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The Association between Education Levels and the Interest Level in Gene-Based Nutrition Services in Indonesia

Hubungan Tingkat Pendidikan dengan Tingkat Ketertarikan Masyarakat terhadap Pelayanan Gizi berbasis Gen di Indonesia

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ABSTRACT

Background: Non-communicable diseases (NCDs) constitute significant causes of global mortality, with their prevalence continually rising each year. The development of nutrigenetic science and gene-based nutrition services plays a vital role in mitigating NCDs, despite the lack of awareness among many individuals.
Objectives: This study aims to investigate the relationship between education levels and the level of interest in gene-based nutrition services among Indonesians.
Methods: A cross-sectional study design was conducted online using the Qualtrics Survey during May and June 2023 in DKI Jakarta, West Java, Central Java, East Java, and DI Yogyakarta. The cluster sampling technique was employed. Structured questionnaires were designed, covering sociodemographic information and interest levels, and were validated and tested for reliability. Data analysis involved chi-square testing.
Results: Indonesians exhibited a substantial interest in gene-based nutrition services (92.3%). Most participants (89.7%) expressed willingness to recommend nutrigenetic testing to their families. Additionally, 97.5% of participants agreed that gene-based nutrition services offer numerous benefits (97.5%), and a significant proportion was open to paying more for such services (62.4%). A large percentage of Indonesians demonstrated interest in undergoing nutrigenetic testing to ascertain disease susceptibility (95.9%). However, no significant association was observed between education levels and the interest in gene-based nutrition services in Indonesia (p=0.134, OR: 0.551, CI=95% (0.27-1.11)).
Conclusions: The study findings suggest that the educational background of Indonesians does not significantly impact their interest in gene-based nutrition services. However, a majority of Indonesians display interest and recognize the potential benefits of gene-based nutrition services, particularly in the context of preventing NCDs.

INTRODUCTION

Non-communicable diseases (NCDs) contribute 63% of deaths in the world with annual death rates of 36 million and 80% of deaths caused by NCDs occur in low-middle income countries[1]. World Health Organization (WHO) data reveal that 582,300 men and 481,700 women in Indonesia died in 2011 due to non-communicable diseases. The 2018 Basic Health Research reported that stroke has become the main cause of death in Indonesia with a prevalence of 15.4%, followed by communicable diseases such as tuberculosis (TB) with a prevalence of 7.5%[2]. The development of science and technology enables early prevention of disease by detecting the emergence of a disease. As a preventive measure, this can be done through gene-based nutrition services in the form of nutrigenetic tests to help prevent NCDs, support health in some vulnerable age groups including pregnant women, and the implementation of individual nutrition services to realize the implementation of precision medicine[3–5]. Nutrigenetics is a field of science that examines how genetic factors play a role in a person's diet response[3–5]. It focuses on examining how nutrition and health/disease status interact with genetic factors in the human body using single nucleotide polymorphism (SNP)[6,7].

The human genome can be mapped which reveals that the majority of humans have the same base arrangement in the genome. Only <1% of genes that differ from one another. Studies by various research institutions and universities over the past 20-30 years report that genetic variations are related to various diseases[8]. Nutrigenetic case studies make it easier for nutritionists to provide optimal nutritional services to patients. This helps nutritionists identify the appropriate

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diet by examining the interaction between genes and nutrients and applying nutrigenetic principles. Thus, applying nutrigenetic studies makes it easier to achieve optimal health status[8–11]. In addition, the development of knowledge is related to the prevention and treatment of degenerative diseases over the last two decades[10,12].

A previous study in Quebec Province, Canada expressed lower interest in nutrigenetic testing. The level of education and the level of interest in nutrigenetic testing show an inverse correlation where people with low knowledge of nutrigenetics have a higher interest in nutrigenetic testing than those with good knowledge of nutrigenetics. Besides, the level of interest in testing macronutrients such as fat, sugar, carbohydrates, protein, and saturated fat is higher compared to interest in testing micronutrients[13]. A study conducted in Malaysia revealed that stakeholders agreed that nutrigenetic testing is very useful[14]. Studies concerning public interest in gene-based nutrition services in Indonesia have not been available. Therefore, this present study aims to examine the relationship between the level of education and the level of public interest in gene-based nutrition services in Indonesia.

METHODS

This study is the first stage of a study on "Overview of the Level of Community Knowledge and the Association of Level of Education and Level of Interest in Gene-Based Nutrition Services in Indonesia: A Mixed Method Study" where the next stage will be qualitative research through in-depth interviews to examine respondent's knowledge related to genetics, gene-based nutritional services and examinations, gene-based nutritional services and prevention of NCDs, and interest in carrying out gene-based nutritional examinations (research results have not yet been published)[15]. This study was conducted in some provinces in Indonesia, namely, DKI Jakarta, West Java, Central Java, East Java, and DI Yogyakarta that already have gene-based nutrition service facilities in Indonesia. This study was conducted in May-July 2023 and data collection used questionnaires for Qualtrics Survey distributed via social media such as Instagram, WhatsApp, TikTok, and Twitter (https://bit.ly/Nutgene-community).

This study was based on predetermined inclusion and exclusion criteria. The inclusion criteria were 1) Indonesian citizen; 2) aged 20-60 years, and 3) staying in DKI Jakarta, West Java, Central Java, East Java, and DI Yogyakarta. Meanwhile, the exclusion criteria were respondents who did not complete the questionnaire. The sample was determined using a cluster sampling technique involving 439 subjects. The independent variable was the level of education, while the dependent variable was the level of public interest. The questionnaire was tested for validity and reliability to produce a valid and reliable questionnaire. The research instruments used in this study were a questionnaire regarding respondents' socio-demographic data, and a questionnaire regarding public interest in gene-based nutrition services in Indonesia with a Likert scale of strongly agree, agree, strongly disagree and disagree. Education levels were categorized into high and low, while high education levels referred to respondents who had completed a diploma, bachelor's degree, etc. Meanwhile, low education levels referred to respondents who have graduated from elementary school, junior high school, and senior high school. The measurement of level of interest used the natural cut-off formula where a score of ≥25 indicates a high interest level, while a score of <25 indicates a low interest level.

Data were analyzed using univariate and bivariate analysis with the help of SPSS version 25.0. Bivariate analysis used the chi-square test to determine the relationship between education level and the level of public interest in gene-based nutrition services in Indonesia. This study has received approval from the Alma Ata University Ethics Commission (No: KE//AA/V/1011113/EC/2023). All respondents signed the informed consent before participating in this study.

RESULTS AND DISCUSSION

A total of 767 respondents filled in the questionnaire until 30 June 2023. Based on the inclusion and exclusion criteria, this study obtained 439 respondents. The respondent recruitment process can be seen below.

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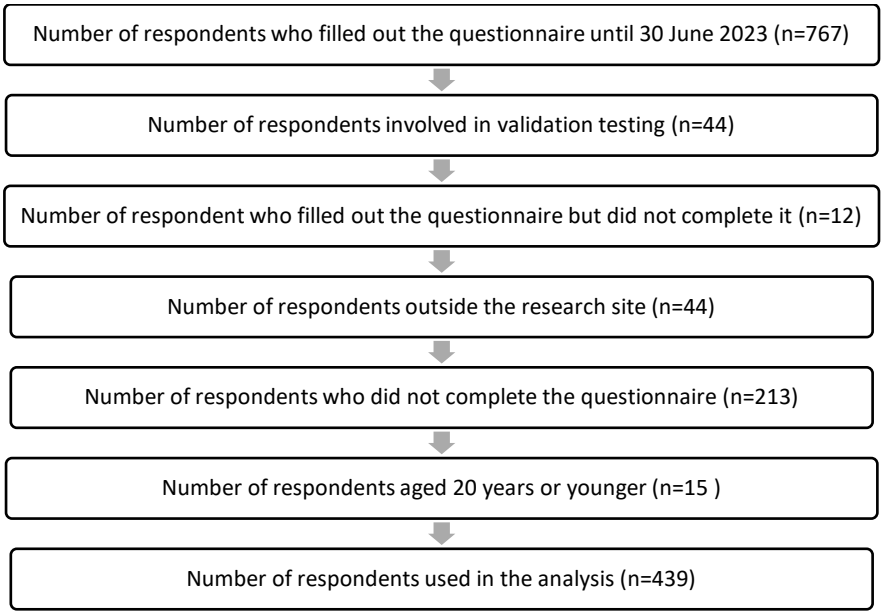

Figure 1. Respondent recruitment process

Characteristics of Respondents

Table 1 shows the characteristics of respondents based on age with the domination of age 20-39 years, namely 403 respondents (91.8%). In terms of gender, the majority of the respondents are women with a total of 354 respondents (80.6%). Besides, most of them are from Java with a total of 135 respondents (30.8%). Most of the respondents are unemployed, namely 312 respondents (71.1%). In terms of income, they are mostly from low-income families with a total of 317 respondents (72.2%). In terms of marital status, most respondents are unmarried with a total of 357 respondents (81.3%). Besides, the ethnic category is dominated by Javanese with a total of 344 respondents (78.4%). A total of 221 respondents (50.3%) are familiar with nutrigenetic services.

Table 1. Characteristics of respondents

Characteristics	n	%
Age, year		
20-39	403	91.8
40-60	36	8.2
Sex		
Male	85	19.4
Female	354	80.6
Origin		
DKI Jakarta	41	9.3
West Java	75	17.1
Central Java	135	30.8
East Java	59	13.4
DI Yogyakarta	129	29.44
Employment		
Employed	129	28.9
Unemployed	310	71.1
Income/pocket money		
Low (≤ IDR 2.000.000)	317	72.22
Moderate (IDR 2.000.000 – 4.000.000)	70	15.9
High (> IDR 4.000.000)	52	11.8
Marital status		
Married	82	18.7
Unmarried	357	81.3
Ethnicity		
Java	344	78.4
Non-Java	95	21.6
Familiar to gene-based nutrition services		
No	218	49.7
Yes	221	50.3
Source of information related to gene-based nutrition services		

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Characteristics	n	%
Online media	161	36.7
Nutritionist	46	10.5
TV	5	1.1
Printed media	5	1.1
Doctor	4	0.9
Experience in testing DNA or providing gene-based services		
No	414	94.3
Yes	25	5.7
Availability of genetic testing facilities		
No	279	63.6
Yes	160	36.4

A total of 161 respondents (36.7%) heard about gene-based nutrition services through online media. Then, 414 respondents (94.3%) had never had a nutrigenetic test or gene-based nutrition services. The majority of the respondents, namely 279 respondents (63.6%) stated that there are no genetic testing facilities in their residence. The results of this study are not in line with other studies that genetic testing services are widely available and not limited to developed countries. Malaysia has twenty genetic testing laboratories both private and public offering genomic services (including genetic counseling and testing)[16]. The government of Malaysia committed to adopting a gene-based nutrition service approach in creating individual nutrition services and precision medicine. Besides, the public perception in this country is positive towards this new technological innovation so many people are interested in trying and supporting this gene-based nutrition service[14].

Status of Public Interest

Table 2 shows that a total of 405 respondents (92.3%) have a high interest in gene-based nutrition services in Indonesia. Meanwhile, the remaining 34 respondents (7.7%) have low interest in gene-based nutrition services. The majority of respondents agree that they will advise their families to undergo nutrigenetic testing (89.7%). They agree that gene-based nutrition services will provide many benefits for them (97.5%). Besides, they are willing to pay more to get gene-based nutrition services (62.4%). Most respondents are interested in carrying out a nutrigenetic test to find out whether they are at risk of disease or not (95.9%).

Table 2. Status of public interest

Level of interest	n	%
High	405	92.3
Low	34	7.7

Studies conducted in some European and American countries revealed that the public is interested in carrying out personalized genetic and genomic testing[13,17–20]. Another study conducted in Canada found that the majority of participants had good interest and felt the potential health benefits associated with nutrigenetic testing[18]. Other studies suggest that people find DNA-based diets more valuable and easy to understand than food-based dietary guidelines, which motivates them to change their diets using personalized, gene-based nutritional information[21,22].

Studies conducted in Durham Province, North Carolina found that the public had a high level of interest in genetic testing. A total of 92% of respondents stated that they agreed or strongly agreed that DNA testing could detect disease early. On the other hand, they believe that the test has some consequences. Most respondents agreed that DNA testing could change a person's future (56.3%), affect a person's ability to claim health insurance (51.3%), and affect job finding process (16%)[23].

Another study conducted in Canada revealed that the public had low interest in nutrigenetic testing. Respondents were also asked about their interest in testing 23 nutrients and the result showed that they were more interested in testing macronutrients such as fat, sugar, carbohydrates, protein and saturated fat than testing micronutrients, alcohol, caffeine and other nutrients. other common nutrients are associated with food tolerance such as gluten and lactose[13]. Community support for new technology and its application is important for its successful implementation in society[14]. Other studies show that if genomic technology can predict disease and provide dietary advice based on a person's genetic profile, then it is important to study a person's intentions to get a personalized diet and make modifications according to consumer expectations. The social context surrounding a technology becomes the most important determining factor in the development and adoption of a technology in the future[22].

Education Level

Table 3 shows that the latest educational level status is dominated by high school graduates with a total of 261 (59.5%) respondents, the rest do not complete junior high school and senior high school. Meanwhile, the level of education is dominated by low levels of education with a total of 266 (60.6%) respondents, while the remaining 40.4% have high levels of education.

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Table 3. Education level

Variable	n	%
Latest education level of respondents		
Completed Junior High School	3	0.7
Not completed Senior High School	2	0.5
Completed Senior High School	261	59.5
Diploma	19	4.3
Bachelor's degree (D4)	131	29.8
S2	9	2.1
S3	2	0.5
Profession/specialist	12	2.7
Status of education level		
High	173	39.4
Low	266	60.6

Respondents with a low level of education are respondents who have elementary to high school education, while respondents with a high level of education are respondents who have completed diploma, Bachelor's degree (D4), Masters, Doctoral, and Professional/Specialist

Employment Status

Based on the results of the study, the majority of respondents work as private employees (16%), while the rest work as entrepreneurs and civil servant. The majority of respondents who did not work are students (65.8%), and the rest are housewives and Islamic boarding school students. Based on Statistics Indonesia's (BPS) website, 37.02% of Indonesia's population worked as laborers and employees in 2021. This percentage is the largest compared to other employment statuses.

Table 4. Employment Status

Variable	n	%
Employed	126	28.7
Civil servant	30	6.8
Entrepreneur	26	5.9
Private worker	70	16
Unemployed	313	71.3
University student	289	65.8
Non-University student	24	5.5

A total of 19.57% of the Indonesian population opened their businesses and 16.49% of them are assisted by temporary workers. Furthermore, 14.63% of the Indonesian population works as family workers, and 5.11% works in the agricultural and non-agricultural sectors. Then, the majority (29.59%) of employment opportunities for the Indonesian population are in the agricultural, fisheries and forestry sectors. It is followed by wholesale and retail with a percentage of 19.20%.

The relationship between the Characteristics of Respondents and Level of Interest

This study found that respondents with a low level of education had a higher level of interest compared to those with a low level of education. The statistical calculation of the relationship between level of education and level of interest in gene-based nutrition services obtained a p-value of 0.134 which is higher than 0.05 ($p<0.05$). This indicates that there is no relationship between the level of education and the level of public interest in gene-based nutrition services in Indonesia. Another study conducted in Canada found that respondents with a good level of literacy or knowledge about nutrigenetics had a low level of interest in nutrigenetic testing. In this case, the respondent with the best genetic literacy is not an expert in the field of genetics. This explains why they have more conservative thinking compared to respondents who have a lower level of literacy. Therefore, the results of this present study consistently show an inverse correlation between the level of education and interest in nutrigenetic testing[13]. Studies conducted at a university in Ogun State, Nigeria revealed that students thought that gene-based nutrition services could provide more benefits than risks. Moreover, students who take and do not take nutrition courses show significant differences in perceptions regarding gene-based nutrition services[24]. Thus, a good level of literacy or knowledge about nutrigenetics does not influence individuals' interest in gene-based nutrition services. Besides, students with a good level of literacy and taking nutrition courses during college agree that gene-based nutrition services provide more benefits than risks.

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Table 5. The relationship between respondent characteristics and respondents' level of interest

Characteristics	Level of interest		*p-value*	OR	CI 95%
	High	Low			
Level of education					
High	155	18	0.134	0.551	0.273-1.113
Low	250	16			
Age					
20-39 years	372	31	0.751	1.091	0.317-3.760
40-60 years	33	3			
Gender					
Male	81	4	0.347	1.875	0.642-5.473
Female	324	30			
Employment					
Employed	112	15	0.066	0.484	0.238-0.986
Unemployed	293	19			
Income/pocket money					
Low	297	20	0.193	-	-
Moderate	62	8			
High	46	6			

CI: Confidence Interval; OR: Odd Ratio.

This study reveals no relationship between age and the level of public interest in gene-based nutrition services in Indonesia. Studies conducted in Puskesmas Aek Goti the age factor is related to the incidence of NCDs. In addition, the age group ≥45 years has a greater risk of NCDs than the age group of <45 years[25]. This shows that the older a person gets, the greater the risk of experiencing NCDs. Therefore, people with a greater risk of NCDs should have a higher level of interest in gene-based nutrition services. Respondents in the age group <40 years have a higher level of interest, but there is no relationship between age and level of interest because both the age groups <40 years and ≥40 years have a high level of interest in gene-based nutrition services in Indonesia. Studies conducted in Durham, Northern Carolina revealed that in a multivariate model, age, racial group, and education level are statistically significant after adjusting for other demographic factors, but there is no significant pairwise interaction[23]. The age factor does not influence a person's level of interest in gene-based nutrition services. the < 40-year-old group has a higher level of interest in gene-based nutrition services than the ≥40-year-old group.

This present study does not show a relationship between gender and the level of public interest in gene-based nutrition services because both women and men had a high level of interest, but men had a higher percentage of interest than women. It is in line with a previous study conducted in Ogun State, Nigeria that there is no significant difference between men and women in terms of perceptions regarding gene-based nutrition services[24]. It is also in line with studies conducted in Quebec, Canada d that there are no significant differences between men and women in genetic testing[18]. Gender does not affect the level of interest in gene-based nutrition services. Meanwhile, men have a higher level of interest than women.

Furthermore, this study does not show a relationship between the type of work and the level of interest in gene-based nutrition services in Indonesia. Unemployed respondents have a higher level of interest than employed respondents because the majority of unemployed respondents are students where education affects a person's reception of information. The higher a person's education, the easier to receive information which ultimately will increase knowledge[8]. Education is one of the factors affecting the level of interest in gene-based nutrition services. The majority of unemployed respondents are students so they have a higher level of interest than those who are employed. Another study conducted at a university in Ogun, Nigeria revealed that students perceive that gene-based nutrition services can provide more benefits than the risks[24]. The type of work does not affect the level of public interest in gene-based nutrition services.

This study does not show a relationship between income/pocket money and the level of public interest in gene-based nutrition services. Economic status is an external factor affecting interest where the higher a person's economic status, the higher their level of interest[22]. In this present study, the majority of respondents have low incomes because they are students and have no fixed salary/income. Respondents with low incomes have a higher level of interest in gene-based nutrition services than respondents with medium and high incomes. Respondents with an income of less than 75,000 are 1.48 times more likely to have a low interest in nutrigenetic testing (95% CI: 1.24-1.78). In addition, the majority of individuals had a high interest in low-cost or free genetic testing. Among respondents with incomes less than $75,000 per year, 51.3% of them expressed a high interest in genetic testing. This percentage changes to be higher, namely, 83.3%, if genetic testing is offered at low cost or free26. Another study reveals the influence of socioeconomic status on a person's interest[27]. Socioeconomic status tends to influence a person's level of interest. However, socioeconomic status does not influence the level of public interest in gene-based nutrition services. The majority of the respondents are interested and agree that gene-based nutrition services can provide many benefits, particularly for preventing NCDs. Most of them agree that nutrigenetic tests can detect disease earlier.

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CONCLUSIONS

Most of the respondents have a low level of education. Mostly, they are still studying at the university level. The education level, either high or low is not related to interest in gene-based nutrition services. However, the majority of people are interested and agree that gene-based nutrition services can provide many benefits, particularly for preventing NCDs.

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Conflict of Interest and Funding Disclosure

The author declares that this study has no conflict of interest and this study is solely funded by the author.

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