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The Association of Current Knowledge on Gene-Based Nutrition Services with Involvement and Confidence Levels among Nutrition Workers in Indonesia

Hubungan Pengetahuan tentang Pelayanan Gizi Berbasis Gen dengan Keterlibatan dan Kepercayaan Diri Tenaga Gizi di Indonesia

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ABSTRACT

Background: The knowledge, involvement, and self-confidence of nutrition professionals are highly required in the implementation of gene-based nutrition services. The limited number of nutrition professionals applying gene-based nutrition services poses a unique challenge in the developmental process of gene-based nutrition services in Indonesia.
Objectives: This study aims to identify the association between the knowledge, engagement, and confidence levels of nutrition workers with gene-based nutrition services in Indonesia.
Methods: This cross-sectional study was conducted in May-June 2023. The participants consisted of nutrition workers from five provinces in Indonesia. The instrument of this study used structured questionnaires encompassing socio-demographic information, knowledge, engagement, and confidence levels of nutrition workers distributed using the Qualtrics Survey platform. Data analysis employed the chi-square test with the help of Statistical Package for the Social Sciences (SPSS) version 25.0.
Results: This study involved a total of 423 respondents. Findings indicated that 53.4% of nutrition workers possessed limited knowledge, 60.0% exhibited minimal engagement, and 51.8% held low confidence levels in gene-based nutrition services. Notably, a significant correlation was identified between knowledge and confidence in gene-based nutrition services (p=0.001; PR=2.0; CI=1.35-2.94). Additionally, a significant association was present between knowledge and engagement in gene-based nutrition services (p=0.001; PR=2.00; CI=1.34-2.96).
Conclusions: This study highlights the association of low nutritionists' knowledge with low personal involvement and confidence levels to gene-based nutrition services in Indonesia. Nutrition professionals are encouraged to enhance their grasp of genetics and its relevance to nutrition through dedicated training, participation in seminars, and ongoing education initiatives.

INTRODUCTION

Genetics and environmental interactions become the basis for all health and diseases. Genes determine susceptibility to disease, while environmental factors including diet and exercise determine who is susceptible to diseases[1]. The field of nutritional genomics has increasingly developed towards the prevention and treatment of degenerative diseases over the last two decades[2–6]. Nutritional genomics is a science that studies gene responses to food and eating patterns which can be used to find out changes in the body due to food intake[7]. Some experts use nutritional genomics as a general term to describe nutrigenomics and nutrigenetics or known as gene-based nutritional services.

Rapid developments in genome research result in gene-based nutritional services, which include nutrigenomics and nutrigenetics[8]. In its application, nutritional genomics needs technological support and it provides benefits to more accurately predict the risk of Non-Communicable Diseases (NCDs) and produce nutritional recommendations for a person based on their genetic variations and type to prevent disease earlier[9,10]. Nutritionists need to understand nutritional genomics because it can provide information regarding how

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nutrition and genotype interact with phenotype[6]. Increasing knowledge about gene-based nutrition through diet and lifestyle choices is expected to change a person's susceptibility to disease and increase health potential.

Nutrition professionals from various countries, namely England, the United States, and Germany have widely practiced nutritional genomics. However, the practice of gene-based nutrition services is still low. It is caused by some factors such as nutritionists' low confidence in the application of genetics and molecular biology, lack of knowledge about the role of genetics in the development of chronic diseases, and public concerns about direct-to-consumer (DTC) tests to obtain their genetic information as related to the ethic of genetic testing, test reliability, scientific validity, clinical utility, and efficacy of this new technology[1]. Yilmaz et al (2021) reported that nutritionists relatively have low engagement, confidence and knowledge of genetics and nutrigenomics (mean knowledge score 56.3%), low engagement (mean number of activities taken 20.0–22.7%), and low trust (average trust score 25.8–29.7%)[8].

In Indonesia, the application of nutritional genomics science has been adapted to the existence of genetic examination services for individuals following a diet that suits their health condition offered by agencies such as Prodia, Kalbe Farma, and Cordlife[6]. However, studies regarding the knowledge and role or involvement of nutrition workers in nutritional genomics or gene-based nutrition services in Indonesia are very limited. To fully play their role, nutrition workers need to build a foundational knowledge of food science and nutrition to improve their understanding of human genetics[11]. They need to keep up with the times and health technology where health and nutrition services in particular have become more advanced and more personalized. Gene-based nutrition services in Indonesia are limited. Nutrition workers must prepare themselves to be able to compete and develop their competencies. Therefore, nutrition workers need to have a good role in understanding and translating genomic aspects into useful and relevant nutritional advice[12–14]. Therefore, this present study focuses on examining the relationship between knowledge about gene-based nutrition services and the involvement and self-confidence of nutrition workers in Indonesia.

METHODS

Research Design and Subjects

The descriptive quantitative research used a cross-sectional design. It was carried out on 1-30 June 2023 through an online survey involving nutrition workers in five provinces in Indonesia, namely Jakarta, West Java, East Java, Central Java, and DI Yogyakarta that have provided gene-based nutrition services. This study emphasized the knowledge, confidence, and involvement of nutrition workers in the provision of gene-based nutrition services. The results of quantitative survey results were deepened through qualitative studies by conducting Focus Group Discussions (FGD) with selected nutrition workers. In this research, the nutrition workers referred to health workers consisting of dietitians and nutritionists based on Article 11 Paragraph 9 of Law Number 36 of 2014 concerning Health Workers[15].

Data Collection

The independent variable of this study is the knowledge of nutrition workers, while the dependent variable is the self-confidence and involvement of nutrition workers. The measurement of these variables used a questionnaire that was divided into four parts, namely respondent identity, involvement and self-confidence, knowledge about genetics, and training in genetics and the career path of nutrition workers. The respondent's identity section consisted of name, age, gender, and origin, while the questionnaire on the level of knowledge, self-confidence, and involvement of nutrition workers used a structured questionnaire. This study used the Qualtrics Survey Software Application. The Qualtrics Survey consisted of several research questionnaires including 1) informed consent to ensure that the respondent is willing to take part in the research; 2) Questionnaire data on subject characteristics such as name, place of work, gender, educational level, length of work and age of the respondent; 3) Knowledge, Involvement and Confidence Questionnaire for Nutrition Workers. The questionnaire was developed by Whelan et al (2008) and translated into Indonesian to assess nutrition workers' confidence and knowledge about gene-based nutrition services[16]. The questionnaire was validated and adapted into Indonesian by a sworn translator twice, namely from English to Indonesian and vice versa to check the suitability. Furthermore, the translated questionnaire was tested for validity and reliability to get an idea of the respondents' understanding of filling out the questionnaire.

This research used a non-probability sampling with a purposive sampling technique to determine the research subject. The determination of the subject referred to predetermined inclusion and exclusion criteria and obtained a total of 872 subjects. After cleaning the data, only 423 subjects can be used for further analysis. Information about the number of respondents' recruitment is presented in Figure 1. The questionnaire was distributed by distributing links via social media such as Instagram, Whatsapp, Linkedin, and Facebook, as well as contacting the Indonesian Nutritionist Association (PERSAGI) and carrying out paid promotion through third parties that support this research. The inclusion criteria were 1) Clinical Nutrition Specialist Doctors, Nutritionists who collaborate with Genetic Service Providers, and Nutritionists who collaborate with nutrition service provider platforms, 2) nutritionists who work in the clinical/hospital sector, the industrial sector, universities, government institutions, 3) nutrition workers in the research area, 4) nutrition workers who have an STR (Registration Certificate), and 5) nutrition workers who are willing to participate in the survey. However, the exclusion criteria were nutrition workers who did not fill out the questionnaire completely.

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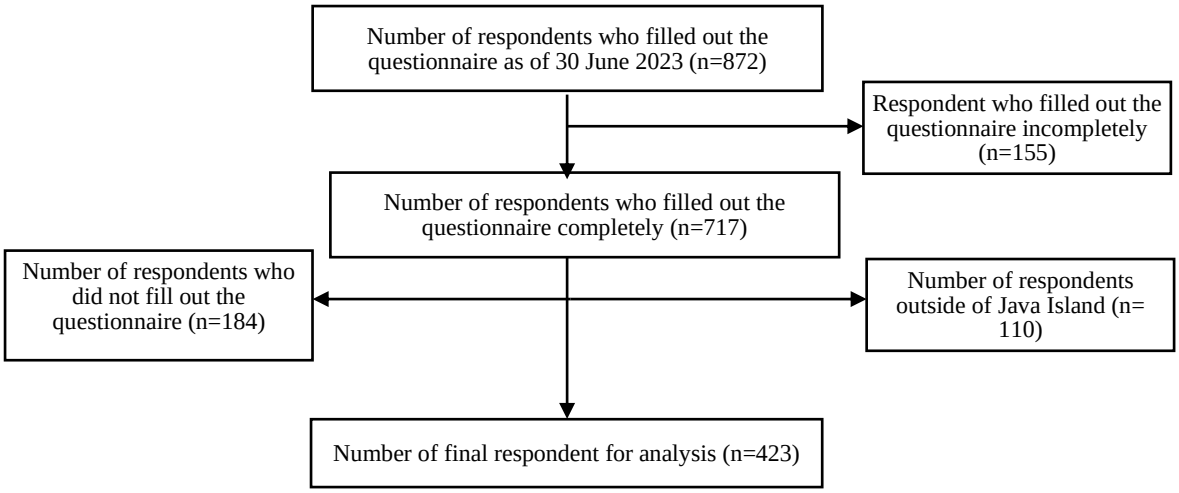

Figure 1. Results of Respondent Recruitment Process

Measuring Involvement and Self-Confidence Variables

Respondents were asked to indicate their involvement in gene-based nutrition services in the past year. The nutrition service activities covered eleven activities, namely "taking DNA information as part of a family history of the disease", "discussing the genetic basis of a disease with the patient'', “referring patients for genetic counseling related to the disease'', ''providing counseling to patients with genetic disorders about the possible impacts'', ''providing education to patients regarding genetic disorders'', “obtaining written consent to release information genetic tests to laboratories providing genetic tests'', ''discussing with patients about the basis of diseases that have a relationship between genetic type and diet'', ''advising patients where they can access information about a disease with genetic type and diet'', ''discussing with patients how diet can interact with genetics'', ''providing training to students or other health workers about human genetics'', and ''providing training to students or other health workers about diseases related to diet and genetic'. Each "yes" answer was scored 1, and a "no" answer was scored 0. So, the maximum score is 11. Respondents were asked to indicate their level of confidence in carrying out gene-based nutrition services. The self-confidence questions consisted of 11 question items with a five-point Likert scale, namely (1 = very low, 2 = low, 3 = average, 4 = high, and 5 = very high).

Measurement of Nutritional Knowledge Variables

The knowledge section consisted of 12 multiple-choice questions related to genetics (8 questions) and nutritional genomics (4 questions). Each question consists of 4 options and 'don't know' options. Questions related to genetics required respondents to identify basic genetic terminology, while questions related to nutritional genomics required respondents to identify specific interactions between genetics, diet, and disease. Respondents were asked to identify the correct definition of “nutrigenetics”; diseases related to diet and genetics; identify genes; linking dietary fat intake and cardiovascular disease (CVD); and disorders associated with the *MTHFR* 677 C→T polymorphism. Each correct answer was scored 1, and an incorrect was scored 0. So, the maximum score is 12.

Statistical Data Analysis

Data were analyzed using SPSS version 25.0. The characteristics of respondents were analyzed descriptively, while data on knowledge, involvement, and self-confidence were categorical data and analyzed using the chi-square test. The Chi-square test was carried out to determine the relationship between knowledge about gene-based nutrition services and the involvement and confidence of nutrition workers and to estimate the Prevalence Ratio (PR) of the level of knowledge of the involvement and confidence of nutrition workers about gene-based nutrition services. A p-value with a significance level of less than 0.05 is considered statistically significant. All respondents have signed informed consent before participating in the survey. This research has obtained ethical approval from the Ethics Institute of Alma Ata University (No: KE/AA/IV/101155/EC/2023).

RESULTS AND DISCUSSION

Characteristics of Respondents

Table 1 shows subjects with a mean age of 31.65 years (SD score ± 8.511) or considered as 32 years. The majority of respondents were in the productive age range/early workers aged 25-34 years (248 people or 58.6%). The respondents were dominated by females (377 women or 89.1%). Most of the respondents' domiciles were in Central Java (123 respondents or 29.1%). In terms of educational level, most respondents have a Bachelor's degree (S1), namely 181 people (42.8%). Most nutrition workers (70.7%) did not receive genetic material during lectures, but they were familiar with genetics (52.2%). Concerning the knowledge status and involvement of nutrition workers in Gene-Based Nutrition Services, the majority of nutrition workers had low knowledge status (53.4%) and were not involved (60.0%) in gene-based nutrition services. Besides, the majority of nutritional workers' self-confidence status was low (51.8%).

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Table 1. Characteristics of Respondents

Characteristics of Respondents	Mean (SD)	n	%
Age			
Young (15-24 years)		60	14.2
Early Worker (25-34 years)		248	58.6
Middle Aged (35-44 years)	31.65 (8.511)	69	16.3
Pre-Retired (45-54 years)		38	9.0
Retired (55-64 years)		8	1.9
Sex			
Male		46	10.9
Female		377	89.1
Domicile			
DI Yogyakarta		39	9.2
Central Java		123	29.1
East Java		117	27.7
West Java		81	19.1
Jakarta		63	14.9
Education Level			
D3		144	34.0
D4		72	17.0
S1		182	43.0
S2-S3		6	1.4
Profession/Dietitian/RD		13	3.1
Clinical Nutrition Specialist		2	0.5
Diploma 1		4	0.9
Participation in Genetic Training			
Taking Genetic Training		17	4.0
Taking Genetic Course		7	1.7
Taking More Menetic Training		100	23.6
Not Getting Genetic Materials		299	70.7
Familiarity with Genetics Science			
Yes		221	52.2
No		202	47.8
Status of Knowledge about Gene-Based Nutrition Services (PGBG)			
High		197	46.6
Low		226	53.4
Status of Involvement in Gene-Based Nutrition Services (PGBG)			
Involved		169	40.0
Not Involved		254	60.0
Status of Self-Confidence about Gene-Based Nutrition Services (PGBG)			
High		204	48.2
Low		219	51.8

n: frequency; %: Percentage; SD: Standard Deviation; RD: Registered Dietitian; PGBG: Gene-based nutrition services; D3: Diploma 3; D4: Diploma 4; S1: Strata 1; S2: Strata 2; S3: Strata 3

The results of the analysis show that the majority of respondents were productive age/early workers aged 25-34 years. This is in line with Van Dijk et al (2020) that at the productive age of 20-35 years, individuals play an active role in society and social life. Besides, this age group spends more time reading and does not have a decline in intellectual abilities, problem-solving, and verbal abilities. Age can influence a person's ability to understand and think. The older the person, the more developed the grasping power and thinking patterns, so that the knowledge one obtains will get better[17].

Based on the educational level, the majority of respondents have a Bachelor's degree (S1). This is in line with the Association of Indonesian Nutrition Higher Education Institutions AIPGI) data in 2023 that Higher Education Institutions in Indonesia that have most nutritional science study programs with the level of Bachelor of Nutrition (S1), namely 113 institutions, followed by Diploma 3 Nutrition Program with a total of 33 institutions, the Diploma 4 Nutrition Program with a total of 5 institutions, the Professional Dietitian Program with a total of 9 institutions, the Master Program in Nutrition Science with a total 6 institutions, and the Doctoral Study Program in Nutrition Science with a total of 2 institutions. The higher a person's level of education, the easier it will be to receive information enabling the person to get more knowledge[18,19].

The results of this study show that the majority of respondents have low knowledge of gene-based nutrition services. The knowledge of productive age nutrition workers (25-34 years) about gene-based nutrition services is low. This is in line with previous research that nutritionists in the United States, Australia, and England have low knowledge (average knowledge score 56.3%) in gene-based nutrition services[13]. Internal factors such as education, employment, and age can affect individuals'

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knowledge. Age influences a person's understanding and thinking patterns. The older the person, the more developed the thinking patterns and understanding to gain knowledge[17].

The Relationship between Characteristics of Nutrition Workers and Knowledge of Gene-Based Nutrition Services

Table 2 shows that there is no relationship between the age and the knowledge of nutrition workers regarding gene-based nutrition services (p=0.20; PR=1.3; 95% CI=0.9-1.9). The chi-square results indicate that there is a relationship between taking training and gene courses with high knowledge of nutrition workers in gene-based nutrition services. This means that nutrition workers who take training and courses related to genetics are 1.6 times more likely to have high knowledge of gene-based nutrition services (p=0.02; PR=1.6; 95% CI=1.1-2.5).

Table 2. The Relationship between Characteristics of Nutrition Workers and Knowledge of Gene-Based Nutrition Services

Characteristics of Respondents	High Knowledge		Low Knowledge		Total		P-*Value*	PR (95% CI)
	n	%	n	%	N	%		
Age of Nutrition Workers								
Productive Age	122	61.9	126	55.8	248	58.6	0.20	1.3 (0.9-1.9)
Non-Productive Age	75	38.1	100	44.2	175	41.4		
Genetics Training								
Taking Genetics Training and Courses	68	34.5	55	24.3	123	29.1	0.02	1.6 (1.1-2.5)
Not Taking Genetics Training and Courses	129	65.5	171	75.7	300	70.9		

n: frequency; N: Total; %: percentage; PR: Prevalence Ratio; CI: Confidence Interval

The Relationship between Knowledge and Self-confidence of Nutrition Workers in Gene-Based Nutrition Services

Table 3 shows that most nutrition workers have low knowledge and low self-confidence, namely 135 people (61.6%). only 113 people (55.4%) have high knowledge status and high self-confidence. There is a relationship between the knowledge and self-confidence of nutrition workers. Nutrition workers who have high knowledge about gene-based nutrition services are twice as likely to have high confidence in providing gene-based nutrition services (p=0.001; PR=2.0; 95% CI=1.3-2.9).

Table 3. The Relationship between Knowledge and Self-Confidence of Nutrition Workers in Gene-Based Nutrition Services

Variable	High Self-Confidence		Low Self-Confidence		Total		P-*Value*	PR (95% CI)
	n	%	n	%	N	%		
Status of Knowledge about Nutrition								
High	113	55.4	84	38.4	197	46.6	<0.001	2.0 (1.3-2.9)
Low	91	44.6	135	61.6	226	53.4		

n: frequency; N: total; %: Percentage; PR: Prevalence Ratio; CI: Confidence Interval

Some studies report that the low knowledge and self-confidence of nutrition workers and dietetics students regarding nutritional genomics requires professional development or formal postgraduate training[8,13,18,20]. Besides, previous surveys in the United States, Canada, and the United Kingdom indicate low knowledge of gene-based nutrition services and lack of confidence in incorporating this knowledge into practices[13]. Nutritionists with a high confidence level in their knowledge of genetics and nutritional genomics are more likely to provide effective nutritional counseling to clients, make appropriate dietary adjustments based on genetic data, and answer clients' questions or concerns about the influence of genetics on nutrition.

Health professionals, especially nutrition workers, need to be confident and competent in basic genetics, legal considerations relevant to genetic testing, and clinical interactions with patients undergoing nutrigenomic testing[18]. The application of gene-based nutritional service knowledge in nutritional service practice in Indonesia is still limited. Most nutrition workers had a lack of knowledge regarding the interaction of food and genetics. Increased knowledge, training of nutrition professionals and increased delivery of information related to interactions and genetics are expected to develop rapidly. Education on the interaction of food and genetics can be applied in nutrition education in Indonesia to increase nutrition workers' knowledge of genetics[21].

Nutritionists are considered the first line of contact with patients regarding nutritional genomics, and they are identified as prime candidates to provide advice on nutrition and genetics[22]. However, current nutrition and dietetics curricula do not include courses related to advanced human genetics, such as discussions of omics technologies, interpretation of genetic variation information, and legal, ethical, and social aspects of genetic information[22,23]. Education and training for nutrition professionals is relevant because the basic science and evidence surrounding nutritional genomics continues to develop, while clinical practice guidelines do not yet exist for gene-based nutrition advice and expectations for nutrition professionals are increasing in response to increasing demand for genetic testing[21]. In-

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depth knowledge of the implications of genetic variation in the field of nutrition to promote health, both to prevent and manage disease is required, along with the skills to develop and implement therapeutic approaches that match diet and lifestyle to the client's genetic makeup[19]. Other studies report that nutrition education is effective in increasing knowledge about nutrition[24]. People with a higher level of education can easily understand information than those with a lower level of education[25].

Confidence in gene-based nutrition services is identified as the strongest predictor of nutrition service implementation. Lack of adequate education for health practitioners in the field of genetics and nutrition is one of the challenging factors and obstacles in the provision of nutrigenomic services. Practitioners need to know how to understand and communicate information, and how to use nutritional information to advise patients on dietary modifications. However, effective communication about the relationship between genes and nutrition demands knowledge of both genetics and nutrition, and evidence suggests that health practitioners lack adequate training in this field[26]. The education and training components become challenging gaps to overcome due to the lack of nutritional genomics practitioners available for practice teaching and mentoring. Practitioners should have direct experience with nutritional assessment that includes nutrigenetic testing[27]. To increase knowledge, self-confidence and a sense of the importance of the profession in the field of nutritional genomics, educational innovation in the tertiary sector, both undergraduate and postgraduate levels must be encouraged as a main strategy in improving professional skills[22,23]. The lack of knowledge and confidence in gene-based nutrition is mainly due to a lack of training and an unsupportive environment[28].

The Relationship between Knowledge and Involvement of Nutrition Workers in Gene-Based Nutrition Services

Table 4 shows that a total of 153 nutrition workers (60.2%) who had low knowledge were proven to have no involvement in gene-based nutrition services. There is a relationship between knowledge and the involvement of nutrition workers in gene-based nutrition services. Therefore, nutrition workers who have high knowledge about gene-based nutrition services are twice as likely to be involved in providing gene-based nutrition services (p=0.001; PR=2.0; 95% CI=1.3-3.0).

Table 4. The Relationship between Knowledge and Involvement of Nutrition Workers in Gene-Based Nutrition Services

Variable	Involved		Not Involved		Total		P-*Value*	PR (95% CI)
	n	%	n	%	N	%		
Knowledge								
High	96	56,8	101	39,8	197	46,6	<0,001	2,0 (1,3-3,0)
Low	73	43,2	153	60,2	226	53,4		

n: Frequency; N: total; %: Percentage; PR: Prevalence Ratio; CI: Confidence Interval

Gene-based nutrition services are approached that consider individual genetic factors to provide more precise and personalized nutritional recommendations to individuals. Information about genetic predispositions to the body's response to food and nutrition can be identified through genetic analysis[29]. This allows nutrition workers to develop more effective nutritional recommendations that are tailored to individual needs. The involvement of nutrition workers is the main factor in increasing public awareness and understanding regarding the importance of balanced nutrition and fulfillment of the body's daily energy needs. However, the implementation of gene-based nutrition services in Indonesia is still in the early stages and requires support from the government, health institutions, and skilled and trained human resources in the field of genetics and nutrition[30].

The results of this study indicate that the knowledge, involvement, and self-confidence of nutrition workers related to genetics and nutritional genomics are still limited. Efforts to increase the awareness and competence of health workers in relation to genetics and genomics have been carried out through various approaches. Eleven gene-based nutrition service activities in the past year showed that there is a significant relationship between the involvement and knowledge of nutrition workers in gene-based nutrition services. Four of the activities are (79%) nutrition workers who are involved in ''discussing the genetic basis of a disease'', ''providing counseling if there are gene abnormalities and their impacts'', ''providing education to patients about genetic disorders'', ''discussing with the patient how diet can interact with genes''. This is in line with Nacis et al (2022) that the involvement of nutrition experts in gene-based nutrition services was low, namely less than 50% (average number of activities carried out 20.0-22.7%) of experts were involved in activities related to nutrigenomics including referring individuals for genetic counseling. The majority of nutritionists reported no involvement in each of the eleven activities related to genetics and gene-diet interactions in the past year[31]. The involvement of nutrition workers in nutritional genetics and genomics refers to the extent to which they actively integrate genetic information into nutrition services including assessing the client's genetic data, understanding how genetics may influence nutritional needs, and tailoring dietary recommendations based on the individual's genetic profile. More involved nutrition professionals can actively seek out relevant research, attend workshops, or collaborate with genetic counselors and other specialists[22].

CONCLUSIONS

Low nutrition professionals' expertise is associated with low self-confidence and involvement in gene-based nutrition services in Indonesia. Nutrition workers are expected to increase their knowledge regarding genetics and its relationship with nutrition through training, seminars, and further education. Future studies can focus on a deeper analysis of factors related

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to nutrition workers' knowledge, involvement, and trust in gene-based nutrition services in Indonesia.

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Author Contributions

AUF and RDH: Equally 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. YK 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. IFZ, SAP, RA: Involved in planning, data collection and analysis to get relevant findings.

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