Exploring Knowledge and Attitudes of Personal Nutrigenomics Testing among Dietetic Students and its Value as a Component of Dietetic Education and Practice

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ABSTRACT

Background: Personal nutrigenomics testing (PNT) is becoming an increasingly common practice amongst registered dietitians (RDs); however, nutrigenomics education is only a minor component of a select few undergraduate dietetic programs. Objective: This study explored dietetic students’ knowledge and attitudes about PNT and its value as a potential additional component to the dietetic curriculum. Subjects and Methods: A total of 23 students participated in focus groups. An educational video describing nutrigenomics was shown to the participants. A semi-structured questionnaire guided the discussion and explored several topics including ethics, knowledge, awareness, perceived legitimacy and interest in PNT. Transcriptions were qualitatively analyzed. Results: The future of dietetics was identified as the global theme, while organizing themes included: further education, advancing the profession, a holistic approach, and ethics. Participants viewed PNT as a positive contributor to advancing the field of dietetics. Overall, students’ had minimal knowledge of nutrigenomics, but a strong desire to learn more. Conclusion: Results of this study indicate that potential future RDs believe that nutrigenomics is the future of dietetics and demonstrate a strong desire to learn more. With the increased use of PNT in dietetic practice, it is essential to include the science of nutrigenomics in the dietetic curriculum.

Keywords: Personal Nutrigenomics, Dietetic Students, Knowledge, Attitudes


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INTRODUCTION

The science of nutrigenomics explores the interaction between genetics, nutrients, proteins and metabolism to impact gene expression and health (1). It explores how genetic variation can cause individuals to biochemically respond differently to the same foods, beverages, nutrients or supplements consumed (2,3). Research in nutrigenomics has allowed registered dietitians (RDs) and other healthcare professionals to appreciate that population health recommendations based on nutrition epidemiological studies may not be the best personalized nutrition care plans (1). Genetic testing, as a component of individualized nutrition planning, focuses on the prevention of chronic disease and the promotion of optimal health. Personal nutrigenomics testing (PNT) provides individuals with information related to their risk for developing certain nutrition-related diseases/conditions based on their genes. PNT also includes dietary information and recommendations to help decrease one’s risk for developing the diseases/conditions to which they may be susceptible. Thus, PNT can be used to provide focused, individualized, patient-centered nutrition care plans through concentrating on dietary components specified by nutrigenomics results (4).

Several studies have provided convincing evidence to suggest that an individual’s genetic makeup may in fact influence their risk of developing certain diseases based on the degree of exposure to dietary components (5–7). For example, caffeine metabolism and its relationship to myocardial infarction has been associated with variations in the CYP1A2 gene (7). Carriers of this gene’s risk variants are considered ‘slow metabolizers’ of caffeine and thus have an increased risk for myocardial infarction. This occurs only when caffeine intake exceeds 200 mg/day (7). Other novel research has linked dietary fat consumption with insulin sensitivity and single nucleotide polymorphisms (SNPs) near the interleukin-6 gene (6). Total dietary fat intake was positively related to insulin resistance specifically in carriers homozygous for the G allele of the SNP of interest. An inverse relationship was found in carriers homozygous for the A allele (6). Importantly, a randomized controlled trial indicated that the nutrition recommendations based on PNT are more easily understood and accepted by patients when compared to the provision of general dietary advice (4). PNT could therefore increase patients’ motivation to meet these personalized dietary recommendations (4). From this, we can speculate that patients will have improved health outcomes.

While PNT is a promising addition to dietetic practice, multiple health professionals (including RDs), as well as consumers, have limited knowledge of nutrigenomics (8–15). RDs have expressed a particular interest in PNT (8) although they felt that they were lacking the background knowledge and expertise to apply nutrigenomics to their practice (8) despite consumers perceiving them as the best source for the provision of PNT. Given the consumer perception of dietitians being well-versed in this area of nutrition, it is clear that education will be a key component of integrating the science of nutrigenomics into the practice of RDs. In addition, improved knowledge of nutrigenomics among RDs is significantly associated with their university education ($P < 0.001$) (9) providing support
to include this topic as a component of the undergraduate curriculum. Nonetheless the science of nutrigenomics is a component of only a select few undergraduate programs in dietetics (10). As trusted sources of nutrition information and recommendations it is vitally important to provide current and future practicing RDs with education in genetics and nutrigenomics (8,11,12,16–18). Notably, the current position of the Academy of Nutrition and Dietetics states that nutrigenomics is not yet ready for routine incorporation into nutrition counseling because of limited knowledge and education related to nutrigenomics among RDs (19). In Canada, the College of Dietitians of Ontario (CDO) recognizes that nutrigenomics is an innovative approach to nutrition care that falls within the RD’s scope of practice (20). These statements highlight the importance of keeping up with innovative nutrition care strategies while ensuring that current and future RDs are knowledgeable in these new areas of practice, including nutrigenomics testing.

Exploring the value of teaching the science of nutrigenomics to dietetic students is important as consumer demand for PNT continues to rise (21). The United States nutrigenomics testing marketing market was approximated to be worth CDN$796 million in 2010, with a growth estimate of 20% per year thereafter (21). Rapid economic growth in PNT is expected, and increasing evidence supports that nutritional genomics is an improved test for assessing and predicting disease predisposition (18). Furthermore, nutrigenomics has shown to be a promising means of changing behaviours related to obesity and weight loss (22). As such, we can speculate that the future of dietetics would benefit from more RDs trained in nutrigenomics but more research is required to assess if further education in nutrigenomics results in a greater involvement of RDs in this area. The purpose of this study was to explore students’ knowledge, attitudes and beliefs about PNT and their perceived values regarding the incorporation of this topic into dietetic education and practice.

SUBJECTS AND METHODS

Study participants and recruitment: Participants were undergraduate dietetic students recruited from a Brescia University College mandatory third-year course Diet and Nutritional Assessment. All students from this course (n = 110) were invited to participate. At this educational institution, the topic of nutrigenomics is introduced in the curriculum in one fourth year elective course, Clinical Nutrition III. The students had not yet completed a dietetic internship so their practical clinical experience at this point in time was limited. A course in genetics specifically was not included in the nutrition and dietetics curriculum at this educational institution. A select number of students had been introduced to the topic of nutrigenomics through a peer presentation in a food science course. Otherwise, students had not been introduced to the topic. Participants were given a $10 CDN gift card to Brescia University College cafeteria upon study completion. The Western University Research Ethics Board approved this study and all participants provided informed written consent.
Study design: Each audio-recorded focus group was semi-structured around a list of open-ended questions related to the study objectives; these questions guided the discussion. A five-minute educational video introducing nutrigenomics was shown to the participants prior to exploring their knowledge and awareness of nutrigenomics. This video was the only source of information regarding nutrigenomics that was provided to participants. It was selected based on its clear and concise explanation of nutrigenomics. It was also selected since it was developed by the only company in Canada offering PNT exclusively through healthcare professionals, including RDs. The focus groups investigated a variety of topics including: ethical concerns, knowledge, awareness, attitudes, and interest in PNT.

During each focus group, three trained researchers utilized an approach of concurrent data collection and analysis as a verification strategy to ensure scientific rigor (23, 24). To maximize reliability and consistency, the same researcher facilitated five out of six focus groups. A trained research volunteer facilitated one focus group due to scheduling challenges. This research volunteer was trained and well-versed in the role of focus group facilitation. The moderators read from a scripted list of unbiased questions developed by the authors who avoided leading and loaded questions. Participants remained anonymous to the professors teaching their course to minimize conflicts of interest. Personal identifying information was not used in data transcription. These elements of confidentiality and anonymity were explained to students immediately before focus groups began and were also described in the study’s letter of information. This helped to further develop comfortable speaking environments and minimize response bias.

Statistical analysis: Inductive content analysis was utilized in order to establish meaningful inferences from the data (25). All focus groups were audio-recorded, transcribed verbatim, and reviewed for accuracy. Four trained researchers independently analyzed transcriptions, coded, and categorized emerging themes. Themes were agreed upon through consensus of all researchers involved in analyzing the data. An audit trail was kept as documentation of the results and decisions of the analytical processes.

RESULTS

A total of six 30-minute focus groups (n = 23) occurred from November to December of 2013. Three to five participants took part in each focus group session and all participants were female. Several codes were identified during preliminary transcription analysis and the codes were used to independently identify evident, meaningful themes. The inductively derived themes were organized based upon the research objectives (Table 1). Data saturation was reached at n = 23. The objectives of this study were to explore students’ knowledge, attitudes and beliefs about PNT and their perceived values regarding the incorporation of this topic into dietetic education and practice.

The future of dietetics was identified as the global theme as it directly related to all research objectives. Further education, ethics, a holistic approach, and advancing the
profession were the four organizing themes. These themes are organized below based on the three research objectives (Table 1).

RESEARCH OBJECTIVE 1: EXPLORING KNOWLEDGE RELATED TO PNT. The first organizing theme was further education. This theme was apparent throughout all focus groups. Students were mainly motivated to learn more about nutrigenomics, as they perceived this science as an important component of their future careers and yet their current knowledge was limited. The presentation of a brief educational video seemed to further enhance their interest in gaining knowledge of nutrigenomics. Limited knowledge of the topic was evident in response to the first question, which explored students’ current knowledge of PNT. The majority of students had very minimal knowledge about the topic as they stated that they had “no idea” what nutrigenomics was, and they “don’t really hear people talk about it” so they knew “nothing.” Students expressed a strong desire to learn more about this area of nutrition and dietetics. Their desire to improve their knowledge in this area was noted both before and after the educational video was shown as participants posed several questions about nutrigenomics throughout the entire duration of each focus group session. One student stated, “I think we just have more questions after that video!” Specifically, they aspired to increase their knowledge with respect to the science and research behind the current recommendations for the genetic variations that have been shown to respond to dietary changes.

"If I were to use it in practice, I would want to have a good understanding of the science behind it."

While students indicated an interest in learning more about nutrigenomics as a whole, after viewing the educational video, they were particularly interested in improving their knowledge of the genetic tests and supporting research that related to caffeine metabolism. The relationship between genetic variation and caffeine metabolism was more commonly discussed compared to other nutrigenomics tests available. Students’ interest in this specific component of PNT was exemplified when some students stated that they wanted to undergo PNT “especially for the caffeine one” or because “that caffeine component totally hits home.” Others mentioned that the nutrigenomics test for caffeine “really got [their] attention” and caffeine was often used as an example in various discussions about nutrigenomics. However, caffeine was also highlighted in the video to a greater extent than other dietary components. Students were also specifically interested in genetic familial connections. Many participants related nutrigenomics testing to improving their understanding of their risk for developing certain diseases/conditions that were prevalent in their families. This interest seemed to stem from personal interests as participants stated they would want to compare their results to “another family member,” or to their personal “family history” such as the health of their mother, father, and/or siblings.
The vast majority of students were interested in undergoing PNT and also taking a course on nutrigenomics, if it were offered as a component of their undergraduate education. However, students did not believe that undergoing PNT would help them to improve their understanding of nutrigenomics. They felt like taking a course would be a better approach to learning about PNT as it would certainly “answer some questions.” They also believed that “a lot of people would take [the course]” if it were offered.

"I think nutrigenomics is such a specific thing that it almost seems appropriate for it to be a post-graduate study, but if it can be simplified into an undergrad type course, then it should be included in our [courses] prior to going into internship."

Ethics was identified as another organizing theme. While some students identified confidentiality, privacy, accessibility, and cost as key ethical considerations, their complete comprehension of the various ethical considerations associated with PNT was limited. During the focus group sessions, participants were asked, “What ethical concerns relating to nutrigenomics do you think need to be considered?” This was often followed by a hesitation from participants in responding to the question, indicating that students found it challenging to come up with an answer. Many students did not recognize any ethical considerations with this type of testing.

"I really don’t see how [PNT]’s going to affect them ethically, to be honest."

When ethical considerations were discussed, one participant led the discussion in five out of six focus groups, and prompted others to engage in conversation. Accessibility was frequently discussed; students were concerned that individuals in more rural communities, or geographically isolated areas might not have access to PNT. Additionally, they were concerned that individuals of low socioeconomic status would be disadvantaged. They thought that PNT could cause “inequalities in healthcare” and that access was a “huge issue.” Accessibility was also related to participants’ discussions around the cost of testing. Lastly, some students recognized privacy and confidentiality as ethical concerns related to PNT. They expressed unease about who would have access to the DNA and PNT results. Specifically, they questioned whether or not this information would be attainable by insurance companies. Students were also concerned about where the DNA would be stored and they agreed that confidentiality would be “absolutely key” for the incorporation of nutrigenomics into dietetic practice.

**RESEARCH OBJECTIVE 2: EXPLORING ATTITUDES TOWARDS PNT.** A holistic approach was identified as an organizing theme for this research objective. Although students mainly perceived PNT in a positive light, they did express a concern related to maintaining a holistic approach in dietetics. They wanted to ensure that RDs would not lose touch of “the big picture” with the incorporation of PNT into their practice. A concern arose related to dietitians potentially straying away from “the normal way of doing things” with the addition of nutrigenomics to their practice.
They suggested that dietitians should not “lose sight” of the current holistic approach used in practice by continuing to incorporate multiple nutrition-related factors into their assessments and recommendations.

"I feel like it would be like good to have [nutrigenomics] in the practice but that shouldn’t be the center of attention.

They discussed the importance of “relying on the whole picture” by stating that RDs should continue to include “all the other components of [the] assessment.”

RESEARCH OBJECTIVE 3: EXPLORING THE VALUE OF PNT TO DIETETIC EDUCATION AND PRACTICE. Advancing the profession was the organizing theme for this objective. Students believed that this area of food and nutrition would help develop and advance the field of dietetics. They viewed nutrigenomics as a valuable component of both dietetic education and practice and thought that it would be a positive contributor to professional development. Enthusiasm surrounded the notion that the company who developed the video offers this type of testing through RDs. Participants thought that the incorporation of PNT into dietetic practice would help RDs to “seem more like scientists” and would help them to “become more involved with the medical team as a whole.” They expressed a concern surrounding RDs not necessarily receiving “all the credit they deserve.” They believed that PNT could potentially improve RD credibility within the healthcare team. With the perception of PNT as a more scientific approach to nutritional counseling, students believed that this scientific approach would help the field to progress. They felt like PNT would allow for “a deeper look into things” resulting in improvements to patient care, and subsequent improved health outcomes.

RESEARCH OBJECTIVES 1, 2, AND 3: EXPLORING KNOWLEDGE, ATTITUDES, AND THE VALUE OF PNT TO DIETETIC EDUCATION AND PRACTICE. As all research objectives and organizing themes linked back to the future of dietetics, this theme was identified as the global theme. Students identified nutrigenomics as a potential component of their future practice and as such, they strongly believed that this topic should be included in their education. They perceived nutrigenomics as the future of dietetics; with their common goals of becoming RDs, students believed that PNT would be strongly desired by their patients in the future. Multiple factors played into their desire to improve their knowledge in this area. As previously mentioned, the most common factor discussed related to their perception that the demand for PNT as a component of dietetic practice would be increasing in the future. Overall, students expressed positive attitudes towards the potential use of PNT in their future practice. They described this type of testing as “progressive,” “future-forward,” “amazing, and “a really interesting concept.” Students thought that it “would be a really valuable tool” in their future practice.
"If this is where the future’s going, it would be nice to know everything about it from the start, sort of when it’s fresh, and then watch the progression of it and see how it impacts everything."

Students also had positive attitudes towards the potential incorporation of nutrigenomics education into dietetic programs, as a way to improve knowledge in this area. In fact, many students expressed their frustrations towards the lack of current nutrigenomics education within their undergraduate dietetic curriculum. One student stated, “If it could potentially be part of our practice then why aren’t we being told about it?” Students perceived PNT as a valuable component of future dietetic education and practice. This value can be related back to their lack of knowledge and attitudes on this topic, as discussed in detail above. It may have also been influenced by the video promoting the topic of nutrigenomics in a positive light.

DISCUSSION

The purpose of this study was to explore students’ knowledge, attitudes and beliefs about PNT and its incorporation into dietetic education and practice. The low response rate of 21% may have been related to the focus groups taking place towards the end of the academic semester when students were preparing for exams and meeting deadlines for major assignments. Our findings indicate that although undergraduate nutrition students’ knowledge of PNT is limited, there is interest in learning more. This was salient throughout all focus groups, and is consistent with findings from previous research (11, 12,14). A focus group study of over 20 Canadian health care professionals found that only half of the dietitians, nutritionists, and naturopaths were aware of the term “nutrigenomics” compared to no physicians or pharmacists (11). Similarly, further qualitative research conducted through interviews with 15 general practitioners indicated that only one participant was familiar with the term "nutrigenomics/nutrigenetics" (14). Comparably, participants in a focus group study of Canadian health care professionals discussed their limited competency in providing PNT to patients (12). Exploring RDs specifically, a survey in the United Kingdom (n=600) found an overall knowledge gap in this group (9,13). Notably, these researchers further found that increased knowledge with respect to nutrigenomics was significantly associated with dietitians’ university education (P< 0.001) and that involvement in genetics and nutrigenomics-related activities improved dietitians’ confidence (9,13). While health care professionals view themselves as the appropriate providers of PNT, they also feel a lack of confidence about incorporating this testing into their practice (12). With this knowledge gap and lack of confidence, it is concerning that a recent randomized controlled trial found that consumers viewed dietitians as the best providers of PNT (23).

As PNT in Canada and the United States is currently offered through dietitians and other healthcare professionals (25, 26), education on this science should be at the forefront of
the dietetic curriculum (23). Having a greater involvement of dietitians in this area of healthcare is essential since dietitians are regulated health professionals (27) who specialize in the area of nutrition and are thus the most reliable providers of evidence-based nutrition advice. It is logical that the dietetic student and/or dietetic intern population would be an appropriate target for education on this science. Not surprisingly, this study suggests that this limited knowledge also exists among undergraduate dietetic students. Thus, the integration of nutrigenomics as a component of university-level training could help to bridge this knowledge gap (28) and subsequently advance the field of dietetics in the area of PNT. By incorporating nutrigenomics education into the dietetic curriculum, we can further help to relieve concerns noted in the literature surrounding health care practitioners’ limited knowledge about nutrigenomics (9,12-14,16,19).

A preliminary model for incorporating nutrigenomics education into undergraduate dietetic curricula has been studied and published (16). Prasad et al’s model is focused on seven specific learning objectives centered around teaching background knowledge on genetics, gene-diet interactions, genetic testing methods, ethical, social and legal issues, as well as statistical methods used in the analysis and interpretation of genetic data (16). Prasad et al’s model can be used alongside the results of this study to guide and inform curricular development. Moreover, the results of this study lend important insight for informing specific learning objectives of dietetic curriculums. The development of an education model that incorporates a strong focus on the science and research behind the nutrigenomics testing currently available on the market, including those related to caffeine is suggested. This recommendation is based on the results of this study and the theory of intrinsic motivation (29), in addition to suggestions from Prasad et al.(16) and the Academy of Nutrition and Dietetics (19). The Academy’s 2014 position paper regarding nutrigenomics stated that the use of PNT in clinical practice requires that dietitians have the knowledge and ability to “understand, interpret, and communicate complex test results”(19). Educating dietetic students on nutrigenomics would result in trained and knowledgeable future dietitians in this area.

As nutrigenomics education is only a component of a select few undergraduate dietetic programs (18), yet is currently practiced by hundreds of RDs in different countries (22,26), the need for this education is clear. The results from this study provide convincing evidence that validate this need further. The approach to nutrigenomics education should be multi-disciplinary, as this topic incorporates components of “human genomics, genetics, molecular nutrition, nutrition and dietetic education and medicine”(16) and holistic, as students in this study expressed a concern related to ensuring a holistic approach for the incorporation of PNT into practice. Overall, the results of this study in conjunction with the literature demonstrate evidence that education in nutrigenomics may allow for greater incorporation of PNT into practice, which could ultimately maximize patient-centered care and improve patients’ health outcomes.

The limitations of this study are detailed in the following paragraph. Consistent with qualitative research, there was a risk for moderator bias (30), however facilitators in this
study made every attempt to minimize this risk by refraining from answering any questions, or making any statements to the participants that might influence their responses related to personal knowledge, attitudes and beliefs regarding PNT. Second, since the educational video used in the focus groups was developed from a company involved in PNT sales, there was a risk that students’ attitudes towards PNT were biased. However, this video was chosen based on the premise that it clearly and concisely explained the concept of nutrigenomics, and provided students with knowledge about a major Canadian company currently offering PNT through RDs (26). Moreover, students’ positive attitudes towards nutrigenomics and their desire to improve knowledge related to PNT was evident throughout the entire duration of the focus groups, both pre and post video showing.

CONCLUSION

The results of this study indicate that undergraduate dietetic students are motivated to increase their nutrigenomics-related knowledge. This knowledge is evidently required with the substantial projected growth of PNT, and the state of the current nutrigenomics markets in which PNT is offered through RDs. To allow for progression and innovation of the dietetic field, educators should strive to provide students with the up-to-date knowledge required to analyze and think critically about novel areas of dietetics, such as PNT. Researchers should continue to explore specific aspects of nutrigenomics’ course design as well as the appropriate educational level of study whether it is at the undergraduate, masters, doctorate, or RD level.

Qualitative research exploring professors’ knowledge, attitudes and perceptions of nutrigenomics would also be beneficial to help inform education and curricular development. Education in nutrigenomics is of utmost importance as PNT provides patients with more individualized nutrition advice thus aiming to enhance patient-centered care and improve health outcomes. In a regulated profession, rooted in ethical integrity through evidence-based practice, it is vital to educate current and future RDs on the science of nutrigenomics.

Conflicts of Interest

The authors indicated no potential conflicts of interest pertaining to this study during data collection, analysis and the writing of this manuscript. However, during the editing process one of the authors, Justine Horne, worked as a consulting dietitian with a company that sells PNT.

Acknowledgments

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REFERENCES


Table 1. Emerging themes based on research objectives

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<tr>
<th>Research Objective</th>
<th>Themes</th>
<th>Representative Quotation</th>
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<tr>
<td>Knowledge Related to PNT</td>
<td>Future of Dietetics</td>
<td>“I think it’s interesting and I would definitely take the [nutrigenomics] class, because it is something that’s new and upcoming so it would be good to know for our future.”</td>
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<tr>
<td></td>
<td>Further Education</td>
<td>“…it’s not something that has been introduced to us at this point in time so I basically looked up the definition online and I’m just interested in finding out more about it.”</td>
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<td></td>
<td>Ethics</td>
<td>“I don’t think it’s really an ethical issue” “…and it’s like only a saliva test so I don’t really know how it can be an ethical issue.”</td>
</tr>
<tr>
<td>Attitudes Towards PNT</td>
<td>Future of Dietetics</td>
<td>“[Nutrigenomics] seems very progressive and future forward.”</td>
</tr>
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<td></td>
<td>Holistic Approach</td>
<td>“It’d be a nice piece of the puzzle.”</td>
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<tr>
<td>Value of PNT in the Dietetic Curriculum and Profession</td>
<td>Future of Dietetics</td>
<td>“This kind of looks like our future. You know, we’re digging more into the human genome for everything. So, it makes sense that it would come around to nutrition and we are going to start seeing these things.”</td>
</tr>
<tr>
<td></td>
<td>Advancing the Profession</td>
<td>“It would definitely help the field to be more advanced and like seem more scientific like through the public’s eye.”</td>
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