Amerta Nutrition
e-ISSN: 2580-1163 (Online)
p-ISSN: 2580-9776 (Print)
Khouridhiya et al. | Amerta Nutrition Vol. 8 Issue 2 (June 2024). 222-229

RESEARCH STUDY
English Version
OPEN ACCESS

The Association between Current Knowledge and Interest Levels of Gene-Based Nutrition Service among Indonesians

Hubungan Tingkat Pengetahuan dan Minat Masyarakat dengan Pelayanan Gizi Berbasis Gen di Indonesia

Mumtaz Khouridhiya[1], Arif Sabta Aji[1,2]*, Herni Dwi Herawati[1,2], Sintha Dewi Purnamasari[1,2], Fani Listiyana[1], Fatma Annisa Wulandari[1], Shelini Surendran[3]

[1]Nutrition Department, Faculty of Health Sciences, Alma Ata University, Bantul, Daerah Istimewa Yogyakarta, Indonesia
[2]Public Health Department, Faculty of Health Sciences, Alma Ata University, Bantul, Daerah Istimewa Yogyakarta, Indonesia
[3]Faculty of Health and Medical Sciences, University of Surrey, Guildford, United Kingdom

ARTICLE INFO

Received: *07-09-2023*
Accepted: *05-01-2024*
Published online: *07-06-2024*

Correspondent:
Arif Sabta Aji
sabtaaji@almaata.ac.id

DOI:
10.20473/amnt.v8i2.2024.222-229

Available online at:
https://e-journal.unair.ac.id/AMNT

Keywords:
Knowledge, Interest, Gene, Nutrition, Service

ABSTRACT

Background: The rapid technological development has led to the emergence of gene-based nutrition services, which hold promise in reducing the prevalence of Non-Communicable Diseases (NCDs). However, a considerable portion of the population remains unaware of these innovative nutrition services.
Objectives: This study aims to identify the correlation between the extent of public knowledge and their interest in gene-based nutrition services in Indonesia.
Methods: This study used a cross-sectional design. This study was conducted online via the Qualtrics Survey platform during May-June 2023. The determination of the sample used a cluster sampling technique across five provinces in Indonesia. The research instrument used a questionnaire on socio-demographic characteristics and a validated structured questionnaire assessing knowledge and interest levels in gene-based nutrition services. Statistical data analysis employed the Chi-Square test.
Results: This study involved a total of 439 respondents from five provinces in Indonesia. The majority of the respondents exhibited low levels of knowledge (51.7%) and interest (55.4%) in gene-based nutrition services. A statistically significant association was observed between knowledge and interest in gene-based nutrition services (p-value=0.029, PR=1.5, 95% CI=1.04-2.22).
Conclusions: The findings of this study underline a relationship between the extent of knowledge and the level of interest in gene-based nutrition services in Indonesia. To increase public interest, it is necessary to increase knowledge regarding gene-based nutrition services through online media, nutritionists or print media that discuss nutrigenetics and nutrigenomics.

INTRODUCTION

Non-communicable diseases (NCDs) become the main cause of death in developing countries including Indonesia. Besides, Indonesia faces the issue of a continuously increasing number of degenerative disease patients. The 2018 Basic Health Research data reveal that the Indonesian population suffers from asthma (2.4%), cancer (1.8%), stroke (10.9%), chronic kidney disease (3.8%), joints (7.3%), Diabetes Mellitus (2%), heart disease (1.5%), hypertension (34.1%), and obesity (BMI ≥ 27) (21.8%)[1]. The adoption of modern lifestyles such as bad eating patterns, alcohol consumption, smoking, and low physical activity contributes to the increasing prevalence of NCDs. Genetic factors are risk factors for degenerative diseases such as obesity with a prevalence of 33%[2,3]. Degenerative diseases cannot be treated completely but they can be managed by improving lifestyle through diet, regular physical activity, consuming fruit and vegetables and medication[4].

Rapid technological development influences the development of nutritional genomics in efforts to prevent and treat degenerative diseases. The application of nutritional genomics is beneficial for health professionals in order to predict the risk of non-communicable diseases (NCDs) in individuals. Besides, it can be useful to provide nutritional recommendations based on genetic variations and a person's genetic type in order to prevent disease as early as possible[5–9]. Nutrigenomics or nutritional genomics, utilizes all the information that studies every aspect of the interaction of diet and the human body involving a deep understanding of the genome and other biological molecules. The concept of nutrigenomics covers the application of genomics to explain the relationship between specific nutrients and generic factors, such as the impact of food regimens or food

How to cite: *Khouridhiya, M., Aji, A. S., Herawati, H. D., Purnamasari, S. D., Listiyani, F., Wulandari, F. A., & Surendran, S. (2024) The Association between Current Knowledge and Interest Levels of Gene-Based Nutrition Service among Indonesians: Hubungan Tingkat Pengetahuan dan Minat Masyarakat dengan Pelayanan Gizi Berbasis Gen di Indonesia. Amerta Nutrition, 8(2), 222–229.*

ingredients on gene expression[10]. Meanwhile, nutrigenetics is another alternative in nutrition services focusing on the role of genetic factors in shaping individual diets and its ability to predict disease risk based on genetic[11–13].

The existence of gene-based nutritional services to help prevent non-communicable diseases, especially for carriers of polymorphisms that can cause certain diseases is not familiar to the public. A previous study conducted in Canada found that 82.7% of respondents did not know the term nutrigenetic testing[14]. Another study conducted in Israel also showed that 94% of respondents had a low level of knowledge regarding nutrigenetics[15].

A study conducted in Canada showed that 90.7% of respondents were interested in following a personalized diet based on nutrigenetic testing, especially those who felt that they were polymorphisms carriers. Meanwhile, respondents who have good genetics were less interested in nutrigenetic testing. This indicates that the perceptions, knowledge, and attitudes of the respondents regarding personalized nutrition through genetic testing are quite consistent with other studies[14].

In Indonesia, studies concerning gene-based nutrition services are limited. Based on the explanation above, degenerative diseases become the main cause of death and the level of public knowledge and interest in nutrigenetic testing is low. Therefore, this present study aims to identify and further the relationship between the level of public knowledge and interest in gene-based nutritional services in Indonesia.

METHODS

This study is part of a large study entitled "Overview of the Level of Public Knowledge and the Relationship between Level of Education and Interest in Gene-Based Nutrition Services in Indonesia: A Mixed Method Study". This quantitative study used a cross-sectional design. Data were collected by conducting in-depth interviews with respondents to obtain an in-depth understanding of respondents' knowledge related to genetic aspects, gene-based nutritional services, and examinations, gene-based nutritional services as prevention of NCDs, and interest in carrying out gene-based nutritional examinations. The population of this study was people living in DKI Jakarta, West Java, East Java, Central Java, and DI Yogyakarta Provinces. This study was conducted in May-June 2023. This study was conducted online using the Qualtrics survey platform and the questionnaire link was distributed via social media such as Instagram, WhatsApp, Twitter, and TikTok.

The selection of the respondents used a cluster sampling technique with the inclusion criteria of 1) Indonesian people; 2) Aged 20-60 years; 3) staying in DKI Jakarta, West Java, East Java, Central Java, and DI Yogyakarta provinces that have gene-based nutrition services provided by PT. Kalbe Farma and PT. Prodia Widyahusada. DI Yogyakarta province has nutrigen-me tests at JIH Hospital and Panti Rapih which are affiliated with PT. Kalbe Farma Tbk. Central Java Province has a NutriGen-me test at Telogorejo Hospital in Semarang. East Java has a NutriGen-me test at Husada Utama Hospital. DKI Jakarta has gene-based nutrition services at Medistra Hospital and Brawijaya Hospital. Meanwhile, the exclusion criteria were people who did not complete the questionnaire according to the instructions given. This study involved 723 respondents but 284 respondents did not meet the inclusion criteria. The exclusion was grouped based on the results of data sorting, namely respondents who did not complete the questionnaire, respondents outside the study location, and age of respondents who did not meet the inclusion criteria. Thus, this study finally involved 439 respondents.

The independent variable in this study was the level of knowledge and the dependent variable was public interest in gene-based nutrition services. The instruments used questionnaires covering respondent characteristics, knowledge, and interest. The knowledge questionnaire was divided into two sub-theme questions, namely the knowledge related to gene adopted from Oosthuizen (2011)[16]. The questionnaire regarding gene-based nutrition services was self-developed. Meanwhile, the questionnaire related interest in gene-based nutrition services was self-developed. All questionnaires were tested for validity and reliability on 31 respondents. The questionnaire about knowledge related to gene-based nutrition services consisted of 12 valid questions and the validity test obtained r-count values of 0.407; 0.405; 0.622; 0.638; 0.654; 0.546; 0.503; 0.458; 0.555; 0.558; 0.511; 0.478. Then, the questionnaire related to interest in gene-based nutrition services had 12 valid questions and the validity test obtained r-count values of 0.678; 0.724; 0.551; 0.394; 0.769; 0.845; 0.785; 0.725; 0.749; 0.733; 0.810; 0.669. Meanwhile, the reliability test obtained an S Alpha value of 0.738 which means reliable. In terms of respondent characteristics, education was divided into low (not completing elementary school - completed high school) and high (Diploma - S3). The knowledge questionnaire covered questions about genetic knowledge (six questions) and knowledge of nutrition services (six questions). Then, the questionnaire related to interest ingene-based nutrition services covered questions about interest in Deoxyribonucleic Acid (DNA) testing, public interest in gene-based nutrition services, and the application of technology to gene-based nutrition services. The questionnaire related to the interest in gene-based nutrition services used a Likert scale with 4 options, namely strongly agree, agree, disagree, and strongly disagree. The determination of low and high levels of knowledge used the median score with a total score of 12 where a score of <6.5 indicating a low knowledge level and ≥6.5 indicating a high knowledge level. Besides, the determination of low and high interest levels in gene-based nutrition services was based on the median score with a total score of 48 where a score of <24.5 indicating a low interest level and ≥24.5 indicating a high interest level.

Data were analyzed using univariate and bivariate analysis with the help of SPSS version 25.0. Univariate analysis presented data in the form of frequencies and percentages (%) including socio-demographic characteristics of respondents, frequency distribution of knowledge and interests. The Chi-square test was to determine the relationship between the level of knowledge and interest in gene-based nutrition services

How to cite: *Khouridhiya, M., Aji, A. S., Herawati, H. D., Purnamasari, S. D., Listiyani, F., Wulandari, F. A., & Surendran, S. (2024) The Association between Current Knowledge and Interest Levels of Gene-Based Nutrition Service among Indonesians: Hubungan Tingkat Pengetahuan dan Minat Masyarakat dengan Pelayanan Gizi Berbasis Gen di Indonesia. Amerta Nutrition, 8(2), 222–229.*

and to estimate the Prevalence Ratio (PR) of the level of knowledge in gene-based nutrition services. A p-value of less than 0.05 was considered statistically significant. This study obtained an approval from the Alma Ata University Ethics Commission (No: KE/AA/V/1011113/EC/2023). All respondents had signed informed consent before filling out the questionnaire and data collection.

RESULTS AND DISCUSSION

This study was conducted in five provinces of Indonesia from May to June 2023. Figure 1 shows the results of the subject recruitment process based on predetermined inclusion and exclusion criteria. Many respondents did not meet the inclusion criteria. Then, a total of 284 respondents met the inclusion criteria as presented in Figure 1 below.

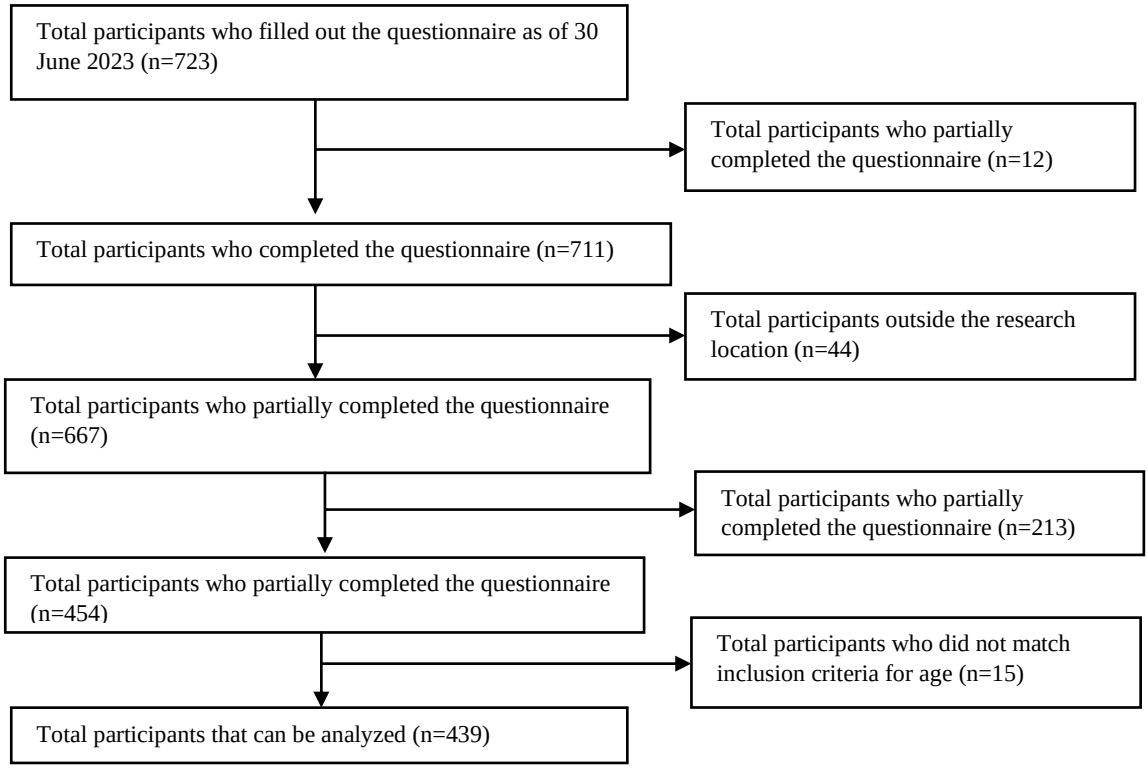

Figure 1. Respondent Recruitment Process

Characteristics of Respondents

The characteristics of respondents covered age, gender, origin, education level, employment, income, marital status, and ethnicity. The researchers can analyze results contextually based on those characteristics. The respondent's characteristic data were then linked to their level of knowledge and interest. The distribution of respondent characteristics is presented in Table 1.

Tabel 1. Distribution of Respondent Characteristics by Level of Knowledge and Interest

Characteristics	N = 439	Knowledge Level		*p-value*	Interest		*p-value*
		Low	High		Low	High	
		n = 227	n = 212		n = 243	n = 196	
Age, year							
20-39	403 (91.8%)	206 (90.7%)	197 (92.9%)	0.512	224 (92.2%)	179 (91.3%)	0.881
40-60	36 (8.2%)	21 (9.3%)	15 (7.1%)		19 (7.8%)	17 (8.7%)	
Sex							
Male	85 (19.4%)	52 (22.9%)	33 (15.6%)	0.068	48 (19.8%)	37 (18.9%)	0.913
Female	354 (80.6%)	175 (77.1%)	179 (84.4%)		195 (80.2%)	159 (81.1%)	
Province							
DKI Jakarta	41 (9.3%)	19 (8.4%)	22 (10.4%)		21 (8.6%)	20 (10.2%)	
West Java	75 (17.1%)	48 (21.1%)	27 (12.7%)		40 (16.5%)	35 (17.9%)	
Central Java	135 (30.8%)	68 (30%)	67 (31.6%)	0.035*	77 (31.7%)	58 (29.6%)	0.072
East Java	59 (13.4%)	22 (9.7%)	37 (17.5%)		24 (9.9%)	35 (17.9%)	
DI Yogyakarta	129 (29.4%)	70 (30.8%)	59 (27.8%)		81 (33.35)	48 (24.5%)	
Latest Education							
Low	266 (60.6%)	135 (59.5%)	131 (61.8%)	0.689	153 (63%)	113 (57.7%)	0.301
High	173 (39.4%)	92 (40.5%)	81 (38.2%)		90 (37%)	83 (42.3%)	
Employment							

How to cite: *Khouridhiya, M., Aji, A. S., Herawati, H. D., Purnamasari, S. D., Listiyani, F., Wulandari, F. A., & Surendran, S. (2024) The Association between Current Knowledge and Interest Levels of Gene-Based Nutrition Service among Indonesians: Hubungan Tingkat Pengetahuan dan Minat Masyarakat dengan Pelayanan Gizi Berbasis Gen di Indonesia. Amerta Nutrition, 8(2), 222–229.*

Characteristics	N = 439	Knowledge Level		*p-value*	Interest		*p-value*
		Low	High		Low	High	
		n = 227	n = 212		n = 243	n = 196	
Civil servant (PNS)	32 (7.3%)	16 (7%)	16 (7.5%)		15 (6.2%)	17 (8.7%)	
Self-employed	29 (6.6%)	17 (7.5%)	12 (5.7%)	0.698	16 (6.6%)	13 (6.6%)	0.432
Private employee	60 (13.7%)	34 (15%)	26 (12.3%)		29 (11.9%)	31 (15.8%)	
Unemployed/student	318 (72.4%)	160 (70.5%)	158 (74.5%)		183 (75.3%)	135 (68.9%)	
Income							
< Rp 2.000.000	316 (72%)	167 (73.6%)	149 (70.3%)		175 (72%)	141 (71.9%)	
Rp 2.000.000 – 4.000.000	90 (20.5%)	46 (20.3%)	44 (20.8%)	0.518	55 (22.6%)	35 (17.9%)	0.100
> Rp 5.000.000	33 (7.5%)	14 (6.2%)	19 (9%)		13 (5.3%)	20 (10.2%)	
Marital Status							
Married	82 (18.7%)	49 (21.6%)	33 (15.6%)	0.135	46 (18.9%)	36 (18.4%)	0.978
Not married	357 (81.3%)	178 (78.4%	179 (84.4%)		197 (81.1%)	160 (81.6%)	
Ethnicity							
Javanese	344 (78.4%)	182 (80.2%)	162 (76.4%)	0.401	190 (78.2%)	154 (78.6%)	1.000
Non-javanese	95 (21.6%)	45 (19.8%)	50 (23.6%)		53 (21.8%)	42 (21.4%)	
Familiar with gene-based nutrition services							
No	218 (49.7%)	123 (54.2%)	95 (44.8%)	0.062	127 (52.3%)	91 (46.4%)	0.263
Yes	221 (50.3%)	104 (45.8%)	117 (55.2%)		116 (47.7%)	105 (53.6%)	
Source of information related to gene-based nutrition services							
Online media	161 (72.9%)	78 (75%)	83 (70.9%)		81 (69.8%)	80 (76.2%)	
Nutritionists	46 (20.8%)	18 (17.3%)	28 (23.9%)		27 (23.3%)	19 (18.1%)	
TV	5 (2.3%)	4 (3.8%)	1 (0.9%)	0.466	3 (2.6%)	2 (1.9%)	0.869
Printted media	5 (2.3%)	2 (1.9%)	3 (2.6%)		3 (2.6%)	2 (1.9%)	
Doctor	4 (1.8%)	2 (1.9%)	2 (1.7%)		2 (1.7%)	2 (1.9%)	

PNS is civil servant; *significant *p-value* (p<0.05)

Table 1 shows the relationship between the characteristics of respondents and their level of knowledge and interest in gene-based nutrition services. Respondents aged 20-39 years have a low level of knowledge (90.7%) and female respondents have a high level of knowledge (84.4%). In terms of province, respondents from Java province have the highest level of knowledge (31.6%) compared to other provinces. Respondents with low education have a low level of knowledge (59.5%) regarding gene-based nutrition services. Then, unemployed respondents have a low level of knowledge (70.5%) regarding gene-based nutrition services. Most respondents have a low income of < IDR 2,000,000 and a low level of knowledge (73.6%) regarding gene-based nutrition services. Unmarried respondents have a high level of knowledge regarding gene-based nutrition services (83.4%). In terms of ethnicity, Javanese respondents have a high level of knowledge regarding gene-based nutrition services (83.6%) and have a low level of knowledge regarding gene-based nutrition services(80.2%). Respondents who are familiar and unfamiliar with gene-based nutrition services have a fairly balanced knowledge. In terms of the source of knowledge regarding gene-based nutrition services from online media indicates a low level of knowledge (75%). Therefore, respondents have a high level of knowledge related to gene-based nutrition services by gender (female), province, and marital status (unmarried). Respondents have a low level of knowledge related to gene-based nutrition services by age (20-39 years), type of work, income, and ethnicity,

Then, respondents aged 20-39 years have a low interest in gene-based nutrition services (92.2%). Female respondents also have a low level of interest in gene-based nutrition services (80.2%). Respondents in DI Yogyakarta province have the lowest interest (33.3%) in gene-based nutrition services compared to other provinces. Respondents with low education levels have low interest (63%) in gene-based nutrition services. Unemployed respondents have low interest (75.3%) in gene-based nutrition services. Most respondents with an income of <IDR 2,000,000 have a low-interest level (72%) in gene-based nutrition services. Unmarried respondents have a high interest level in gene-based nutrition services (81.1%). Javanese respondents have a low-interest level (78.2%) in gene-based nutrition services. Respondents who are familiar and unfamiliar with gene-based nutrition services have fairly balanced interests. The source of gene-based nutrition services from online media indicates a low level of interest in gene-based nutrition services (69.8%).

Status of Public Knowledge of Gene-Based Nutrition Services

Knowledge status is an important aspect to identify the public's understanding of science and technology, especially in gene-based nutrition services. Based on the public knowledge, we can identify the level of readiness and acceptance of a personalized nutrition service approach. The results of statistical calculations on the level of knowledge in gene-based nutrition services in Indonesia are presented in Figure 2.

How to cite: *Khouridhiya, M., Aji, A. S., Herawati, H. D., Purnamasari, S. D., Listiyani, F., Wulandari, F. A., & Surendran, S. (2024) The Association between Current Knowledge and Interest Levels of Gene-Based Nutrition Service among Indonesians: Hubungan Tingkat Pengetahuan dan Minat Masyarakat dengan Pelayanan Gizi Berbasis Gen di Indonesia. Amerta Nutrition, 8(2), 222–229.*

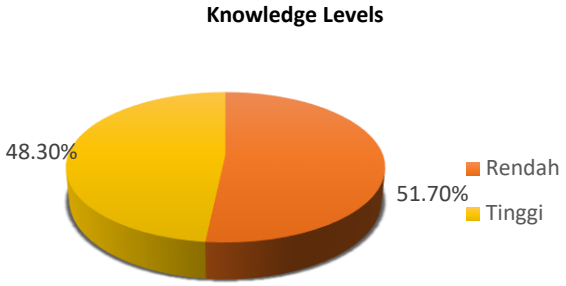

Figure 2. Status of Public Knowledge of Gene-Based Nutrition Services

Figure 2 shows that the status of public knowledge regarding gene-based nutrition services is categorized into two levels, namely low and high. More than half of respondents have a low knowledge level of gene-based nutrition services (51.7%). The percentage of knowledge level in this study is higher compared to previous studies in some countries[14,17,18]. Place of residence (province of origin) has a significant relationship with knowledge. Respondents living in Central Java (31.6%) and DI Yogyakarta (27.8%) have a high level of knowledge compared to other provinces.

The results of this study are in line with a previous study conducted in France that participants were not familiar with the term "nutrigenetics" (82.7%). Meanwhile, respondents who are familiar with nutrigenetics get information from television, newspapers and radio (27.7%), web media (22.3%) or social networks (14.6%)[14]. However, these results are still relatively low compared to another study conducted in Durham with an average score for genetic knowledge and genetic testing of 84%[15].

Both public and nutritionists (94%) in Israel have a low knowledge level of gene-based nutrition services[17]. This is in line with a study conducted in Greece involving both general students and health students that 69% of respondents did not know about the nutrigenetic test[18]. However, the results differ in students who took genetics courses and had read about genetics. In Nigeria, 63% of students are familiar with nutrigenomic tests[19].

Status of Interest in Gene-Based Nutrition Services

The analysis of public interest in gene-based nutrition services aims to find out the acceptance of this gene-based nutrition service innovation in Indonesia. Figure 3 shows that the public interest in gene-based nutrition services is low. It is associated with the public's knowledge in Figure 2 where more than half of the respondents have low knowledge of gene-based nutrition services. However, the results of the study show that the public is interested in gene-based nutritional services to regulate diet and prevent disease but there are cost barriers[20].

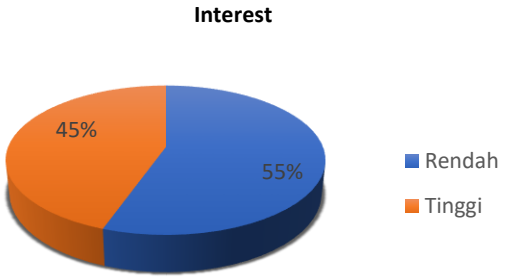

Figure 3. Status of Interest in Gene-Based Nutrition Services

Figure 3 shows that more than half of respondents have a low interest in gene-based nutrition services (55.4%). Education influences the level of knowledge, where the higher the education level, the more information is obtained through interactions with other people and the mass media[21]. Knowledge can also influence a person's interests. The results of this study show that more than half of the respondents have low levels of education and it influences respondents' interest to be low (63%). Besides, knowledge related to gene-based nutrition services also influences respondents' interest. Many respondents are unfamiliar with gene-based nutrition services leading to a low interest in gene-based nutrition services (52.3%).

This contradicts another study conducted in Europe and the United States in which participants positively supported the use of genetic testing as they believed that the test would bring benefits related to heritable diseases[22]. Another study conducted in France involving Canadian citizens shows that the respondents are more interested (90.7%) in carrying out genetic tests, especially those who have a medical history related to genetics[14].

How to cite: *Khouridhiya, M., Aji, A. S., Herawati, H. D., Purnamasari, S. D., Listiyani, F., Wulandari, F. A., & Surendran, S. (2024) The Association between Current Knowledge and Interest Levels of Gene-Based Nutrition Service among Indonesians: Hubungan Tingkat Pengetahuan dan Minat Masyarakat dengan Pelayanan Gizi Berbasis Gen di Indonesia. Amerta Nutrition, 8(2), 222–229.*

Some other studies also do not match the results of studies conducted in research in Indonesia, for example, a study conducted in Finland shows that the majority (90%) of respondents agree and are willing to take part in genetic testing[23]. Another study in England reveals that 69% of respondents are significantly more interested in carrying out genetic testing. Respondents are interested in predicting susceptibility to heart disease rather than cancer because heart disease is seen as more preventable than cancer[24].

Table 2. The Association Between Level of Knowledge Level and Interest in Gene-Based Nutrition Services

Level of Knowledge	Interest				PR (95% CI)	P-Value
	Low		High			
	N	%	n	%		
Low	137	56.4	90	45.9	1.5 (1.04-2.22)	0.029*
High	106	43.6	106	54.1		

PR: *Prevalence Ratio*

Table 2 shows that respondents with low knowledge have a low interest in gene-based nutrition services (56.4%). Meanwhile, respondents who have high knowledge have a high interest in gene-based nutrition services (54.1%). Chi-square tests obtained a significant relationship between knowledge and public interest in gene-based nutrition services (p-value = 0.029, PR=1.5, 95% CI=1.04-2.22). Therefore, interest in gene-based nutrition services is 1.5 times higher for people with high knowledge than those with a lower level of knowledge related to gene-based nutrition services.

Respondents aged 40-60 years (8.2%) have a low level of knowledge in the field of gene-based nutrition services. More than half of the respondents had a low education level (60.6%). A high level of education can influence information acceptance[25]. Another factor influencing the low level of interest in gene-based nutrition services is the amount of income of the majority of the respondents, namely <IDR 2,000,000 (72%). Thus, some respondents do not agree with the cost of gene-based nutrition services which ranges from >IDR 2,000,000 to IDR 11,000,000.

In line with another previous study, individuals with good genetic knowledge have more interest in genetic testing and vice versa[26]. A high knowledge score reflects the effectiveness of information related to basic genetic studies obtained[27]. However, the results of this study contradict a study conducted on Canadian people in France that the Canadian people have low knowledge about nutrigenetics (82.7%), but they have a high interest in implementing a personalized diet (90.7%)[14]. Studies conducted in Indonesia are in line with a previous study conducted in Canada that Canadians have limited genetic knowledge. Low knowledge about genetics indicates low interest in nutrigenomics but respondents consider nutrigenomics to be a valuable technology[28].

CONCLUSIONS

The level of knowledge and public interest in gene-based nutrition services in Indonesia shows a significant relationship. Interest in gene-based nutrition services is 1.5 times higher for respondents with high knowledge than those with low knowledge levels. Increasing public knowledge regarding gene-based nutrition services through online media, nutritionists, or print media that discuss nutrigenetics and nutrigenomics can increase public interest in gene-based nutrition services.

ACKNOWLEDGEMENTS

The author highly appreciates all respondents for their participation in this study and the supervisor for guiding the completion of this study. The author also appreciates the reseacrh group entitled, " Overview of the Level of Public Knowledge and the Relationship between Level of Education and Interest in Gene-Based Nutrition Services in Indonesia: A Mixed Method Study". The author also appreciates all other parties who have supported this study.

Conflict of Interest and Funding Disclosure

This study was conducted according to personal wishes without any conflict of interest. This study is personally funded and does not receive any funding support from other parties.

Author Contributions

MK: contributed to the writing of this research article and appointed as co-first authors, carried out data analysis and interpretation, prepared the manuscript draft, revised the draft, and carried out data collection; ASA: responsible for all scientific content of articles, formulating research problems, analyzing and interpreting data to obtain relevant findings, creating research concepts and designs, leading data collection, providing supervision and guidance in preparing manuscripts, analyzing and interpreting data, criticizing the manuscript, and providing input and suggestions for writing the manuscript; SDP and HDH: supervising and guiding the preparation of the manuscript, analysis and interpretation of data, criticizing the manuscript, providing input and suggestions for writing the manuscript; FL and FAW: involved in planning, data collection and analysis to get relevant findings; SS: supervised and guided in research instruments development and abstract preparation, as well as provide research instruments license of Qualtrics platform.

REFERENCES

1. Kementrian Kesehatan RI. *Dietetik Penyakit Tidak Menular*. (2018).
2. Indra, M. R. DASAR GENETIK OBESITAS VISERAL. *Jurnal Kedokteran Brawijaya* **21**, 19 (2006).

How to cite: *Khouridhiya, M., Aji, A. S., Herawati, H. D., Purnamasari, S. D., Listiyani, F., Wulandari, F. A., & Surendran, S. (2024) The Association between Current Knowledge and Interest Levels of Gene-Based Nutrition Service among Indonesians: Hubungan Tingkat Pengetahuan dan Minat Masyarakat dengan Pelayanan Gizi Berbasis Gen di Indonesia. Amerta Nutrition, 8(2), 222–229.*

3. Suiraoka, I. P. *Penyakit degeneratif, mengenal, mencegah dan mengurangi faktor resiko 9 penyakit degeneratif*. (2012).
4. Hafsah, H., Alang, H., Hastuti, H. & Sri Yusal, Muh. Peningkatan Pengetahuan Tentang Penyakit Degeneratif Pada Masyarakat Petani di Desa Laliko Sulawesi. *Kreativasi : Journal of Community Empowerment* **1**, 63–71 (2022).
5. Alathari, B. E., Aji, A. S., Kalpana, C. A., Vimaleswaran & S, K. Vitamin D Pathway-related gene polymorphisms and their association with metabolic diseases : a literature review. *Journal of Diabetes & Metabolic Disorders* 1701–1729 (2020).
6. Alathari, B. E. *et al.* Interaction between vitamin d-related genetic risk score and carbohydrate intake on body fat composition: A study in southeast asian Minangkabau women. *Nutrients* **13**, 1–13 (2021).
7. Aji, A. S. *et al.* A genetic approach to study the relationship between maternal Vitamin D status and newborn anthropometry measurements: the Vitamin D pregnant mother (VDPM) cohort study. *Journal of Diabetes and Metabolic Disorders* **19**, 91–103 (2020).
8. Ordovas, J. M., Ferguson, L. R., Tai, E. S. & Mathers, J. C. Personalised nutrition and health. *BMJ (Online)* **361**, 1–7 (2018).
9. van Ommen, B. *et al.* Systems biology of personalized nutrition. *Nutrition Reviews* **75**, 579–599 (2017).
10. Proboningsih, J. Nutrigenomik Alternatif Penanganan Kesehatan di Masa Depan. *Jurnal Keperawatan* **VIII**, 50–52 (2015).
11. Aji, A. S. *Personalized Functional Foods: Masa Depan Penerapan Personalized Nutrition Advice. Prosiding Seminar Nasional Online*. *Personalized functional foods: MASA DepAn penerApAn Personalized nutrition advice* (2020).
12. Surendran, S. *et al.* A nutrigenetic approach for investigating the relationship between vitamin B12 status and metabolic traits in Indonesian women. *Journal of Diabetes and Metabolic Disorders* **18**, 389–399 (2019).
13. Alsulami, S. *et al.* Interaction between the genetic risk score and dietary protein intake on cardiometabolic traits in Southeast Asian. *Genes and Nutrition* **15**, (2020).
14. Vallée Marcotte, B. *et al.* Current knowledge and interest of French Canadians regarding nutrigenetics. *Genes and Nutrition* **14**, 1–7 (2019).
15. Haga, S. B. *et al.* Public Knowledge of and Attitudes Toward Genetics and Genetic Testing. *Genetic Testing and Molecular Biomarkers* **17**, 327–335 (2013).
16. Oosthuizen, L. Aspects of the involvement, confidence and knowledge of South African registered dietitians regarding genetics and nutritional genomics. (Stellenbosch : University of Stellenbosch, 2011).
17. Kaufman-shriqui, V., Salem, H., Boaz, M. & Birk, R. Knowledge and Attitudes Towards Nutrigenetics: Findings from the 2018 Unified Forces Preventive Nutrition Conference (UFPN). *Nutrients* **12**, 1–10 (2020).
18. Parisi, V., Gkogka, P. & Doulgeraki, S. *Nutrigenetic test: Knowledge and Attitude of the Greek Public*. *Public Health and Toxicology* (European Publishing, 2022). doi:10.18332/pht/149826.
19. Ademiluyi, D. D. Knowledge and Perception of Undergraduate Students towards Nutrigenomics for Personalized Nutrition in Federal University of Agriculture, Abeokuta, Ogun State. *International Journal of Innovative Science and Research Technology* **7**, 545–598 (2022).
20. Wulandari, F. *et al. Gambaran Pengetahuan Masyarakat Terhadap Pelayanan Gizi Berbasis Gen dalam Pencegahan Penyakit Tidak Menular di Indonesia*. (2023). doi:10.13140/RG.2.2.15277.67047.
21. Febrianty, N., Andriane, Y. & Fitriyana, S. Hubungan Tingkat Pendidikan dengan Pengetahuan Mengenai Obat Tradisional The Relationship Education Level with Knowledge

How to cite: *Khouridhiya, M., Aji, A. S., Herawati, H. D., Purnamasari, S. D., Listiyani, F., Wulandari, F. A., & Surendran, S. (2024) The Association between Current Knowledge and Interest Levels of Gene-Based Nutrition Service among Indonesians: Hubungan Tingkat Pengetahuan dan Minat Masyarakat dengan Pelayanan Gizi Berbasis Gen di Indonesia. Amerta Nutrition, 8(2), 222–229.*

about Traditional Medicine. *Pendidikan Dokter* **4**, 420–425 (2018).

22. Mustapa, M. A. C., Amin, L. & Frewer, L. J. Predictors of Stakeholders' Intention to Adopt Nutrigenomics. *Genes and Nutrition* **15**, 1–15 (2020).
23. Aro, A. R. *et al.* Acceptance of Genetic Testing in a General Population: Age, Education and Gender Differences. *Patient Education and Counseling* **32**, 41–49 (1997).
24. Sanderson, S. C., Wardle, J., Jarvis, M. J. & Humphries, S. E. Public Interest in Genetic Testing for Susceptibility to Heart Disease and Cancer: A Population-Based Survey in The UK. *Preventive Medicine* **39**, 458–464 (2004).
25. Yuliana, E. Analisis Pengetahuan Siswa Tentang Makanan Yang Sehat Dan Bergizi Terhadap Pemilihan Jajanan Di Sekolah. (Universitas Muhammadiyah Purwokerto, 2017).
26. Morren, M., Rijken, M., Baanders, A. N. & Bensing, J. Perceived Genetic Knowledge, Attitudes Towards Genetic Testing, and The Relationship Between These Among Patients with A Chronic Disease. *Patient Education and Counseling* **65**, 197–204 (2007).
27. De, S. *et al.* Ethical Aspects of Genotype Disclosure: Perceptions of Participants in a Nutrigenetic Study in Finland. *Public Health Genomics* **24**, 33–43 (2021).
28. Castle, D. Public knowledge, awareness and perceptions of nutrigenomics A study of Canadian perspectives. *Agro Food Industry Hi-Tech* **21**, 14–17 (2010).

How to cite: *Khouridhiya, M., Aji, A. S., Herawati, H. D., Purnamasari, S. D., Listiyani, F., Wulandari, F. A., & Surendran, S. (2024) The Association between Current Knowledge and Interest Levels of Gene-Based Nutrition Service among Indonesians: Hubungan Tingkat Pengetahuan dan Minat Masyarakat dengan Pelayanan Gizi Berbasis Gen di Indonesia. Amerta Nutrition, 8(2), 222–229.*