 2011; Sales *et al*., 2014).** The interplay between food consumption patterns, environmental predisposition, and human health is a central focus in nutritional studies, contributing to our understanding of maintaining health in diverse dietary conditions **(Gibney and Walsh, 2013).**

Nutritional medicine, rooted in nutrigenomics, contends that whole-food, plant-based, nutritionally dense diets positively impact gene expression and disease incidence **(Sharma and Dwivedi, 2017).**

Human genetic variation underlies phenotypic diversity and disease susceptibility, with genome-wide association studies linking genetic variations to complex traits and common diseases. Despite the challenges in explaining all genetic implications, research in this realm promises to elucidate the genetic architecture of human health, generating hypotheses and directions for medical research **(Ye and Gu, 2011).**

Dietary and nutritional effects, mediated by epigenetic mechanisms, can be transmitted to the next generation. This project seeks to explore the influence of epigenetic markers on nutritional therapy, focusing on various dietary factors and their impact on personalized nutrition **(Park *et al*., 2017).**

Nutrigenomics holds promise in reducing the incidence of complex diseases, including non-communicable diseases that contribute significantly to global mortality. However, the successful implementation of personalized nutritional care faces challenges such as limited public awareness, the complexity of the field, and ethical concerns. Barriers include the need for increased understanding, acceptance, and support for nutrigenomics technologies, particularly among emerging adults, who represent a critical demographic for the future of personalized nutrition **(Fenech *et al*., 2011 and Oria and Kumanyika, (2017).).**

The students also form a very diverse and influential population, coming from a wide range of cultural and seriocomic backgrounds. Therefore, examining the knowledge and perceptions of university students could help researchers and healthcare providers strategize, identify future opportunities, and address potential challenges in this rapidly evolving scientific field.

MATERIALS AND METHODS

# METHODOLOGY

**Study Design**

The research design is cross-sectional study aimed to access the awareness and perception of undergraduate students towards nutrigenomics for personalized nutrition therapy at the Federal University of Agriculture, Abeokuta. Independent variables included gender, age, current academic standing, college major, awareness of nutrigenomics and nutrigenetics, and current or past enrolment in college-level genetics or nutrition courses.

**Sampling technique and procedure**

The study applied a multistage sampling method.

a) Stage 1: Selection of colleges

b) Stage 2: Selection of departments

c) Stage 3: Stratified respondents into Strata

Selected departments are being stratified into strata (level) using a stratified sampling technique. These departments are (1) Food Science and Technology (2) Nutrition and dietetics (3) Pure and Applied Botany (4) Biochemistry (5) Plant Breeding and Seed Technology (6) Plant Physiology and Crop Production (7) Animal Breeding and Genetics and (8) Animal Nutrition

Nutrigenetics enables us to realize how our genes affect the method we react to foods beverages, and supplements. This analyses how genetic makeup or variations of individuals affect their response to diet. It has long been visible that certain people react differently from others to particular foods

d) Stage 4: Selection of respondents

**Method of Data collection**

The survey questionnaire was adapted from the questionnaire (Wilkins, 2017) and modified to reflect the demographics of the survey area and comprised four main sections including 1) general demographics, 2) perceptions related to nutrigenomics for personalized nutrition, 3) factors affecting consciousness to knowledge of nutrigenomics and 4) general knowledge of genetics. The survey Nutrients in food, such as proteins and vitamins, provide our bodies with the energy questionnaire consists of a total of 30 questions. #### Nutrigenomics is a new and developing science that studies the interaction between the nutrients in our food and the genes in our bodies. we need to live

Part I: General Demographics

Part I of the survey included six general demographic questions including age, ethnicity, weight, height, class ranking, and participation in college-level nutrition or genetics courses. Descriptive statistics was used to calculate means, standard deviations, frequencies, and percentages for analysis of data collected from Part I.

Part II: Perceptions of Nutrigenomics for Personalized/Individualized Nutrition

Survey was used to assess the perception or attitudes of respondents to nutrigenomics through a series of 22 questions **(Wilkins, 2017; Berdanier and Berdanier, 2021).**

Part III: Factors influencing the perception towards the knowledge of Nutritional genomics

Data collected in this section of the survey was measured using a five-point Likert-type scale, ranging from (1) to (5) indicating different degree of awareness.

Part IV: General Genetic Knowledge

This portion of the survey assessed college students' general genetic knowledge. The questions in this section of the survey were measured using a true-false quiz. Genetic knowledge was assessed based on responses to a 19-question assessment **(Wilkins, 2017).**

### Data Analysis

Analysis of the results was completed using the Statistical Package for Social Sciences (SPSS) version 25 The independent variables are gender, age, field of study, current academic status, knowledge of nutrigenomics, and current or previous enrollment in college-level genetics or nutrition courses. Dependent variables include general genetic knowledge and conceptions of nutritional genomics for personalized nutritional therapy. Independent sample t-tests were be conducted comparing the mean scores of genetics knowledge and nutrigenomics perception among gender groups, and groups who may either be familiar with nutrigenomics for personalized nutrition therapy or not. A Pearson correlation coefficient was calculated for the relationship between genetics knowledge scores and perception of nutrigenomics scores. ANOVA was used to determine whether there are differences in genetics knowledge and perceptions. A significance of $P \leq 0.05$ is set for all t-test and ANOVA measureme

## RESULTS AND DISCUSSION

## RESULTS

### Socio-Demographic Characteristics

The study analysed socio-economic and demographic features, such as age, gender, academic level, and department affiliation. Table 1 summarizes the demographic data of 305 participants, aged 18 to 35, with a mean age of 21.17 years. Females constituted 61.3% of respondents, primarily falling within the 18-23 age range (81%). About 51% reported involvement in a college-level nutrition course, and 70% in a genetics course. The departmental distribution indicated NTD as the highest at 19%, followed by PPCP and PBST (13.5% and 13%, respectively), and AGB and FST collectively accounting for 25%.

### Figures and Tables

**Table 1: Socio-Demographic Characteristics of the respondents**

| Variables | Frequency | Percentage (%) |
|---|---|---|
| **Gender** | | |
| Male | 155 | 38.7 |
| Female | 245 | 61.3 |
| Total | 400 | 100.0 |
| **Mean ± SD -** 21.17 ± 2.70 | | |
| **Age** | | |
| 18-23 | 247 | 81.0 |
| 24-29 | 56 | 18.4 |
| 30-35 | 2 | 7 |
| Total | 305 | 100.0 |
| **Level** | | |
| 100 | 68 | 17.0 |

| | | |
|---|---|---|
| 200 | 114 | 28.5 |
| 300 | 84 | 21.0 |
| 400 | 58 | 14.5 |
| 500 | 76 | 19.0 |
| Total | 400 | 100.0 |
| **Department** | | |
| COLANIM | 88 | 22.0 |
| COLPLANT | 106 | 26.5 |
| COLFHEC | 127 | 31.8 |
| COLBIOS | 79 | 19.8 |
| Total | 400 | 100.0 |

## Genetic Knowledge Assessment

with Table 2 presenting the results adjusted for missing data. On average, participants correctly answered approximately 56% (n=223) of the questions The findings revealed a non-significant negative linear relationship, r (398) = -0.037, $p \leq 0.461$, indicating that positive attitudes toward nutrigenomic testing were not significantly associated with higher genetics knowledge scores among the surveyed college students

Table 2: Genetic Knowledge Test Scores among Respondent

| Item | Mean ± SD (n) | Correct % (n) | Incorrect % (n) | Don't know % (n) |
|---|---|---|---|---|
| *True or false* | | | | |
| A gene is a portion of DNA, which codes for protein, which leads to a trait. | 1.06 ± 0.46 (383) | 93.7 (359) | 2.6 (10) | 3.7 (14) |
| Males inherit two X-chromosomes at birth, one from their mother and one from their father. | 0.83 ± 1.48 (384) | 42.2 (162) | 48.4 (186) | 9.4 (36) |
| The human genome project has estimated that humans have between 20,000 and 25,000 genes. | 1.95 ± 1.16 (391) | 35.8 (140) | 11.3 (44) | 52.9 (207) |
| Genes contain chromosomes. | 0.45 ± 0.85 (396) | 21.7 (86) | 70.5 (279) | 7.8 (31) |
| A genotype is the genetic make-up of an organism. | 1.09 ± 0.56 (397) | 88.4 (351) | 4.8 (19) | 6.8 (27) |
| In humans, each cell normally contains 23 pairs of chromosomes, for a total of 46. | 1.12 ± 0.54 (396) | 90.7 (359) | 2.3 (9) | 7.1 (28) |
| A phenotype is a physical expression of alleles (brown eyes or blue eyes). | 1.20 ± 0.67 (397) | 85.4 (339) | 3.0 (12) | 11.6 (46) |
| A mutation occurs when the structure of a gene changes. | 1.21 ± 0.74 (396) | 81.3 (322) | 5.3 (21) | 13.4 (53) |
| Mutations always lead to negative health outcomes. | 1.00 ± 1.19 (392) | 29.1 (114) | 47.2 (185) | 23.7 (93) |
| An allele is the different forms of a gene, represented by letters. | 1.52 ± 1.02 (397) | 61.0 (242) | 8.8 (35) | 30.2 (120) |
| A dominant trait is a trait that is hidden in the F1 generation. | 1.14 ± 1.14 (392) | 41.3 (162) | 34.4 (135) | 24.2 (95) |
| Epigenetics is the study of changes in an organism's gene expression without a change in the genetic code. | 1.79 ± 1.22 (397) | 50.6 (201) | 7.6 (30) | 41.8 (166) |
| DNA repair is a collection of processes where a cell identifies and repairs DNA molecules that encode its genome. | 1.47 ± 0.90 (391) | 72.1 (282) | 2.8 (11) | 25.1 (98) |
| A point mutation is a type of mutation that causes a single nucleotide base substitution, insertion, or deletion. | 1.66 ± 1.04 (394) | 56.9 (224) | 6.9 (27) | 36.3 (143) |
| An example of a genotype that is heterozygous is AA. | 1.02 ± 1.04 (394) | 47.2 (186) | 34.5 (136) | 18.3 (72) |
| An example of a genotype that is homozygous is cc. | 1.40 ± 0.97 (397) | 65.2 (259) | 9.8 (39) | 24.9 (99) |

------------------------------------------------------------------------------------------------------------------------------------

| | | | | | |
|---|---|---|---|---|---|
| **Mutations can create variations in protein "switches" that control protein function.** | **1.57 (392)** | **± 0.97** | **64.5 (253)** | **4.6 (18)** | **30.9 (121)** |
| **Mutations cannot be reversed through DNA repair.** | **1.65 (397)** | **± 1.24** | **35.3 (140)** | **21.4 (85)** | **43.3 (172)** |
| **A recessive trait can be carried in a person's genes without appearing in their phenotype.** | **1.34 (397)** | **± 0.92** | **69.3 (275)** | **9.3 (37)** | **21.4 (85)** |
| **RNA contains the genetic information which is encoded in gene preserve for generation to come.** | **0.91 (396)** | **± 1.24** | **14.4 (57)** | **60.1 (238)** | **25.5 (101)** |

***Note.*** *Abbreviations.*SD, standard deviation; n, number of members in the sample.

***Note.*** *Abbreviations.*SD, standard deviation; n, number of members in the sample.

## Compare the mean knowledge scores between participants who indicated participation in college-level nutrition and/or genetics course

An independent sample t-test (Table 3  students in a nutrition course, no significant effect was observed (p > 0.098), as both participating (mean score: 11.02 ± 4.07) and non-participating students (mean score: 11.69 ± 3.69) displayed comparable genetics knowledge scores. Conversely, students involved in a genetics course exhibited significantly lower scores (mean score: 11.25 ± 3.81, p > 0.571) on the
genetics knowledge assessment

Table 3: Differences in Genetics Knowledge Scores according to College Genetics and/or Nutrition Course Participation

| College Course participation | Mean ± SD | (n)% | p-Value |
|---|---|---|---|
| **Offer Nutrition related Course** | | | |
| **Yes** | **11.02 ± 4.07** | **(196) 50.8** | **0.652** |
| **No** | **11.69 ± 3.69** | **(190) 49.2** | |
| **Offer Genetic related Course** | | | |
| **Yes** | **11.29 ± 3.81** | **(272) 69.9** | **0.004** |
| **No** | **11.54 ± 4.45** | **(117) 30.1** | |
| **Have you heard or read about these genetic fields** | | | |
| **Yes** | **11.44 ± 3.831** | **242** | **0.081** |
| **No** | **11.23 ± 4.341** | **143** | |

*Show t-test statistical significance, where statistical significance was set at α-0.05.
Abbreviations: SD, standard deviation; n, number of members in the sample

## Genetics Knowledge Scores based on Departmental levels

The analysis revealed a significant difference in genetics knowledge among class ranks (p = 0.002). Post-hoc Tukey tests indicated no significant distinctions between 100-level, 200-level, and 300-level students (p > 0.05). However, both 500-level and 400-level students exhibited significantly lower scores on the genetics knowledge test compared to 100-level and 200-level students (p = 0.002), as well as 300-level students (p > 0.003).

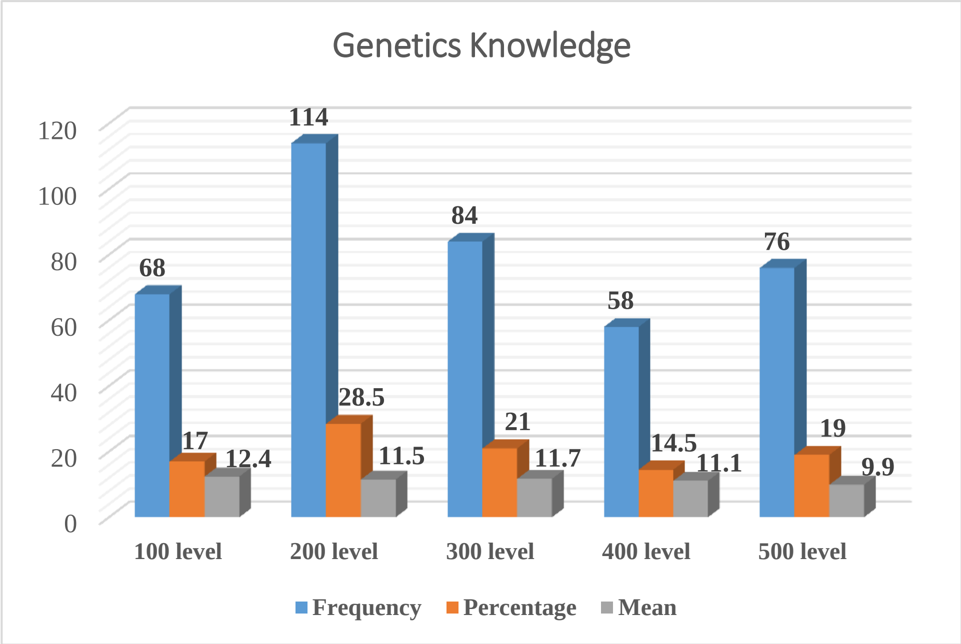


Figure 1: Genetics Knowledge Scores based on Departmental level

**Perception of Respondent toward Nutrigenomics for Personalized Nutrition.**

Results from perceptions, presented in Table 5 on a 5-point Likert scale, highlighted strong agreement (mean response: 3.58 ± 0.48, n=396) with the idea that "Knowledge of nutrigenomics for personalized nutrition will lead to the prevention of some diseases." Notably, 49% expressed concerns about the cost and accessibility of nutrigenomic tests, concurring with the statement, Independent sample t-tests, exploring mean perception scores based on gender and familiarity with nutrigenomic testing, revealed no significant gender-based differences ($p \geq 0.05$). However, participants in a genetics course held significantly more positive perceptions towards nutrigenomics than those without awareness ($p = 0.04$).

Table 4: Awareness and Perception of Respondent toward Nutrigenomics

| Perception | Mean ± SD[a] | A/SA (n) | NEU % (n) | D/SD % (n) |
|---|---|---|---|---|
| **Screening for known genes is the way forward for medicine and nutrition.** | **3.83 ± 1.06** | **77.5 (303)** | **12.5 (49)** | **10 (39)** |
| **Gene testing for personalized nutrition will lead to the prevention of some diseases.** | **4.94 ± 0.98** | **84.4 (330)** | **7.4 (29)** | **8.2 (32)** |
| **In my lifetime, I expect to see significant medical improvements due to the use of genetics in nutrition.** | **4.30 ± 2.17** | **86.6 (338)** | **9.5 (37)** | **3.8 (15)** |
| **I am concerned that my genetic information will be made available for research purposes.** | **3.59 ± 1.04** | **63.3 (242)** | **18.8 (72)** | **17.8 (68)** |
| **My genes have influenced my health.** | **3.88 ± 1.12** | **72.3 (281)** | **15.2 (59)** | **12.6 (49)** |
| **Nutrigenomics knowledge for personalized nutrition is too hard to understand.** | **2.92 ± 1.12** | **31.4 (120)** | **29.6 (113)** | **39 (149)** |
| **I would like to know about future diseases through the knowledge of nutrigenomics.** | **3.97 ± 0.92** | **80.4 (314)** | **12 (47)** | **7.7 (30)** |
| **I think there is too much focus on genetics when money could be spent on the world's starving population.** | **2.84 ± 1.24** | **30 (117)** | **26.9 (105)** | **43.1 (168)** |

| | | | | |
|---|---|---|---|---|
| **Genetic testing for personalized nutrition should be available to everyone.** | **4.11 ± 0.89** | **72.5 (282)** | **15.2 (59)** | **12.4 (50)** |
| **I am concerned that not enough will be done to protect the confidentiality and privacy of my genetic information.** | **3.24 ± 1.16** | **45.5 (176)** | **26.9 (104)** | **27.6 (107)** |
| **Having Knowledge about nutrigenomics allows individuals to control their lifestyle more easily.** | **4.01 ± 0.96** | **84.4 (330)** | **7.4 (29)** | **8.2 (32)** |
| **Genetic knowledge for personalized nutrition will result in discrimination.** | **2.76 ± 1.95** | **23.9 (93)** | **26.1 (101)** | **50 (194)** |
| **Nutri-genetic for personalized nutrition will help people to live longer.** | **3.92 ± 0.96** | **79.1 (312)** | **11.2 (44)** | **9.7 (38)** |
| **All individuals should be made aware of nutrigenomics for personalized nutrition.** | **4.21 ± 2.26** | **84.9 (332)** | **9.5 (37)** | **5.7 (22)** |
| **I am concerned that not enough will be done to protect the confidentiality and privacy of my genetic information.** | **3.24 ± 1.16** | **45.5 (176)** | **26.9 (104)** | **27.6 (107)** |
| **Having Knowledge about nutrigenomics allows individuals to control their lifestyle more easily.** | **4.01 ± 0.96** | **84.4 (330)** | **7.4 (29)** | **8.2 (32)** |
| **Genetic knowledge for personalized nutrition will result in discrimination.** | **2.76 ± 1.95** | **23.9 (93)** | **26.1 (101)** | **50 (194)** |
| **Nutrigenetics for personalized nutrition will help people to live longer.** | **3.92 ± 0.96** | **79.1 (312)** | **11.2 (44)** | **9.7 (38)** |
| **All individuals should be made aware of nutrigenomics for personalized nutrition.** | **4.21 ± 2.26** | **84.9 (332)** | **9.5 (37)** | **5.7 (22)** |
| **Nutrigenomics knowledge would cost too much and would only be available to the educated.** | **3.28 ± 1.21** | **48.7 (191)** | **22.2 (87)** | **29.1 (114)** |
| **I am worried that nutrigenetics testing may lead to eugenics (the science of improving the human population by controlling breeding to increase desirable characteristics).** | **3.31 ± 1.15** | **49.9 (194)** | **26.5 (103)** | **23.6 (92)** |
| **Nutrigenomics knowledge for personalized nutrition will make medical cures for diseases more possible.** | **4.16 ± 2.26** | **317 (81.3)** | **48 (12.3)** | **24 (6.2)** |
| **Nutrigenomics knowledge for personalized nutrition should be promoted extensively.** | **4.14 ± 0.94** | **83.8 (326)** | **11.2 (43)** | **4.9 (19)** |
| **I do not believe that nutrigenomics for personalized nutrition is backed by sound science.** | **2.61 ± 1.09** | **20.2 (77)** | **31.8 (121)** | **48.1 (183)** |
| **Genetic testing for personalized nutrition goes against my religious beliefs.** | **2.02 ± 1.14** | **51 (13.3)** | **10.4 (40)** | **76.2 (292)** |
| **I believe it is essential to assign more money to nutrigenomic developments.** | **3.97 ± 0.93** | **299 (76.9)** | **58 (14.9)** | **32 (8.2)** |

a = calculated from a 5-point Likert style scale where (1) equals *strongly disagree* and (5) equals *strongly agree*. Abbreviations*:* A/SA, agree/strongly agree; **NEU**, neutral; **D/SD**, disagree/strongly disagree; SD, standard deviation; (n), number of memb

## Influencing Awareness about Nutrigenomics

(Table 5) revealed no significant gender differences except for the belief that there is no expert in the field (p = 0.007), where female respondents expressed more encouragement to participate. Free **Factors** responses indicated limited understanding, interest, and concerns about the accuracy of results as barriers, while motivations included improved health, fitness, and quality of life.

Table 5: Factors influencing the awareness about Nutrigenomics for personalized nutrition among respondent

| Factors | Gender | Mean ± SD | (n) | p-Value |
|---|---|---|---|---|
| **Dogmatic belief towards traditional Medicine** | **Male** | **2.58 ± 1.29** | **149** | **0.106** |
| | **Female** | **2.37 ± 1.18** | **233** | |
| **I believe is still a hypothesis** | **Male** | **2.74 ± 1.12** | **149** | **0.741** |
| | **Female** | **2.70 ± 1.14** | **239** | |
| **Availability of more detailed Information** | **Male** | **3.62 ± 1.11** | **146** | **0.476** |
| | **Female** | **3.40 ± 1.12** | **230** | |
| **I believe there are no expectations to handle this field both in health and education sector** | **Male** | **2.66 ± 1.14** | **147** | **0.007*** |
| | **Female** | **2.84 ± 1.34** | **238** | |
| **Family or friend's advice** | **Male** | **3.05 ± 1.25** | **150** | **0.332** |
| | **Female** | **3.04 ± 1.36** | **235** | |
| **Family history of particular disease** | **Male** | **2.45 ± 1.33** | **150** | **0.195** |
| | **Female** | **2.57 ± 1.40** | **240** | |
| **Lack of money to pay for testing treatments or possible** | **Male** | **3.22 ± 1.30** | **147** | **0.468** |
| | **Female** | **3.13 ± 1.35** | **238** | |
| **Lack of time** | **Male** | **2.99 ± 1.60** | **146** | **0.507** |
| | **Female** | **2.96 ± 1.37** | **233** | |
| **Fear to discover some fact about my genetic makeup and what type of food to Eat** | **Male** | **2.67 ± 1.32** | **144** | **0.713** |
| | **Female** | **3.05 ± 1.51** | **236** | |
| **I think it's useless** | **Male** | **1.88 ± 1.27** | **145** | **0.600** |
| | **Female** | **1.86 ± 1.16** | **239** | |
| **It is not within my course specification** | **Male** | **2.24 ± 1.36** | **140** | **0.718** |
| | **Female** | **2.20 ± 1.33** | **229** | |
| **It is an invasion of privacy** | **Male** | **2.05 ± 1.20** | **148** | **0.597** |
| | **Female** | **2.07 ± 1.23** | **235** | |

Table 5 Continued.

| Item | Gender | Mean ± SD | (n) | p-Value |
|---|---|---|---|---|
| **Nutrigenomics use many difficult fields to access and search for understanding** | **Male** | **3.12 ± 1.28** | **150** | **0.767** |
| | **Female** | **3.17 ± 1.23** | **234** | |
| **I don't have a lecturer that has a major Degree in the field unlike every other** | **Male** | **2.32 ± 1.30** | **150** | **0.713** |
| | **Female** | **2.37 ± 1.24** | **232** | |

| | | | | |
|---|---|---|---|---|
| **first.** | | | | |
| **It is just a recent advance in the field of nutrition and health though have gained large the ground in the developed Country** | **Male**<br>**Female** | **2.96 ± 1.33**<br>**3.12 ± 1.26** | **150**<br>**234** | **0.876** |
| **It requires sophisticated equipment to carry out genetic testing** | **Male**<br>**Female** | **3.60 ± 1.23**<br>**3.08 ± 1.26** | **151**<br>**237** | **0.473** |
| **Little or no Hospital facilities have the capability in term of trained staff to carryout genetic test for Personalized Nutrition** | **Male**<br>**Female** | **3.35 ± 1.21**<br>**3.08 ± 1.30** | **150**<br>**230** | **0.506** |
| **I dislike anything that has to deal with Gene** | **Male**<br>**Female** | **1.85 ± 1.16**<br>**1.86 ± 1.15** | **149**<br>**237** | **0.958** |
| **Nutrigenomics as a course is very difficult to Understand** | **Male**<br>**Female** | **2.32 ± 1.44**<br>**2.37 ± 1.34** | **147**<br>**237** | **0.129** |
| **The tools of study used to understand nutrigenomics (e.gepigenomics, proteomics, metabolomics, etc.) are difficult to understand.** | **Male**<br>**Female** | **2.66 ± 1.20**<br>**2.68 ± 1.19** | **150**<br>**237** | **0.703** |

Note. The mean was calculated from data from a 5-point Likert style scale where one equals 'Not at all likely' and five equals 'completely likely'. *Show statistical significance, where statistical significance was set at $p \leq 0.05$. Abbreviations: **SD**, standard deviation; **n**, number of members in the sample.

The study included 400 participants, with a gender distribution of 38.7% male and 61.3% female. This distribution contrasts with **Wilkins' (2017)** study, which reported a predominance of female respondents (73%). Additionally, the age range of participants in this study (17 to 35 years) was narrower compared to Wilkins' broader range (18 to 60 years). Participants were selected through a multi-stage sampling method involving random selection of four colleges and subsequent departments, differing from Wilkins' targeted selection approaches

Nutritional genomics concerns assessing an individual's genetic variations and using this information, coupled to the gene variant–diet and lifestyle–disease associations, to develop therapeutic interventions that will improve disease management and provide effective approaches for disease prevention. 94% of respondents indicated they are not sufficiently knowledgeable in personalized nutrition

The gender distribution in this study (38.7% males and 61.3% females) reflects a trend observed by Wilkins (2017), who noted a similar predominance of female respondents in related studies. The age range of 17 to 35 years in this study is pertinent, as this demographic is often more receptive to technological innovations and data-driven approaches, which are essential for advancing nutrigenomics and omics science. A substantial portion of the participants, 50.8%, had completed college-level nutrition courses, and 69.9% had studied genetics.

The study observed that 50.8% of participants had completed a college-level nutrition course, and 69.9% had taken a college-level genetics course. This marks a significant improvement compared to the Human Genome Education Model Project, where 80% of health professionals reported no formal genetics **training (Lapham *et al*., 2000; Wilkins, 2017),** suggesting a positive trend in genetics education within higher education curricula.

Sixty percent of students reported prior exposure to nutrigenomics, indicating a higher awareness compared to previous research. For instance, a U.S. national survey found only 14% awareness of nutrigenomic tests (Goddard *et al*., 2009; Wilkins, 2017)  This finding aligns with Wilkins' (2017) study, which reported similar levels of genetic knowledge, and mirrors broader trends observed in other studies involving Dutch chronic disease patients and UK dietitians (**Wilkins, 2017; Whelan *et al*., 2008**). The study highlights the need for college programs to address these knowledge gaps, which are also prevalent among healthcare professionals **(Rolfes, 2006; Mahan, 2016).** Notably, students majoring in biological sciences performed better on genetic knowledge assessments compared to those in agricultural and physical sciences, which is expected given the more extensive genetics content in life sciences programs.

This contrasts with Wilkins' (2017) findings, which pointed to broader issues with genetic education among college students and healthcare professionals

**Alotaibi and Cordero (2021)** similarly stress the general lack of genetics knowledge, underscoring the need to enhance genetic education to better integrate genomics into public health practices.

Participants in this study expressed support for nutrigenomic testing, particularly regarding its potential for disease prevention, though concerns about cost and exclusivity were prevalent. These findings are consistent with other studies highlighting the potential impact of genetic testing on behavioral changes and the significant obstacle of cost **(Grimaldi *et al*., 2017; Keith, 2013).** Privacy issues and religious concerns were less significant in this study compared to previous research **(Fallaize *et al*., 2013; Grimaldi *et al*., 2017; Wilkins, 2017**), suggesting a more open-minded attitude towards nutrigenomics among university students. Cost emerged as a significant concern, corroborating **Mustapa *et al*. (2020)**, who identified cost as a major factor influencing the adoption of nutrigenomics. **Mustapa *et al*. (2020)** also noted that perceived benefits of nutrigenomics mediate factors such as perceived risks, engagement with medical genetics, trust in key players, and religiosity

Keith's (2013) study, which reported a significant decrease in willingness to pay for genetic testing when costs were high. These results highlight the need for more affordable nutrigenomic testing options to ensure broader accessibility. Overall, the study demonstrates substantial engagement in genetic education at the college level but reveals ongoing gaps in genetic knowledge. It supports the need for continued emphasis on genetic education in college programs to bridge these gaps and prepare future healthcare professionals for effective utilization of nutrigenomics in clinical practice.

## CONCLUSION

Nutrigenomics is a powerful tool that guides investigators though a more global and molecular consideration of the various factors that influence the human biological response to diet.
The findings not only contribute to the academic discourse on genetic education but also underscore the practical challenges that need attention for the successful integration of nutrigenomic testing into broader public health initiatives. Addressing the identified gaps in knowledge, optimizing educational strategies, and developing cost-effective approaches to nutrigenomic testing are crucial steps toward realizing the potential of personalized nutrition in disease prevention.

----------------------------------------------------------------------------------------------------------------------------

## REFERENCES

**Alotaibi, A. A. and Cordero, M. A. (2021).** Assessing medical students' knowledge of genetics: Basis for improving genetics curriculum for future clinical practice. *Advances in Medical Education and Practice*, 12, pp. 1521-1530. https://doi.org/10.2147/amep.s337756

**Berdanier, C. D. and Berdanier, L. (2021).** Nutrigenomics. Advanced Nutrition, pp. 171-199. https://doi.org/10.1201/9781003093664-10

**Fallaize, R., Macready, A. L., Butler, L. T. and Ellis, J. A.** (2013). An insight into the public acceptance of nutrigenomic-based personalised nutrition. *Nutritional Research Reviews*, 26(1), pp. 39–48.

**Fenech, M., El-Sohemy, A., Cahill, L., Ferguson, L. R., French, T. C., Tai, E. S., Milner, J., Koh, W., Xie, L., Zucker, M., Buckley, M., Cosgrove, L., Lockett, T., Fung, K. Y. and**

**Gibney, E. R. (2019).** Personalised nutrition – phenotypic and genetic variation in response to dietary intervention. *Proceedings of the Nutrition Society*, 79(2), pp. 236-245. https://doi.org/10.1017/s0029665119001137

**Gibney, M. J. and Walsh, M. C. (2013).** Symposium 2: Intervention study design and personalised nutrition: The future direction of personalised nutrition: my diet, my phenotype, my genes. *Proceedings of the Nutrition Society*, (July 2012), pp. 1–7. https://doi.org/10.1017/S0029665112003436

**Goddard, K. A., Duquette, D., Zlot, A., Johnson, J., Annis-Emeott, A., Lee, P. W. And Rafferty, A. (2009).** Public awareness and use of direct-to-consumer genetic tests: Results from 3 state population-based surveys, 2006. American Journal of Public Health, 99(3), pp. 442–445.

**Grimaldi, K. A., Van Ommen, B., Ordovas, J. M., Parnell, L. D., Mathers, J. C., Bendik, I. and Lovegrove, J. (2017).** Proposed guidelines to evaluate scientific validity and evidence for genotype-based dietary advice. *Nutrition Reviews*, 75(8), pp. 1–12. https://doi.org/10.1186/s12263-017-0584-0

**Head, R. (2011).** Nutrigenetics and Nutrigenomics: Viewpoints on the current status and applications in nutrition research and practice. *Lifestyle Genomics*, 4(2), pp. 69-89. https://doi.org/10.1159/000327772

**Keith, C. M. (2013).** Do we know enough? A scientific and ethical analysis of the basis for genetic-based personalized nutrition. *Current Nutrition and Food Science*, 9(1), pp. 1–7. https://doi.org/10.1007/s12263-013-0338-6

**Kumanyika, S., editors. (2017)**. *Guiding Principles for Developing Dietary Reference Intakes Based on Chronic Disease*. Washington, DC: National Academies Press (US). Available from: https://www.ncbi.nlm.nih.gov/books/NBK465024/

**Lapham, E. V., Kozma, C., Weiss, J. O., Benkendorf, J. L. and Wilson, M. A. (2000).** The gap between practice and genetics education of health professionals: HuGEM survey results. *Genetics in Medicine*, 4(2), pp. 226-231.

**Mahan, L. K. (2016*).*** *Krause's Food and the Nutrition Care Process - E-book: Krause's Food and the Nutrition Care Process*. Elsevier Health Sciences.

**Mustapa, M. T., Pritchard, H. W. and Scholes, R. (2020).** Economic considerations of nutrigenomics. *Journal of Nutritional Science*, 9(3), pp. 1–9.
National Academies of Sciences, Engineering, and Medicine; Health and Medicine Division; Food and Nutrition Board; Committee on the Development of Guiding Principles for the Inclusion of Chronic Disease Endpoints in Future Dietary Reference Intakes;**,**

**Park, J. H., Yoo, Y. and Park, Y. J. (2017).** Epigenetics: Linking nutrition to molecular mechanisms in aging. *Journal of Nutrition and Health*, 22(January), pp. 81–89.

**Pavlidis, C., Patrinos, G. P. and Katsila, T. (2015).** Nutrigenomics: A controversy. *Applied and Translational Genomics*, 4, pp. 50–53. https://doi.org/10.1016/j.atg.2015.02.003

**Rolfes, S. R. (2006).** *Understanding Normal and Clinical Nutrition*. 8th ed. Wadsworth Publishing.

**Sales, N. M. R., Pelegrini, P. B. and Goersch, M. C. (2014).** Nutrigenomics: Definitions and advances of this new science. *Journal of Nutrition and Metabolism*, 2014, pp. 1–6.

**Sharma, P. and Dwivedi, S. (2017).** Nutrigenomics and Nutrigenetics: New insight in disease prevention and cure. *Indian Journal of Clinical Biochemistry*, 32(4), pp. 371-373. https://doi.org/10.1007/s12291-017-0699-5

**Singh, A. and Masuku, M. (2014).** Sampling techniques and determination of sample size in applied statistics research: An overview. *International Journal of Commerce and Management*, 2, pp. 1-22.

**Whelan, K., McCarthy, S. and Pufulete, M. (2008).** Genetics and diet–gene interactions: Involvement, confidence, and knowledge of dietitians. *British Journal of Nutrition*, 99(1), pp. 23–28.

**Wilkins, J. G. (2017).** Knowledge and perception of college students toward genetic testing for personalized nutrition care. *Accessed August 31, 2024*.

**Ye, K., and Gu, Z. (2011).** Recent advances in understanding the role of nutrition in human genome evolution. Advances in Nutrition, 2(6), 486-496. https://doi.org/10.3945/an.111.001024