

Nutrigenomics: Perceptions of South African Dietitians and General Practitioners

Desiré Greyvensteyn^a Corinna May Walsh^a Mariette Nel^b
Elizabeth Margaretha Jordaan^a

^aDepartment of Nutrition and Dietetics, School of Health and Rehabilitation Sciences, Faculty of Health Sciences, University of the Free State, Bloemfontein, South Africa; ^bDepartment of Biostatistics, School of Biomedical Sciences, Faculty of Health Sciences, University of the Free State, Bloemfontein, South Africa

Keywords

Nutrigenomics · Perceptions · Registered dietitians · General practitioners

Abstract

Introduction: Although investigations into the emerging field of nutrigenomics are relatively limited and more research in this field is required, experts agree that there is potential for it to be incorporated into health care practice. If health care professionals can promote healthy dietary behavior based on nutrigenomic testing, it can assist in addressing the health consequences of poor diet and lightning the strain on the South African health care system. **Methods:** Registered dietitians (RDs) and general practitioners (GPs) registered with the Health Professions Council of South Africa (HPCSA) who obtained their qualification in South Africa (SA) were eligible to participate in this cross-sectional study. Participants were identified using convenience and snowball sampling. A self-administered electronic survey using EvaSys Software[®] was completed by those that agreed to participate. **Results:** Nearly all RDs (97.3%), but less than a third of GPs (30.4%), had heard of the term nutrigenomics. Approximately three-quarters of RDs (74.7%) and GPs

(73.9%) had or would personally consider undergoing genetic testing. More than 40% (43.5%) of RDs ranked direct-to-consumer genetic testing companies as the most equipped, while 31.8% of GPs ranked RDs as the most equipped to provide patients with nutrigenomic services. Both RDs and GPs ranked similar reasons as “strongly agree” for why consumers were motivated to make use of nutrigenomic services, which included “motivated by a desire to prevent or manage disease” (56.7%), “prevent a disease based on family history” (65.9%), “control health outcomes based on family history” (54.9%), and “improve overall health-related quality of life” (48.6%). Cost concerns were reported as the greatest barrier to implementing nutrigenomic services (75.7%). Other barriers included confidentiality issues (47.8%) and moral concerns (37.3%). Greater individualization of diet prescription (66.5%), stronger foundations for nutrition recommendations (62.4%), and dietary prescriptions that would manage or prevent certain diseases more effectively (59.0%) were all perceived as benefits of including nutrigenomics in practice. **Conclusion:** This study identified perceived consumer motivators and barriers that might affect the willingness to seek nutrigenomic services in SA. In addition, the need for more nutrigenomic training opportunities, including the planning of personalized diets

based on genetic testing results and interpretation of results, was confirmed. However, both RDs and GPs felt that the emerging field of nutrigenomics needs further development before it can be applied effectively in routine private and public health care in SA.

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Introduction

A large body of evidence has shown that a westernized lifestyle increases the risk for nutrition-related disorders and that nutrition can have a significant effect on health outcomes [1–11]. According to the South African Demographic and Health Survey, 68% of South African women and 31% of men aged 15 years and older are overweight and obese [12]. Obesity is closely linked to an increased risk of developing several noncommunicable diseases (NCDs) [13]. In South Africa (SA), the national health care budget increased by 95% between 2009 and 2016 [14–16].

Modifying unhealthy behaviors can address obesity and NCDs, with a resultant decrease in health care costs. Targeting nutritional intake is one of the most cost-effective methods to encourage a healthy lifestyle to prevent the development of NCDs [17–19]. Compared to general recommendations made at a population level, applying a personalized approach has been shown to be more effective in producing measurable positive improvements in nutritional intake and health outcomes of individuals [20]. If a predisposition to a specific disease is identified at an early stage, the development thereof could be prevented or delayed by making lifestyle changes relevant to the individual [19, 21].

Nutrigenomics is defined as the study of how nutrients affect gene function [22]. A better understanding of the benefits of including nutrigenomic services in the routine practice of health care professionals may translate to personalized care that has the potential to decrease the risk of developing obesity and the resultant NCDs, by preventing rather than managing these conditions. Four approaches to delivering nutrigenomic services have been described. These include the health care professional approach, the multidisciplinary team approach, the public health approach, and the consumer approach. Globally, the consumer approach, where individuals contact a direct-to-consumer (DTC) genetic testing company (often via a website), is currently the most popular genetic testing approach [19]. Genetic testing is done on a sample that the consumer sends to the com-

pany, and the results and recommendations are sent back to the consumer. The DTC method rarely entails face-to-face interaction.

Despite the potential of nutrigenomic testing, several barriers prevent proper implementation. The success of nutrigenomic implementation is reliant on not only evidence-based science but also health professional and consumer acceptance [7]. Although research into nutrigenomics is still a relatively new field, health care professionals agree that the results of genetic testing could potentially be included in routine health care practice [22–24], including diagnosis and treatment of NCDs [25]. Only a limited percentage of genetic tests are presently performed by health care providers. Health care providers appear to have little expertise and confidence in the use of nutrigenomic tests [25]. With genetic testing becoming more widely available, health care providers are required to comprehend and interpret the results of these tests, as well as convey these complex test results [26]. It is critical for health care professional organizations and associations, as well as the genetic testing industry, to understand why health care professionals choose to use nutrigenomic tests in their practice or not [25]. A study about the perceptions and experiences of integrating nutrigenomics into practice conducted by Abrahams et al. [9] among registered dietitians (RDs) from the UK, Canada, SA, Australia, Mexico, and Israel showed that the participants expressed positive perceptions of applying nutrigenomics in practice and felt that it motivated and improved compliance in their clients. The participants were aware of misperceptions regarding what nutrigenomics entails, while they were also unsure in which health care professionals' scope-specific nutrigenomic testing and outcomes fall [9].

Currently, no studies related to the perceptions of RDs and general practitioners (GPs) regarding nutrigenomics in SA are available. In view of the lack of information in SA and conflicting information from other countries about the feasibility of using nutrigenomics in practice, the purpose of the current study was to investigate the perceptions of RDs and GPs in SA regarding nutrigenomics.

Materials and Methods

A cross-sectional study design was applied. Convenience and snowball sampling were used to recruit participants registered with the Health Professions Council of South Africa (HPCSA) at the time of data collection. An electronic newsletter with the invitation and link to the survey was distributed to members by the

Association for Dietetics in South Africa (ADSA). The invitation and link were also posted on Facebook groups for RDs and GPs. By clicking on the link to the survey and reading the first section, participants provided voluntary consent to participate in the current study.

Before collecting data for the main study, a pilot study was conducted among three RDs and three GPs. Results of the pilot study were included in the main study since no changes were made to the survey. Data were collected during April 2020, for 4 weeks, through an electronic self-administered EvaSys survey. The survey consisted of open- and close-ended questions. Responses were rated according to a dichotomous response set, as well as a four-point scale. The four-point scale was used to avoid including a neutral option, but this was not possible for all questions; thus, a five-point scale was used for certain questions. The survey included multiple-choice questions with predetermined options as well as an “other” option. Open-ended questions regarding the perceptions and experiences of the participants were also asked, and the most common answers were presented. Any personal experience involving nutritional genomics was determined using open-ended responses and categorical scales. The 49 questions included in the survey were based on an in-depth literature review. This analysis report does not present any of the open-ended question results, which included identifying information, including but not limited to the participants’ email addresses and HPCSA registration numbers.

Raw data were exported from the EvaSys Software[®], verified and analyzed by the Department of Biostatistics at the University of the Free State. The data analysis for this paper was generated using SAS software. Copyright, SAS Institute Inc. SAS, and all other SAS Institute Inc. product or service names are registered trademarks or trademarks of SAS Institute Inc., Cary, NC, USA. Descriptive statistics, namely, frequencies and percentages for categorical data and medians and percentiles for numerical data, were calculated per group (RDs and GPs). Numerical data had skew distributions; therefore, the summary statistics median and percentiles were used. Categorical variables were compared between the RDs and GPs using the χ^2 test or Fisher’s exact test (when more than 20% of cells had expected frequencies had a value of less than 5). A *p* value below 0.05 was considered statistically significant.

Results

This study included 173 participants, of which 150 were RDs and 23 GPs with a median age of 30 years (min. 22 years; max. 59 years). Significantly more female (93%) than male participants completed the survey (Table 1). The last question in the survey was answered by 150 participants, which gives an overall survey completion rate of 86.7%.

Overall, 47.7% of participants reported having an honor’s degree as the highest level of education. It is likely that these participants may have considered their 4-year bachelor’s degree to be equivalent to an honor’s degree. Most participants (84.8%) were working in the field in which

they obtained their degree. Almost half (47.4%) of the participants were working in the private sector. The RDs’ and GPs’ years of experience varied from 0 to 35 years and 0 to 17 years, respectively. There was no statistically significant difference regarding the years of experience between the two professions (*p* = 0.1295).

Nearly all RDs (97.3%), but less than a third of GPs (30.4%), had heard of the term nutrigenomics (Table 1). After briefly explaining what nutrigenomics entailed in the survey, almost three-quarters of both RDs (74.7%) and GPs (73.9%) stated that they had or would personally consider genetic testing.

Nutrigenomics was included in the undergraduate curriculum of 44.7% of RDs and none of the GPs. A significantly higher percentage of RDs (58.9%) compared to GPs (8.7%) indicated that they had read any scientific literature related to nutrigenomics (*p* < 0.0001).

About a third of RDs reported that they had provided nutrigenomic-related counseling services (32.0%) compared to 13.0% of GPs (*p* = 0.0844). The majority of both RDs (95.3%) and GPs (87.0%) indicated that they were interested in learning more about nutrigenomics (*p* = 0.1567).

Although most dietitians and GPs rated nutrition as “very important” in the medical or health industry, significantly more dietitians rated genetic testing as important (32.9%) compared to GPs (8.7%) (*p* = 0.02) (Table 2). Participants were asked to rate how equipped they felt that a primary physician, dietitian, professional nurse, and DTC genetic testing company interpreted nutrigenomic information to patients (Table 2). More than forty percent (43.5%) of RDs ranked DTC genetic testing companies as the most equipped, while 31.8% of GPs ranked RDs as the “most equipped” and another 31.8% as “very equipped” to provide patients with nutrigenomic services.

More than half of the participants strongly agreed that the factors related to implementing nutrigenomics in health care practice mentioned in Table 2 would be beneficial. These factors are “greater individualization of diet prescription (personal nutrition),” “stronger foundations for nutrition,” and “dietary prescriptions that would effectively manage or prevent certain diseases.”

No statistically significant differences were observed for any of the possible benefits of applying nutrigenomics between RDs and GPs. Although more than half of the RDs believed that they were most likely to change certain aspects of their practice due to new knowledge regarding nutrigenomics, compared to only about a third of GPs, the difference was not statistically significant (*p* = 0.06).

Table 1. Participant characteristics and previous experience with nutrigenomics by profession

	RDs		GPs		p value
	n	%	n	%	
Sex (n = 172)					–
Male (n = 12)	6	4.0	6	27.3	
Female (n = 160)	144	96.0	16	72.7	
Highest level of education (n = 173)					–
Bachelor's degree (n = 57)	39	26.0	18	78.3	
Honor's degree (n = 82)	79	52.7	3	13.0	
Master's degree (n = 26)	26	17.3	0	0.0	
Doctoral/PhD degree (n = 1)	1	0.7	0	0.0	
Other ^a (n = 7)	5	3.3	2	8.7	
Working in the field in which degree was obtained (n = 171)					–
Yes (n = 145)	122	82.4	23	100.0	
No (n = 10)	10	6.8	0	0.0	
Unemployed (n = 16)	16	10.8	0	0.0	
Sector of primary employment (n = 156)					–
Public/governmental (n = 61)	44	33.1	17	73.9	
Private (n = 74)	69	51.9	5	21.7	
University (n = 6)	5	3.8	1	4.4	
Corporate/business (n = 15)	15	11.3	0	0.0	
Have or would you personally consider genetic testing? (n = 173)					0.13
Yes (n = 129)	112	74.7	17	73.9	
No (n = 24)	23	15.3	1	4.4	
Unsure (n = 20)	15	10.0	5	21.7	
Have you previously heard of the term nutrigenomics? (n = 173)					<0.01 ^b
Yes (n = 153)	146	97.3	7	30.4	
No (n = 20)	4	2.7	16	69.6	
Was nutrigenomics taught as a part of your qualification? (n = 173)					<0.01 ^b
Yes (n = 67)	67	44.7	0	0.0	
No (n = 106)	83	55.3	23	100.0	
Provided counseling to clients/patients related to nutrigenomics in the past year (n = 170)					0.08
Yes (n = 50)	47	32.0	3	13.0	
No (n = 120)	100	68.0	20	87.0	
Read scientific literature related to nutrigenomics in the past year (n = 169)					<0.01
Yes (n = 88)	86	58.9	2	8.7	
No (n = 81)	60	41.1	21	91.3	
Interested in learning more about nutrigenomics (n = 172)					0.16
Yes (n = 162)	142	95.3	20	87.0	
No (n = 3)	2	1.3	1	4.4	
Unsure (n = 7)	5	3.4	2	8.7	

^aThe “other” included seven postgraduate diplomas in various field-related topics. ^bp value for percentage difference between RDs and GPs using χ^2 or Fisher's exact tests, as appropriate, $p < 0.05$ considered statistically significant.

More than half of the RDs strongly agreed with the listed consumer motivators that could affect their willingness to use nutrigenomic services, while about a third of the GPs strongly agreed with all the listed consumer motivators (Table 3). The highest ranked consumer motivator was to “prevent a disease based on family history.” Significantly more RDs (68.0%) indicated that they “strongly agree” that disease prevention based on family

history could affect the implementation of nutrigenomics compared to GPs (52.2%) ($p = 0.01$).

About three-quarters of participants regarded cost concerns as the greatest barrier to implementing nutrigenomic testing (Table 3). Other perceived barriers to implementation were confidentiality issues (40.0% for RDs and 60.9% for GPs) and moral concerns (37.3% for RDs and 47.8% for GPs). None of the differences in the

Table 2. Perceptions of RDs and GPs regarding different aspects of nutrigenomics

	RDs		GPs		p value
	n	%	n	%	
Perception of importance of genetic testing and nutrition in the medical or health industry					
How important do you think genetic testing is in the medical/health industry? (n = 172)					0.02 ^a
Not important at all (n = 0)	0	0.0	0	0.0	
Not important (n = 40)	31	20.8	9	39.1	
Important (n = 81)	69	46.3	12	52.2	
Very important (n = 51)	49	32.9	2	8.7	
How important do you think nutrition is in the medical/health industry? (n = 173)					1.00
Not important at all (n = 0)	0	0.0	0	0.0	
Not important (n = 0)	0	0.0	0	0.0	
Important (n = 13)	12	8.0	1	4.4	
Very important (n = 160)	138	92.0	22	95.7	
Rating of how equipped various professions are to provide nutrigenomic counseling					
Primary physician (n = 169)					0.97
Not at all equipped (n = 59)	50	34.3	9	39.1	
Not equipped (n = 52)	44	30.1	8	34.8	
Neutral (n = 38)	34	23.3	4	17.4	
Equipped (n = 16)	14	9.6	2	8.7	
Very equipped (n = 4)	4	2.7	0	0.0	
Dietitian (n = 172)					0.03 ^a
Not at all equipped (n = 17)	15	10.0	2	9.1	
Not equipped (n = 27)	26	17.3	1	4.6	
Neutral (n = 52)	49	32.7	3	13.6	
Equipped (n = 50)	41	27.3	9	40.9	
Very equipped (n = 26)	19	12.7	7	31.8	
Professional nurse (n = 167)					0.47
Not at all equipped (n = 108)	95	65.5	13	59.1	
Not equipped (n = 41)	36	24.8	5	22.7	
Neutral (n = 14)	11	7.6	3	13.6	
Equipped (n = 4)	3	2.1	1	4.6	
Very equipped (n = 0)	0	0.0	0	0.0	
Private Co. (n = 169)					0.06
Not at all equipped (n = 4)	3	2.0	1	4.6	
Not equipped (n = 17)	12	8.2	5	22.7	
Neutral (n = 30)	24	16.3	6	27.3	
Equipped (n = 49)	44	29.9	5	22.7	
Very equipped (n = 69)	64	43.5	5	22.7	
Factors that will be a benefit from the application of nutrigenomics by profession					
Greater individualization of diet prescription (personal nutrition) (n = 173)					0.16
Strongly disagree (n = 3)	2	1.3	1	4.4	
Disagree (n = 8)	6	4.0	2	8.7	
Agree (n = 47)	39	26.0	8	34.8	
Strongly agree (n = 115)	103	68.7	12	52.2	
Stronger foundations for nutrition (n = 173)					0.43
Strongly disagree (n = 3)	2	1.3	1	4.4	
Disagree (n = 8)	8	5.3	0	0.0	
Agree (n = 54)	46	30.7	8	34.8	
Strongly agree (n = 108)	94	62.7	14	60.9	
Dietary prescriptions that would effectively manage or prevent certain diseases (n = 173)					0.35
Strongly disagree (n = 3)	2	1.3	1	4.4	
Disagree (n = 8)	8	5.3	0	0.0	
Agree (n = 60)	50	33.3	10	43.5	
Strongly agree (n = 102)	90	60.0	12	52.2	
Likelihood to change aspects of practice due to new knowledge by profession					
How likely are you to change aspects of your practice due to new knowledge regarding nutrigenomics (n = 168)					0.06
Least likely (n = 5)	3	2.1	2	8.7	
Not likely (n = 10)	8	5.5	2	8.7	
Somewhat likely (n = 68)	56	38.6	12	52.2	
Most likely (n = 85)	78	53.8	7	30.4	

^a p value for percentage difference between RDs and GPs using χ^2 or Fisher's exact tests, as appropriate, $p < 0.05$ considered statistically significant.

Table 3. Perceptions of RDs and GPs regarding motivators and barriers to consumers using nutrigenomics

	RDs		GPs		<i>p</i> value
	<i>n</i>	%	<i>n</i>	%	
Consumer motivators that affect the implementation of nutrigenomics by profession					
Motivated by desire to prevent or manage disease (<i>n</i> = 173)					0.01 ^a
Strongly disagree (<i>n</i> = 3)	1	0.7	2	8.7	
Disagree (<i>n</i> = 14)	10	6.7	4	17.4	
Agree (<i>n</i> = 58)	48	32.0	10	43.5	
Strongly agree (<i>n</i> = 98)	91	60.7	7	30.4	
Prevent a disease based on family history (<i>n</i> = 173)					0.01 ^a
Strongly disagree (<i>n</i> = 2)	0	0.0	2	8.7	
Disagree (<i>n</i> = 10)	7	4.7	3	13.0	
Agree (<i>n</i> = 47)	41	27.3	6	26.1	
Strongly agree (<i>n</i> = 114)	102	68.0	12	52.2	
Control health outcomes based on family history (<i>n</i> = 173)					0.01 ^a
Strongly disagree (<i>n</i> = 1)	0	0.0	1	4.4	
Disagree (<i>n</i> = 17)	12	8.0	5	21.7	
Agree (<i>n</i> = 60)	51	34.0	9	39.1	
Strongly agree (<i>n</i> = 95)	87	58.0	8	34.8	
Improve overall health-related quality of life (<i>n</i> = 173)					0.09
Strongly disagree (<i>n</i> = 1)	1	0.7	0	0.0	
Disagree (<i>n</i> = 28)	20	13.3	8	34.8	
Agree (<i>n</i> = 60)	53	35.3	7	30.4	
Strongly agree (<i>n</i> = 84)	76	50.7	8	34.8	
Rating of perceived barriers to the implementation of nutrigenomics					
Cost concerns (<i>n</i> = 173)					0.66
Strongly disagree (<i>n</i> = 3)	3	2.0	0	0.0	
Disagree (<i>n</i> = 7)	7	4.7	0	0.0	
Agree (<i>n</i> = 32)	26	17.3	6	26.1	
Strongly agree (<i>n</i> = 132)	114	76.0	17	73.9	
Not enough experts to convey professional expertise (<i>n</i> = 172)					0.06
Strongly disagree (<i>n</i> = 9)	9	6.0	0	0.0	
Disagree (<i>n</i> = 23)	22	14.8	1	4.4	
Agree (<i>n</i> = 62)	48	32.2	14	60.9	
Strongly agree (<i>n</i> = 78)	70	47.0	8	34.8	
The lack of continuing education for health care professionals regarding nutrigenomics (<i>n</i> = 172)					0.07
Strongly disagree (<i>n</i> = 11)	11	7.4	0	0.0	
Disagree (<i>n</i> = 22)	22	14.8	0	0.0	
Agree (<i>n</i> = 64)	52	34.9	12	52.2	
Strongly agree (<i>n</i> = 75)	64	43.0	11	47.8	
The lack of continuing education for consumers regarding nutrigenomics (<i>n</i> = 173)					0.39
Strongly disagree (<i>n</i> = 11)	11	7.3	0	0.0	
Disagree (<i>n</i> = 21)	19	12.7	2	8.7	
Agree (<i>n</i> = 71)	58	38.7	13	56.5	
Strongly agree (<i>n</i> = 70)	62	41.3	8	34.8	
Limited access to nutrigenomics for clients or patients (<i>n</i> = 173)					0.06
Strongly disagree (<i>n</i> = 17)	17	11.3	0	0.0	
Disagree (<i>n</i> = 30)	29	19.3	1	4.4	
Agree (<i>n</i> = 51)	43	28.7	8	34.8	
Strongly agree (<i>n</i> = 75)	61	40.7	14	60.9	
Confidentiality issues (<i>n</i> = 173)					0.37
Strongly disagree (<i>n</i> = 74)	60	40.0	14	60.9	
Disagree (<i>n</i> = 66)	59	39.3	7	30.4	
Agree (<i>n</i> = 19)	18	12.0	1	4.4	
Strongly agree (<i>n</i> = 14)	13	8.7	1	4.4	
Moral concerns (<i>n</i> = 173)					0.51
Strongly disagree (<i>n</i> = 67)	56	37.3	11	47.8	
Disagree (<i>n</i> = 59)	50	33.3	9	39.1	

Table 3 (continued)

	RDs		GPs		<i>p</i> value
	<i>n</i>	%	<i>n</i>	%	
Agree (<i>n</i> = 27)	25	16.7	2	8.7	0.96
Strongly agree (<i>n</i> = 20)	19	12.7	1	4.4	
Too many environmental influences to give a definite connection (effect) (<i>n</i> = 173)					
Strongly disagree (<i>n</i> = 13)	12	8.0	1	4.4	0.14
Disagree (<i>n</i> = 63)	54	36.0	9	39.1	
Agree (<i>n</i> = 69)	59	39.3	10	43.5	
Strongly agree (<i>n</i> = 28)	25	16.7	3	13.0	
No clinical trials to prove the efficacy of the personalized interventions (<i>n</i> = 172)					
Strongly disagree (<i>n</i> = 18)	18	12.0	0	0.0	0.14
Disagree (<i>n</i> = 57)	52	34.7	5	22.7	
Agree (<i>n</i> = 60)	49	32.7	11	50.0	
Strongly agree (<i>n</i> = 37)	31	20.7	6	27.3	

^a*p* value for percentage difference between RDs and GPs using χ^2 or Fisher's exact tests, as appropriate, *p* < 0.05 considered statistically significant.

percentage of the two groups of health professionals about perceived barriers to the implementation of nutrigenomics were statistically significant.

Discussion

The current study identified perceptions of RDs and GPs regarding implementing nutrigenomics in SA. Compared to a previous study conducted in SA on a similar topic [27], a higher percentage of respondents in the current study indicated that they had heard of the term “nutrigenomics” before, probably because of the recent increase in information available about this topic. Despite this, nutrigenomics was included in the curriculum of fewer than half of RDs and none of the GPs that participated in the study. A study conducted among health care professionals in Canada found that those who had less than or equal to 10 years in health care practice had greater exposure to nutrigenomics as part of their educational training [28]. The number of peer review publications regarding nutrigenomics continues to increase; however, nutrigenomics offered as a course in undergraduate programs/curricula remains low [26]. Thus, several dietitians might have qualified without receiving any undergraduate training regarding nutrigenomics. Almost all participants indicated that they were interested in learning more about nutrigenomics.

The earlier study conducted about the involvement, confidence, and knowledge of South African RDs regard-

ing genetics and nutrigenomics in 2010 reported that more than a third of RDs ranked genetic testing as “very important” [27] similar to that of the RDs included in the current study. Compared to that study, more RDs in the current study indicated that they had read any scientific literature related to nutrigenomics [27], probably due to the subsequent expansion of the field.

In terms of the perception of being equipped to deliver nutrigenomic counseling to their clients, a total of 43.5% of RDs ranked private companies (DTC genetic testing companies) as “very equipped,” while more GPs (31.8%) ranked RDs as “very equipped” to deliver nutrigenomic counseling. In contrast, a previous study by Mitchell [29] conducted among 20 health care professionals, including doctors, nurses, and dietitians in San Diego County in the USA, reported that private companies (DTC genetic testing company) were rated by none of the health care professionals in their study as “definitely” equipped to deliver nutrigenomic information. In the current study, very few RDs (12.7%) considered themselves as “very equipped” to provide nutrigenomic counseling to clients or patients, which could be why only a third had given nutrigenomics-related counseling to patients. Despite this, 58.9% reported reading scientific literature related to nutrigenomics during the previous year. Feeling equipped to deliver nutrigenomic counseling can significantly affect the confidence to do so, emphasizing the need for improved training of health care professionals about nutrigenomics, if this field is to be

expanded. Findings from a qualitative study conducted among 14 RDs from the UK, Canada, SA, Australia, Mexico, and Israel found that those dietitians who were working with nutrigenomics believed that dietitians do have the skills to provide nutrigenomics services [9]. The multidisciplinary team approach is considered the best standard of practice to interpret the results of a nutrigenomic testing and develop a personalized care plan [30]. The benefits of a multidisciplinary team approach were emphasized by Karamanoglu and Nielsen [28], who also emphasized that the demand for nutrigenomic testing is growing, but it is important that health care professional competence is carefully assessed. Horne et al. [31] created a nutrigenomics care map; the care map provides a first step toward facilitating best practice in the field of nutrigenomics.

All factors related to the application of nutrigenomics were perceived as a possible benefit, with percentages ranging from 59.0% to 66.5%. A study conducted by Rosen et al. [32] in the USA among 913 RDs found similar results compared to the current study, with most of the RDs in their study being optimistic about the benefits of the application of nutrigenomics. The higher ranking of “strongly agree” from RDs in the current study could be due to RDs being more invested in nutrition or dietary prescriptions of patients than GPs are, as it is not their primary field of focus.

In the current study, a lack of continuing professional education about nutrigenomics for health care professionals was reported by 43.6% of participants. Similar barriers were identified for using nutrigenomic services by Rosen et al. [32] regarding the needs of RDs regarding nutrigenomics in the USA. Significantly more RDs than GPs in the current study “strongly agreed” that the desire to prevent or manage disease, prevent a disease based on family history, and control health outcomes based on family history motivated consumers to make use of nutrigenomic services.

In terms of barriers to accessing nutrigenomic services, three-quarters of participants considered cost concerns to be the greatest barrier. Financial restraints have a major impact on the kinds of services that consumers choose to access, with those services that are considered to be nonessential suffering most during financially challenging times. Similarly, the earlier Rosen et al. [32] study identified the lack of certainty that costs related to nutrigenomics would be covered by medical insurance as a major constraint. Since 75.7% of participants identified cost concerns as a barrier to implementing nutrigenomics, the high costs of genetic testing and coverage of those

costs by medical insurance will need to be addressed before nutrigenomics can be provided to a broader base of clients.

Confidentiality issues (42.8%) and moral concerns (38.7%) were also identified as barriers to accessing nutrigenomic services [32]. Similar concerns were reported in the USA by Mitchell et al. [29]. In contrast to some findings of the abovementioned study [32], confidentiality issues (8.1%) and moral concerns (11.6%) were seen as issues reported by the smallest percentage of participants in the current study. The differences in these findings between the current study and those done in other countries could be due to a long time between the studies and that recent technological advances have made it easier to keep information confidential.

Other significant concerns identified in the current study included a perception that there are not enough experts to convey professional expertise (45.4%) and limited access to nutrigenomics for clients and patients (43.4%). Abrahams et al. [9] found that, among dietitians working in the field of nutrigenomics, the availability of unregulated websites offering tests and diets along with the lack of a sustainable public health model for the delivery of nutrigenomics were barriers to dietitians embracing nutrigenomics.

Limitations

We acknowledge certain limitations. The participants who agreed to participate in the survey may have already been interested in nutrigenomics, thus introducing a selection bias. The survey respondents may not be representative of RDs and GPs in SA. The small number of GP participants and the fact that the same recruitment method could not be used for RDs and GPs are considered limitations of the study. The survey was not validated, but was developed based on questions used in previous studies on the topic.

Conclusion

This study identified the perceived consumer motivators that might affect the implementation of nutrigenomics in SA. RDs and GPs perceived the same barriers to implementation of nutrigenomics. Findings of the study were mostly consistent with previous research, which found that RDs and GPs felt that nutrigenomics may provide significant benefits but that it needs further development with more training opportunities, provided before it can be widely applied effectively in routine private and

public health care in SA. The feasibility of genetic testing in SA will need to be explored in future research to ensure that the benefits of these genetic tests will outweigh the cost implications thereof.

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Statement of Ethics

Written informed consent was obtained from the participants to participate in this study. The study protocol was approved by the Health Sciences Research Ethics Committee (UFS-HSD2020/0112/2403) of the University of the Free State, Bloemfontein, Free State, South Africa.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

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Author Contributions

Desiré Greyvensteyn was a master's student supervised by Elizabeth Margaretha Jordaan and co-supervised by Corinna May Walsh. Desiré Greyvensteyn was responsible for the coding of data, and Mariette Nel was responsible for the statistical analysis of the data. All authors read and approved the final manuscript.

Data Availability Statement

Data cannot be shared for confidentiality reasons. Queries about the data should be directed to the corresponding author.

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