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Exploring Knowledge of Gene-Based Nutrition Services among Indonesian Nutritionists: **Gambaran Pengetahuan Ahli Gizi Tentang Pelayanan Gizi Berbasis Gen di Indonesia**

INTRODUCTION The nutritional genomics field, especially the prevention and treatment of degenerative diseases has increasingly developed over the last two decades<sup>1 5</sup>.

**Nutritional genomics is a** science that studies gene responses to food or diet for early identification of possible changes in food intake. Nutritional genomics **is divided into two** scientific disciplines, namely Nutrigenomics and Nutrigenetics<sup>6</sup>. The application of nutritional genomics has been supported by technology.

This can help health workers accurately predict the risk of Non-Communicable Diseases (NCDs) and provide nutritional recommendations in accordance with individual genetic variations for early disease prevention<sup>7 – 9</sup>. **In Indonesia, nutritional genomics is a new science and it needs to be developed. Nutritionists need to understand nutritional genomics as it provides information regarding how nutrition and genotype interact with phenotype<sup>5</sup>. Increasing knowledge about gene-based nutrition regarding diet and lifestyle choices is expected to change the level of susceptibility to disease and increase an <sup>10</sup>.**

**The development of nutritional genomics significantly affects disease prevention and control. Thus, nutritionists need to apply and integrate nutritional genomics into their practice<sup>11</sup>. However, the implementation of gene-based nutrition services is low<sup>12- 13</sup>. The development of gene-based nutrition services in Indonesia faces some challenges such as low trust in genetic technology, lack of knowledge about the role of genetics in chronic disease, and concerns about Direct-To-Consumer (DTC) testing related to the ethics of Exploring Knowledge of Gene-Based Nutrition Services among Indonesian Nutritionists** **Gambaran Pengetahuan Ahli Gizi tentang Pelayanan Gizi Berbasis Gen di**

Indonesia Ifana Fitria Zulfa<sup>1</sup>, Arif Sabta Aji<sup>1,2\*</sup>, Herwinda Kusuma Rahayu<sup>1</sup>, Bunga Astria Paramashanti<sup>1</sup>, Rafiqah Dwita Hafizhah<sup>1</sup>, Sintia Aurilia Putri<sup>1</sup>, Rina Alfiana<sup>1</sup>, Alfina Ulfah Farhan<sup>2</sup>, Shelini Surendran<sup>3</sup> <sup>1</sup>Nutrition Department, Faculty of Health Sciences, Alma Ata University, Bantul, Daerah Istimewa Yogyakarta, Indonesia <sup>2</sup>Public Health Department, Faculty of Health Sciences, Alma Ata University, Bantul, Daerah Istimewa Yogyakarta, Indonesia <sup>3</sup>Faculty of Health and Medical Sciences, University of Surrey, Guildford, UK RESEARCH STUDY English Version OPEN ACCESS ARTICLE INFO Received: 29-08-2023 Accepted: 31-12-2023 Published online: 31-12-2023 \*Correspondent: Arif Sabta Aji [sabtaaji@almaata.ac.id](mailto:sabtaaji@almaata.ac.id) DOI: 10.20473/amnt.v7i2SP.2023.283-292 Available online at: <https://e-journal.unair.ac.id/AMNT> Keywords: Nutritionist, Nutritional genomics, Gene-based nutrition services, Knowledge ABSTRACT 284 Copyright ©2023 Faculty of Public Health Universitas Airlangga Open access under a CC BY SA license | Jointly Published by IAGIKMI & Universitas Airlangga How to cite: Zulfa, I. F., Aji, A. S., Rahayu, H. K., Paramashanti, B. A., Hafizhah, R. D., Putri, S. A., Alfiana, R., Farhan, A. U., & Surendran, S.

(2023) Exploring Knowledge of Gene-Based Nutrition Services among Indonesian Nutritionists: Gambaran Pengetahuan Ahli Gizi Tentang Pelayanan Gizi Berbasis Gen di Indonesia. *Amerta Nutrition*, 7(2SP), 283 – 292. e-ISSN: 2580-1163 (Online) p-ISSN: 2580-9776 (Print) Zulfa et al. | *Amerta Nutrition* Vol. 7 Issue 2SP (December 2023). 283-292 genetic testing, test reliability, scientific validity, clinical utility, and efficacy of this new technology<sup>13</sup>. The main challenge in gene-based nutrition services is limited knowledge and confidence about genetics and nutritional genomics<sup>11</sup>.

A study concerning genetics and nutrigenomics conducted in the United Kingdom (UK) reported low levels of knowledge (mean knowledge score 56.3%), low engagement (mean number of activities taken 20.0% – 22.7%) and low trust (mean trust score 25.8% – 29.7%)<sup>11</sup>. Another study at Ankara Hospital, Turkey revealed that the majority of nutritionists did not have adequate knowledge of nutrigenetics<sup>14</sup>. Moreover, other studies reported that nutritionists still need to develop their skills and knowledge in genetics and diet-gene interactions to better implement nutritional genomics in their practices<sup>15</sup>.

In Indonesia, the implementation of nutritional genomics science has been adapted to the existence of a genetic examination service for individuals following a diet that suits their health condition as offered by some companies such as Prodia, Kalbe, Nalagenetics, and Cordlife<sup>16</sup>. However, studies concerning the knowledge and roles or involvement of nutritionists regarding nutritional genomics or gene-based nutritional services in Indonesia have not been available so far. Studies concerning nutritionists' knowledge of gene-based nutritional services and nutritional genomics science as well

as their application to dietetic practice have not been conducted.

Therefore, this present study tries to identify nutritionists' knowledge about gene-based nutrition services in Indonesia, knowledge about the science of nutritional genomics and gene-based nutrition services, and nutritionists' views on gene-based nutrition services. The data collection method used was a semi-structured interview. The data analysis was carried out using content analysis. The results of the study are expected to be useful for the development of gene-based nutrition services in Indonesia.

**METHODS** This study was a qualitative study conducted in five provinces in Indonesia: DKI Jakarta, Central Java, East Java, West Java, and Yogyakarta. The data collection method used was a semi-structured interview. The data analysis was carried out using content analysis. The results of the study are expected to be useful for the development of gene-based nutrition services in Indonesia.

All informants are female. In terms of educational background, it is dominated by bachelor's degrees (S1). Concerning the type of institution, the majority of informants are from Type B Hospitals and they have worked as nutritionists for 8 years with a range of 2 - 25 years.

Putri, S. A., Alfiana, R., Farhan, A. U., & Surendran, S. (2023) Exploring Knowledge of Gene-Based Nutrition Services among Indonesian Nutritionists: Gambaran Pengetahuan Ahli Gizi Tentang Pelayanan Gizi Berbasis Gen di Indonesia. *Amerta Nutrition*, 7(2SP), 283 – 292. e-ISSN: 2580-1163 (Online) p-ISSN: 2580-9776 (Print) Zulfa et al. | *Amerta Nutrition* Vol. 7 Issue 2SP (December 2023). 283-292

Informants	Province	Age	Gender	Education	Type of institution	Length of work
DKI Jakarta	24	Female	S1	Type B Hospital	2 years	
DKI Jakarta	31	Female	S1	Type B Hospital	9 years	
Central Java	28	Female	S1	Type C Hospital	5 years	
DI Yogyakarta	48	Female	D4	Type A Hospital	25 years	
East Java	26	Female	S1	Type B Hospital	4 years	
West Java	28	Female	D4	Type B Hospital	4 years	
DI Yogyakarta	28	Female	S1	Type B Hospital	5 years	

The key informant in this study was one informant as presented in Table 2. The key

informant is a female nutritionist aged 26 years who provides gene-based nutrition services and has a Bachelor's degree.

The key informant has worked at gene-based nutrition service providers for 1 year and has worked as a nutritionist for 4 years. The key informants stay outside the research area but her workplace, namely the nutrigenetic service providers located inside the research location so her responses are relevant. Table 2. Characteristics of the key informant Province Age Gender Education Type of institution Length of work Banten 26 years Female S1 Nutrigenomics Service Provider 4 years it, s f and re underigic, we'ri witheith ( IF 21rsl d S) Th reslt is in linith Ska Yilma et a ( 14 . Mofe infoma amittedat tha fotten it a thidoroe gen - beder. It in lin Colin et a ( 11 . Sourc of Kle Nutritionists do not get much information and knowledge about nutritional genomics science.

The majority of the informants (5 out of 7 informants) gained this knowledge while studying, but there were only a few classes on nutritional genomics. Other informants (2 out of 7 informants) gained knowledge about this science by attending seminars. A previous study by Wright (2014) concerning self-confidence and education in the science of nutritional genomics revealed that a lack of training and an unsupportive environment resulted in poor knowledge and a lack of confidence in the field of nutritional genomics<sup>17</sup>. This is in line with the following statements. " In S1it'sne ored." ( 21rs o, S) "Thissience and mpe about it. I oe heat in a nutongrs ( 48rsld4 The key informant stated that the college did not offer nutritional genomics classes.

She learned about it from another nutritionist when she wanted to become a nutritionist who provides gene-based nutrition services. It is in line with Mariette Abrahams et al., (2018) that nutritionists seek knowledge about nutritional genomics through communication with each other and the wider scientific community<sup>18</sup>. The statement of the key informant is as follows: "When w cole, ritiongic cs didn't exist yet. have to ln about thene and prov e el romanutist a sialist (, 2 yea o, S) Definitio Nritioneics The majority of informants (6 out of 7 informants) define nutritional genomics science according to their understanding.

They define it as a science related to genes and nutrition. However, none of them mentioned about nutrigenomics and nutrigenetics. Some informants (4 out of 6 informants) said that the output of this science related to nutritional needs can be different for each individual depending on their genes. It can be seen from the following statement. "Asfar know, isabout study , yesaboutgic, omsand tritioirtio to health, ealth ( 48rsld4 286 Copyright ©2023 Faculty of Public Health Universitas Airlangga Open access under a CC BY SA license | Joinly Published by IAGIKMI & Universitas Airlangga How to cite: Zulfa, I. F., Aji, A. S., Rahayu, H. K., Paramashanti, B. A., Hafizhah, R. D., Putri,

S. A., Alfiana, R., Farhan, A. U., & Surendran, S.

(2023) Exploring Knowledge of Gene-Based Nutrition Services among Indonesian Nutritionists: Gambaran Pengetahuan Ahli Gizi Tentang Pelayanan Gizi Berbasis Gen di Indonesia. *Amerta Nutrition*, 7(2SP), 283 – 292. e-ISSN: 2580-1163 (Online) p-ISSN: 2580-9776 (Print) Zulfa et al. | *Amerta Nutrition Vol. 7 Issue 2SP (December 2023)*. 283-292 This is in line with Elsamanoudya et al., (2016) that the nutritional genomics science is a two-way relationship between nutrition and the human genome (nutrigenetics and nutrigenomics).

Nutritional genomics defines gene expression and metabolic responses which possibly influence individual health conditions and disease susceptibility<sup>19</sup>. Sc of Nritional Gnom Scnc All informants agreed that nutritional genomics is related to the concept of individuals having different responses and some of them (4 out of 7 informants) exemplified the fat metabolism of different individuals. It is in line with Sharma et al.,

(2017) that nutrigenomics will help in evaluating individual nutritional needs based on the individual's genetic profile (personalized diet) and curing and preventing chronic diseases such as that dietary cholesterol has an inhibitory effect on the trncrtio fth? -hydroxy- ? -methyl-glutaryl-CoA reduction gene<sup>20</sup>. Most informants (5 out of 7 informants) provided examples of different weight loss. It is in line with a previous study by Alsulami et al (2020) that some Single Nucleotide Polymorphisms (SNPs) have a relationship with obesity and the effect of the interaction between SNPs and a high protein diet on changes in body weight<sup>1</sup>.

Some informants (3 of 7 informants) stated that the efficacy of different diets and disease susceptibility as indicated by the following statement. want s to e autom we rmet might los usthse ece nd ereststurnoutto e different whe persn get one to two ki a m but it do not woor pon B." ( 68rsl4 " Ther no rehip di, aers blood e isnorm othepon,itcn ince o t's thelations wiia Mels (M) . acepon ent expla th n ments. I'morry, I don't rea it der Some informants (4 out of 7 informants) defined nutrigenetics quite precisely. However, they could not provide examples of nutrigenetics.

They define nutrigenetics as the science that explains how genes in line with Elsamanoudya et al, (2016) that nutrigenetics is the science of identifying gene variants associated with differences in response to nutrition and linking gene variations with disease<sup>19</sup>. Nutrigenetics identifies how an inivida eticcooitio esostovaio nutrients<sup>5</sup>. Uthpala et al, (2020) state that nutrigenetics explains how genes influence diet<sup>21</sup>. "So, 'sabout igensa on'snutr isinfluencby r gen. the nutritionaylevfor en nd enar different,bege enexyardent, that my analogy." ( 14rsl1 Definitioutnom Most of the

informants (5 out of 7 informants) could not correctly define nutrigenomics. They tried to guess incorrectly.

"Nutrition is most closely related to genetics (78%) Nutrition scientists study nutrition affect in genetic diseases. All respondents stated that Diabetes Mellitus (DM) is associated with the interaction of genes and nutrition. It is in line with Phillips (2013) that Calpain 10 (CAPN10) is the first DM susceptibility gene identified. Other studies tried to confirm the association between DM risk and the TCF7L2 gene SNP (rs7903146)<sup>22</sup>. Most informants (6 of 7 informants) mentioned heart diseases and obesity (4 of 7 informants). It is in line with Henuhili (2010) that the Fat Mass and Obesity (FTO) gene is responsible for obesity<sup>23</sup>.

Muhammad (2021) explained that the isoflavon daidzein and genistein compounds can reduce LDL-cholesterol levels, and inhibit the production of pro-inflammatory cytokines, cell adhesion protein, iNos, and oxidation of Low Density Lipoprotein (LDL) which positively prevents cardiovascular disease<sup>5</sup>. Two out of seven informants mentioned hypertension and one informant mentioned cancer. Muhammad (2021) stated that good vitamin D status can improve life rates in patients with colorectal and breast cancer<sup>5</sup>. "Maybe it is diabetes, obesity, that it." (44 years old, D), (pointing to the diabetes cell.)

(14%) Knowledge of Genetic Susceptibility All informants could not specifically mention the types of genes influencing the interaction of nutrition and genes. Three out of seven informants expressed that they knew certain types of genes related to a person's disease susceptibility, but did not remember the name of the gene. <sup>287</sup>  
Copyright ©2023 Faculty of Public Health Universitas Airlangga Open access under a CC BY-SA license | Jointly Published by IAGIKMI & Universitas Airlangga How to cite: Zulfa, I. F., Aji, A. S., Rahayu, H. K., Paramashanti, B. A., Hafizhah, R. D.,

Putri, S. A., Alfiana, R., Farhan, A. U., & Surendran, S. (2023) Exploring Knowledge of Gene-Based Nutrition Services among Indonesian Nutritionists: Gambaran Pengetahuan Ahli Gizi Tentang Pelayanan Gizi Berbasis Gen di Indonesia. *Amerta Nutrition*, 7(2SP), 283 – 292. e-ISSN: 2580-1163 (Online) p-ISSN: 2580-9776 (Print) Zulfa et al. | *Amerta Nutrition* Vol. 7 Issue 2SP (December 2023). 283-292 "I cannot memorize the type of gene because I got it a long time ago when I was in college. But, I remember that fat is related to lipoproteins, if I'm not mistaken, diabetes, I don't know it well because I only remember about the heart."

(IF 5, 26 years old, S1) All informants have not applied this knowledge in their workplace using actual procedures. This is in line with Abraham et al (2019) that the application of



gene-based nutrition services throughout the dietetics profession is low<sup>13</sup>. Some informants (4 out of 7 informants) stated that the application can be done by providing education about gene-related diseases during counseling. "It can be done because the examination procedure is not an exam in a lab."

(, 6 years old, S) "I sit at a table where they were difficult to sit after eating in her presence with others, and her behavior was a cause for having an excess weight status (14 years old) The 2 Knowledge of Gene-Based Nutrition Services Mechanism All respondents only knew a little about gene-based nutrition services. They did not know the mechanism of gene-based nutrition services in detail. They stated that this service had special laboratory tests. Only two out of seven informants stated that the examination used saliva samples.

It is in line with Angeline Fanardy (2020) that one of the examinations used saliva samples<sup>24</sup>. "I know it but I don't understand it, us saliva samples are sent to a lab for analysis. The results will then be explained (14 years old) Informants stated that they knew the mechanism for gene-based nutrition services using saliva samples and the results were then interpreted. Then, the outpatient will receive counselling regarding food recommendations, dietary restrictions, and disease susceptibility based on the results of the lab as indicated by the following statements.

" Gene-based nutrition services include laboratory tests using saliva samples or buccal swabs. Sample processing uses Polymerase Chain Reaction (PCR) or microarray. Each provider provides the gene test results differently depending on their panel. Some providers do not provide genetic-based meal plans and only provide general meal plans. Some also do not provide information about a person's susceptibility to certain disease risks. They collaborate with partners such as clinics, hospitals, and nutrition service platforms. Clients can get this service through collaborating partners or directly from the provider via the website and Instagram.

a dietitian and I, we have approached her to get on. It is out of the calorie in one recommendation, etc " (2 years old, S) " My response to the disease, for example, percentage of susceptibility, now we have developed it. I could be one of the factors for the genetic or for other things." (2 years old, S) "We have two of them, namely B to and B C B, we are in partnership with a nutrition provider. We are also providing our services. It can be contacted directly by giving a call that directly provides information." (6 years old) " Here we are participating in a competition." (I, 2 years old, S) The with Mitch 21) the gene-based nutrition services are currently being developed.

participants are only for a, and the address to the coach. The, the cause of the test is to improve

ireatinhb. Il ntro er uthtinstep, nmely, etic g n pndease ssility assn ansltationesion 288  
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F., Aji, A. S., Rahayu, H. K., Paramashanti, B. A., Hafizhah, R. D., Putri, S. A., Alfiana, R.,  
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2580-9776 (Print) Zulfa et al. | *Amerta Nutrition Vol. 7 Issue 2SP (December 2023).*  
283-292 25 . Sourc of Inform Some respondents got information about gene- based  
nutrition services from Instagram, gene-based nutrition service providers, and  
gene-based nutrition service brochures.

This is in line with the results of a previous study that nutritionists received the most  
information about gene-based nutrition services from nutritionists and social media<sup>26</sup>  
as indicated by the following statements. "I don't know about the service mechanism in  
detail, but I know some from brochures." (IF 7, 28 years old, S1). "I know about the saliva  
from Instagram." (IF 6, 28 years old, D4) "I've heard from some hospitals that provide  
nutrigenomics services." (IF 2, 31 years old, S1) Bes of Gne - Baseutrvice All respondents  
believed that gene-based nutrition services were useful for realizing personalized diets,  
preventing disease, and being general diet alternatives that have not been successful.

This is in line with Renzo et al, (2019) that personalized nutrition can explain the  
molecular and cellular effects of nutrition on individuals. This will allow nutritional  
interventions according to individuals' physiological, genetic, ethnic, cultural and  
economic background<sup>27</sup>. Besides, Ferguson et al, (2016) showed that personalized  
nutrition was more effective in preventing chronic disease compared to general diet  
recommendation<sup>28</sup>.

Delmi (2019) revealed that a person can be diagnosed before they get sick, allowing  
doctors to determine a person's genetic predisposition to disease and take preventative  
and curative measures by changing diet and avoiding foods that cause the disease<sup>6</sup>. IF  
56rsl d S) "Yesthat'ssifilly , mnly about nutritionsvi , r ple , provia or nutritioncounsing  
acanc w d the rt condition n tes heart or , t he isoo . In rm nutenoms itis mesifi eac  
individaybt's Based on the results of the interview, all respondents agreed that the test  
has advantages, namely specific dietary interventions, accurate diet targets, a higher  
percentage of diet success, practical and easy-to- use tools, and application of a good  
lifestyle. It is in line with Angeline Fanardy (2020) that nutrigenomic examination was  
comfortable, non-invasive, and fast<sup>24</sup>. "Knowing e enesandmhing ith he nutriginic l er



tfrewe eass can erlateifthey mh."

(, 1 yearso, S) "Maybe wilbe ore ient thfe, mouinterention illhavahigr eves ( 78rsld1 "Basly, isavaila, ided prac and e." ( 14rsld1 No informant stated that this service could be carried out at home. Key informants expressed that this service was practical and could be done at home. Tools will be sent to the client to take samples, then the client will be guided on how to take, store, and send samples. "So, w guidli in caying outswab at e. guith ludevything mst be attto how take e amTh sple ust ced put n rd asti. Then, it be sac."

(6rsld1 The majority of informants (5 out of 7 informants) expressed the disadvantages of this service such as being expensive and limited available in certain areas. Jacus et al, (2021) revealed that cost considerations are a critical dimension that must be addressed before implementing gene-based advice in nutritional practice<sup>29</sup>. "I se articesthat the ere quite expens." , I hin the mis fam wit . Ev not aealterces caly provide nutrneticeres , fexame foher ranks theinsce eric ore erous . it depen the uranagy er cover or not ."

( 2 yea o, S) " Of cours , pe e roblswith thpe, but priisquite ble , evere afford t Or me icab coved insce thit a be a pe mur (I, 2 yea o, S) 289 Copyright ©2023 Faculty of Public Health Universitas Airlangga Open access under a CC BY SA license | Joinly Published by IAGIKMI & Universitas Airlangga How to cite: Zulfa, I. F., Aji, A. S., Rahayu, H. K., Paramashanti, B. A., Hafizhah, R. D., Putri, S. A., Alfiana, R., Farhan, A. U., & Surendran, S. (2023) Exploring Knowledge of Gene-Based Nutrition Services among Indonesian Nutritionists: Gambaran Pengetahuan Ahli Gizi Tentang Pelayanan Gizi Berbasis Gen di Indonesia. *Amerta Nutrition*, 7(2SP), 283 – 292.

e-ISSN: 2580-1163 (Online) p-ISSN: 2580-9776 (Print) Zulfa et al. | *Amerta Nutrition Vol. 7 Issue 2SP (December 2023)*. 283-292 Most informants were unable to provide examples of the service provider. Only three (out of 7 informants) knew the provider's partner hospital or clinic. In Indonesia, gene-based nutrition services were initiated by Kalbe in 2018. Thus, socialization about this service must be improved. Other studies conducted in 2023 revealed that many nutritionists were not familiar with gene-based nutrition services, namely 48 percent<sup>26</sup>. "In Indonesia, I only found Prodia, but I don't know about other places."

(IF 3, 28 years old, S1) The of Nritioniste - Baseut Ses Some informants (4 out of 7 informants) doubted their role in gene-based nutrition services. This is in line with Abraham et al (2018) that the perceived obstacles to expanding the nutritional genomics practices were associated with skepticism among the dietetics community<sup>18</sup>. Informants argued that nutritionists could play a role in interpreting food and

collaborating with clinical nutrition specialists. Clinical nutrition specialists have the responsibility to interpret **the results of the** nutrigenomic examination.

Mitchell (2016) reported that nutritionists will work together with health care practitioners such as doctors and genetic counselors<sup>25</sup>. "It might be better understanding ingredients better than for. So, more native collagen. The doctor in the food affects, the nutrition and avoid it naturally. Maybe can plain and avoid inter-hybrid nutrition canidernativ apply for genoms ( 78rsl1 In practice, nutrition can provide - based services by providing nutrition results clearly stated. "It cannot, so you can hear it from the nutritionist and for a nutritionist (I, 2 years old, S) The Nutritionists Peculiarities of Gene-based Nutrition Services All respondents showed positive to **gene-based nutrition services and** they believed that its existence is important.

Gene-based nutritional services are expected to reduce the prevalence of degenerative diseases whose prevalence is increasing. A study by Sharma et al, (2017) revealed that nutrigenomics would help in the recovery and prevention of chronic diseases<sup>20</sup>. **It is in line with** Justine Horne et al, (2016) that respondents considered **Personal Nutrigenomics Testing (PNT) a positive contributor to advancing the dietetics** field<sup>30</sup>. "In opinion for the future because of the importance of people, if people know themselves better and what the body needs the prevalence of diabetes (type 2 diabetes, diabetes and cancer can be reduced." ( 56rsl1 Almost all informants (6 **out of 7 informants**) wanted their workplace to provide gene-based nutrition services.

Other respondents whose hospitals had **collaborated with laboratories providing nutrigenomic tests also wanted to be able to provide nutrigenomic tests independently, so the costs could be cheaper.** "Yes better because I think it's better for the hospital ( 68rsl4 "Yes, I want it because independently, the costs will be cheaper." (IF 7, 28 years old, S1) On the other hand, the key informant argued that the **gene-based nutrition service providers** in Indonesia are extension providers, so the possibility of hospitals providing this service independently is still difficult.

Angeline Fanardy (2020) stated that after taking the samples, Nutrigenomics Indonesia would send the samples to a laboratory in Canada for analysis using the microarray technique<sup>24</sup> as stated below: "Yes in Indonesia, most provide collaboration with others, they provide like extension, that's our condition." (I, 2 years old, S All respondents were interested in providing gene-based nutrition services so they participated in a study about providing gene-based nutrition services now. This is in line with Jasli, ( 29 . Besides is in Chistoera Coor ( 205 ) at nutritionists not have more experience in dietetics and - gene interaction in different admittance of nutrigenomics. 15 "I rested, but in the study." (I Providers need to prepare many things to provide gene-based nutrition services.

Based on the results of interviews, informants stated that the institutions need to

prepare training, facilities and infrastructure, promotions, and costs to provide this service. S. Nacis et al, (2021) reported that further training and learning will equip nutritionists to provide dietary **advice based on genetic information**. Besides, cost and ethical considerations need to be addressed before integrating gene-based nutrition services<sup>29</sup>. Here's the statement: "Acting, rather workers Yes nutritionists we need be ed rst."

(, 8 years old, D) " Maybe working with related agencies and installing, example, a lab or taking infrastructure, (e)mit' about understood, understood<sup>29</sup> Copyright ©2023 Faculty of Public Health Universitas Airlangga Open access under a CC BY SA license | Jointly Published by IAGIKMI & Universitas Airlangga How to cite: Zulfa, I. F., Aji, A. S., Rahayu, H. K., Paramashanti, B. A., Hafizhah, R. D., Putri, S. A., Alfiana, R., Farhan, A. U., & Surendran, S. (2023) Exploring Knowledge of Gene-Based Nutrition Services among Indonesian Nutritionists: Gambaran Pengetahuan Ahli Gizi Tentang Pelayanan Gizi Berbasis Gen di Indonesia. *Amerta Nutrition*, 7(2SP), 283 – 292.

e-ISSN: 2580-1163 (Online) p-ISSN: 2580-9776 (Print) Zulfa et al. | *Amerta Nutrition* Vol. 7 Issue 2SP (December 2023). 283-292 about it they're interested that the prom." Informants expected that gene-based nutrition services could further develop. Most of them **(5 out of 7 informants)** want training and seminars on nutritional genomics science and gene-based nutritional services. Some argue that such materials **need to be included in** college curricula to improve Human Resources (HR) for nutrition experts in the field of gene-based nutrition services.

This **is in line with** Justin Horne et al, (2016) that nutrition students will be the right target for education about nutritional genomics science. **Thus, the integration of nutrigenomics as a component of university-level training** can help **bridge this knowledge gap** and further advance the field<sup>30</sup>. Inserting nutrigenomics education into dietetics curricula will help alleviate concerns about nutritionists' limited knowledge of nutrigenomics as stated below.

"Yes, based on this study, maybe the process may be specific (68% said) "The response from our work. Even though the edge related to nutrigenomics and nutrigenetics is developing since I'm in Ilgga, 34 and 15% S2 ." **CONCLUSIONS** Nutritionists still have a low level of knowledge about nutritional genomics. They are unfamiliar with **gene-based nutrition services and** only have brief and basic information about the service. Nutritionists have positive perceptions of gene-based nutrition services. They consider this service important and want their agency to provide this service.

However, they are not ready to provide this service and hope that the agency can

provide training for them. Besides, equal distribution of knowledge about gene-based nutrition services in universities can help produce nutritionists who can provide gene-based nutrition services in Indonesia. ACKNOWLEDGMENTS The author highly appreciates the supervisor for guiding the implementation of this study and the participation of all participants in this study.

Besides, the author appreciates the thesis group, entitled "Involvement, Self-Confidence, and Knowledge of Nutritionists about Gene-Based Nutrition Services in Indonesia: A Mixed Method Study." Conflict of Interest and Funding Disclosure This author declares that there is no conflict of interest in this study. This study was partly funded by the Ministry of Research, Technology and Higher Education under the Master's Thesis Research (PTM) grant scheme.

#### INTERNET SOURCES:

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