# Are Nutraceuticals and Functional Foods Remedy for Metabolic Disorders? - A Health Practitioners' Perspective

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**Abstract**

**Background**: In past few years there has been major changes in the living standards and eating behaviours in the developing countries. In habit of aping different cultures there has been detrimental changes in the lifestyle of the people. The global shift toward natural remedies for metabolic disorders emphasizes the potential of nutraceuticals and functional foods. These natural products contain beneficial compounds like antioxidants and omega-3 fatty acids, offering safer alternatives to pharmaceuticals with fewer side effects. This study aims to establish the use of Nutraceuticals and functional Foods as an alternative approach for metabolic disorders.

**Methods**: A cross sectional Study was designed where the role and importance of Nutraceuticals and functional foods as preventive medicine was analyzed with the help of structured questionnaire from 106 respondents practicing as health practioners in Pimpri Chinchwad area of Pune. Convenient sampling method was used to collect the primary data for the study. Data analysis was done through Mean and t-test.

**Results:** A significant value of $P < 0.05$, was seen with all aspects defining Health Practitioners' Confidence, Identifying Perceived Barriers and Facilitators to Integrating Nutraceuticals and Functional Foods in Clinical Practice and Health Practitioners' Attitudes Towards Collaborative Efforts with Nutritionists and Dietitians for Optimizing Patient Outcomes

**Conclusion**: Health practitioner's express confidence in nutraceuticals' benefits despite perceived barriers like time constraints. They emphasize standardized guidelines and interdisciplinary teamwork as crucial facilitators. Their positive collaboration attitudes with nutritionists highlight a commitment to optimize metabolic disorder management through joint efforts, prioritizing patient-centered, tailored care strategies.

**Keywords**: Nutraceuticals, functional foods, regulations, metabolic disorders, lifestyle diseases, nutrition, health effects

## Introduction

According to Yuvraj Krishnamoorthy et al. (2020), in Research article "Prevalence of metabolic syndrome among adult population in India: A systematic review and meta-analysis, one out of three adults in India is suffering from MetS ·In one of the study on "India: Health of the Nation's States", the estimated proportion of all deaths due to Non-Communicable Diseases (NCDs) has increased from 37.09% in 1990 to 61.8% in 2016 (Magrone et al.2013).

The growth in pharma sector due to rampant increase in Lifestyle disorders has been phenomenal. However, problems like Bone health issues, B12 deficiency, Gastro Intestinal issues like -IBD are the major consequences of Pharmaceutical drugs. Nutraceuticals and functional foods like-Alkaloids, Probiotics, Prebiotics, beta glucan, cinnamaldehyde and many could be the preventive and medicinal therapy for Lifestyle diseases with no side effects.

This has pushed the functional food and nutraceutical industries to deepen their research as they provide specific benefits to the diseases while also meeting basic nutritional requirements. Proper diet management also shows great influence in regulating cardiovascular diseases which contribute to a significant fraction of health risks in people of middle age and above. While nutraceuticals and functional foods majorly have a positive impact on health, the current marketed ones do not meet the solid standards that are usually acclaimed in theory. This calls for stronger regulations as well as better-defined criteria for their classification and commercialization. Wider comprehensive and holistic awareness of them is also needed to promote their integration into the normal lifestyle of the population. Sample of 106 nutritionist were surveyed to know the role of Nutraceuticals and functional foods as preventive and remedial medicine for metabolic disorders. The study also analyses the impact of nutraceutical and functional foods on metabolic disorders. The study concludes that there is a significant impact of

nutraceutical and functional foods on metabolic disorders.

It is known since time immemorial that food habits have a direct relationship with health and the prevention of diseases especially metabolic and lifestyle disorders. And this has paved the way for studies into increasing efficiency in dietary complexes leading to the development of functional foods and nutraceuticals. Nutraceuticals etymologically are a mixture of "nutrition" and "pharmaceuticals" and these are components isolated from food that is generally sold in forms that are not "food". Functional foods on the other hand are regular foods with high benefits that are incorporated into diets. Functional foods also present physiological benefits on top of nutritional benefits and thus provide a well-rounded diet addition (Peter, 2002)

The major nutraceutical products or functional food target components reaching the markets are antioxidants (eg: green tea), omega-3 fatty acids and oil, and other probiotics agents along with the usual essential vitamins and other classic nutrients. We also have isoflavones, isolated from soybeans that work as a substitute for hormone treatment for women but with lesser side effects. Omega 3 fatty acids present in fish and fish oil show anti-inflammatory properties and they have a reclining impact on conditions like rheumatoid arthritis (Simopoulos, 1991) It is also well established that a balanced intake of functional foods also helps in regulating cardiovascular diseases by lowering lipid levels, lipoprotein oxidation in blood, and inhibiting platelet aggregation (Hasler, Kundrat & Wool, 2000)

An increase in evidence on how functional foods enhance health with the help of their active components, from both animal and plant sources with plants being the major one, shows how they are the future of the holistic health industry. This also means that functional foods and nutraceuticals help in the prevention of diseases rather than their treatment, thus taking off a lot of burden and responsibility from the general health care system and the health-conscious general public is seeking and taking up diets and food recommendations in an effort to better their personal wellbeing on their own without medical intervention (Gul, Singh, & Jabeen, 2015)

**Literature Review**

From basic essential nutrients extracted from foods, supplements to natural organic components like vitamins, minerals, amino acids and even processed commodities like soups and cereals constitute nutraceuticals (Kharb and Singh, 2004) and these are known to keep a lot of metabolic as well as other chronic diseases at bay. For example, a functional food produced by food processing like antihypertensive sour milk has the potential to decrease blood pressure, and tomato fruit is also proven to have components that help in the purification and removal of toxins from the body, thus keeping it healthy (Aluko, 2012). A variety of components like lipids, proteins, polyphenols, synbiotics, vitamins, and pigments on top of other dietary investments, show a positive influence in the amelioration of fatty liver disease and studies have also shown how the mechanisms that cause these components to act can be categorised into five broad labels according to their action pathway and processes. Gut microbes also influence the fatty liver progression and hence it can be controlled by creating a healthy gut ecosystem using functional foods (Zhao et al., 2021).

Nutraceuticals also have a direct effect on diabetes mellitus, one of the most common metabolic disorders of this age. Diabetes is caused by an imbalance of glucose levels in the blood and integrating both functional foods as well as nutraceuticals proves to keep diabetes controlled. β- glucan a very common nutraceutical product is shown to lower glucose levels in humans. For conditions like diabetes, one can easily prevent it from taking over their life by bringing in minor changes in lifestyle and dietary habits like- increased intake of unsaturated fatty acids, fruits, vegetables, low-fat dairy, whole grains- functional foods rich in polyphenols, terpenoids, flavonoids, alkaloids, etc. A lot of naturally occurring substances are high in anti-hyperglycemic, hypoglycemic, anti-inflammatory, anti-oxidative, anti-hyperlipidemic, and insulin-sensitizing components that proper development of these can make better effects than the current Western medicinal intervention. These not only help in regulating diabetes but also helps in maintaining good overall physical and mental health by preventing cancer, depression, obesity, respiratory disorders, and cognitive decline.

Antioxidant and nutrient-rich food also help in other diabetic-associated conditions like oxidative stress and obesity (Begum et. al. 2021). In short, a balanced and mindful diet plan that includes proper nutrition and nutraceutical is almost the only alter method to regulate diabetes, other than medicinal interventions like metformin and insulin which also do not completely eradicate diabetes (Tosh, Brummer, Wolever, & Wood, 2008). A good diet also leads to healthy and functioning gastro intestinal tract and this culminates in reaching better human physiological, healthy living; increasing the overall quality of life as good health constitutes better management of most resources like time, money and energy (Cencic & Chingwaru, 2010). Metabolic syndrome is defined as complex network of interconnected physiological, biochemical, metabolic factors that could be directly responsible to increase the risk of cardiovascular diseases, type 2 diabetes mellitus (DM) and even mortality. It is constituted by abdominal obesity, insulin resistance, hypertension, and hyperlipidemia.( Dandona, L et al.2017).While there are definite neutral to positive effects of consumption of specific foods on health and wellness and especially in reducing risks in a lot of metabolic diseases and expanding awareness and positive perception among the health-conscious public especially regarding the merits of functional foods and nutraceuticals, the pace of

progress in these industries does not seem to catch up with the demand. According to L. brown and L. Panchal (2015) in their study on "Functional foods as potential therapeutic options for metabolic syndrome**"** Although health improvements continue to be reported for these functional foods in rodent studies, however further evidence showing the safety of these results into humans is essential.

Thus, the concept that the bioactive compounds will act as functional foods in humans to improve health condition and thereby improve diseases state remains intuitive and a possibility rather than proven.

There is progress and research happening but the potential of these foods and components has definitely not been efficiently exploited considering how harmless the processes and development usually are. And widening the gap between them and medical usage will also help in better integration into daily life and for this, there needs to be an investment in developing shelf-stable, tasty, and convenient-to-use products. The more substantiated the products are, the better reception they get in the market and we can hope to see a huge developmental jump in this field (Aryee, N.A., & Boye, J.I. 2014)

The only way to reduce the overload on health care system at the moment is to invest more in prevention mechanisms and this further signifies the relevance of functional foods and nutraceuticals. And these offer variants in both animal based as well as plant based and can always constitute a healthy diet (Shahidi, 2005). Altering and elevating phytochemicals has shown high benefits to humans and more and more research is being done in developing plant based resources for human consumption. The demand for healthier lifestyle by the population boosts the promotion of functional foods, nutraceuticals and other value added food products. And this situation can be further catalysed by better research in nutrigenomics, a branch of science that combines nutrition with genetics, which can use genetic information to help in the prediction of personalized nutraceutical and functional food suggestions and reactions (Olaiya, Soetan, & Esan, 2016)

Something equally important as the research and development into dietary supplements- nutraceuticals and functional foods, is the creation and implementation of a regulatory framework specifically for them. In most cases, there is no specific regulatory framework for 'functional foods' or 'nutraceuticals' There need to be highly specific rules according to the nature of the foodstuff. In the current General Food Law Regulation in the EU, the regulations of dietetic foods and of food supplements could cover 'functional foods' but there needs to be a proper scientific risk assessment (Coppens, da Silva, & Pettman, 2006)

No amount of growth and research development can assure its success unless factors like standards, marketing, quality assurance, and regulation are efficiently calculated and executed. For example, in India, even though the traditional treatment methodology called Indian ayurvedic Medicines (IAM) exists ubiquitously and uses nutraceutical elements, there are no strict regulations and scientifically substantiated awareness on it making it go through tough competition with Western medicines. It is to be noted that geographically and commercially India houses a large domestic market of medicinal herbs and spices with no significant direct competition from foreign influences. Still a larger part of the population fails to commit to it and it is mostly the remote and inaccessible rural masses that rely on herbal and nutraceuticals as both treatments and prevention that are propagated locally. On a global scale, the US and Japan stand tall with their flourishing nutraceutical and functional food industries (Keservani et al, 2010)

Providing high content of required nutrients in small volumes without any undesirable accompanying components like fats and cholesterols makes nutritional supplements and nutraceuticals advantageous over regular foods. But these should be incorporated instead of used as a replacement for regular diet plans as they can cause side effects and overload the body. Extra attention to adverse reactions in the consumers' bodies should be watched out for, even though the chances of them happening unless given in surplus amount is almost negligible (Chukwuebuka Egbuna & Genevieve Dable Tupas, 2020). Some studies Focuses on Chinese herbs as potential nutraceuticals for various health conditions, including metabolic disorders. (Zhang, Y., Liu, D.) also role of yogurt in indigestion (Zourari, A. A. J. P., Accolas, J. P., & Desmazeaud, M. J.) and functional foods to treat hypercholesterolemia is growing (Zhang, Z., Wang et.al).

Magrone et al, in (2013) analysed existing literature and argued that more research is needed to identify and isolate more bioactive ingredients especially the ones in food involved in the modulation of low-grade inflammation in diet-related diseases.

**Objectives**

1. Evaluating Health Practitioners' Confidence in Recommending Nutraceuticals and Functional Foods
2. Identifying Perceived Barriers and Facilitators to Integrating Nutraceuticals and Functional Foods in Clinical Practice
3. Examine health practitioners' attitudes towards collaborative efforts with nutritionists and dietitians in optimizing patient outcomes through personalized nutraceutical and functional food recommendations for metabolic disorders.

**Methodology**

A study encompassing 106 respondents which includes practicing BAMS doctors possessing nutritional certifications ranging from a minimum of 3 months to a maximum of 2 years, along with registered dietitians

located in the Pimpri Chinchwad area of Pune, aimed to investigate the role and significance of nutraceuticals and functional foods in both preventive and remedial measures for metabolic disorders. Additionally, this research undertook an analysis of the influence exerted by nutraceuticals and functional foods on metabolic disorders.

The survey was conducted utilizing a structured questionnaire designed with the Likert Scale, spanning from "Strongly Agree" to "Strongly Disagree". The collection of primary data was executed through a convenient sampling method. The study's data analysis predominantly involved Mean calculations and the application of the t-test for comprehensive assessment.

Sample Size: 106

Sample Unit: Practicing BAMS doctors possessing nutritional certifications ranging from a minimum of 3 months to a maximum of 2 years, along with registered dietitians

Inclusion criteria:

Practicing BAMS doctors in the Pimpri Chinchwad area of Pune with nutritional certifications ranging from 3 months to 2 years.

Registered dietitians in the same geographical area.

Exclusion criteria:

Non-BAMS practitioners or those lacking nutritional certifications.
Dietitians and doctors outside the specified geographic location.

**Results**

The table below shows the general details of the respondents. In 106 respondents 57.6% are males and rest 42.4% are females. 32.1% of them are below 35 years of age, 40.6% are from the age group of 35-46 years and rest 27.3% are above 46 years of age. 52.8 % of the respondents are working as BAMS Doctors practicing in private clinics and 47.1 are dietitians

**Table 1 General Details**

| Variable | Respondent | Percentage |
|---|---|---|
| **Gender** | | |
| Male | 61 | 57.6 |
| Female | 45 | 42.4 |
| **Total** | **106** | **100** |
| **Age profile** | | |
| Below 35 yrs | 34 | 32.1 |
| 35-46 yrs | 43 | 40.6 |
| Above 46 yrs | 29 | 27.3 |
| **Total** | **106** | **100** |
| **Occupation** | | |
| BAMS Doctors | 56 | 52.8 |
| Dietitians | 50 | 47.1 |
| **Total** | **106** | **100** |

**Table 2 Role of Nutraceuticals and functional foods as preventive and remedial medicine**

| S. No. | Statements | Mean | t value | Sig. |
|---|---|---|---|---|
| **Evaluating Health Practitioners' Confidence in Recommending Nutraceuticals and Functional Foods** | | | | |
| 1. | I feel confident in my knowledge about the efficacy of nutraceuticals and functional foods in improving patient health. | 3.69 | 1.991 | 0.025 |

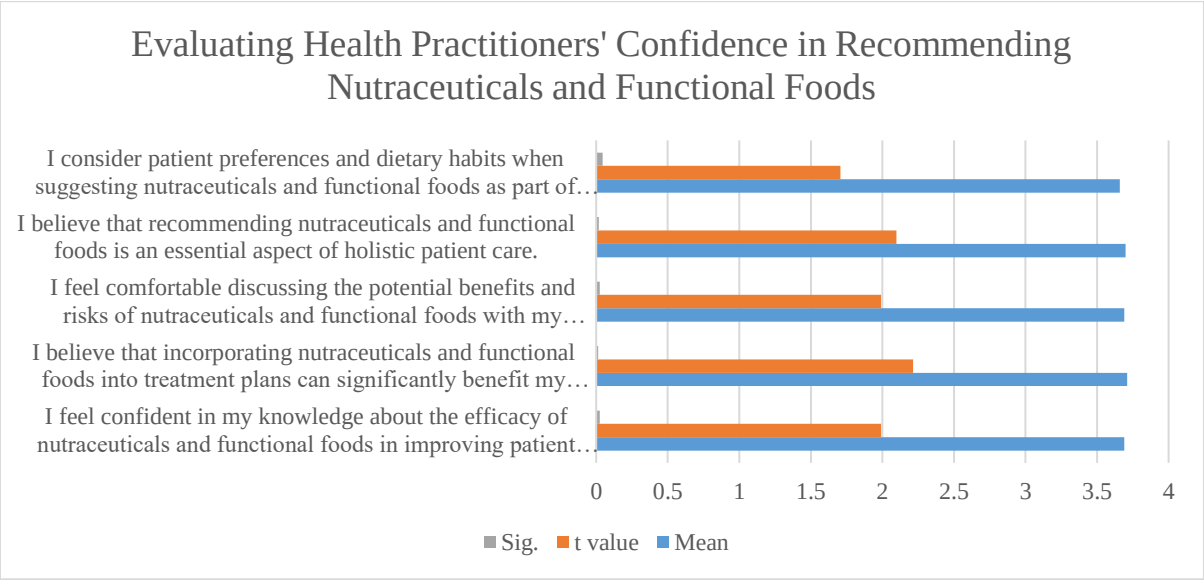
| | | | | |
|---|---|---|---|---|
| 2. | I believe that incorporating nutraceuticals and functional foods into treatment plans can significantly benefit my patients. | 3.71 | 2.214 | 0.014 |
| 3. | I feel comfortable discussing the potential benefits and risks of nutraceuticals and functional foods with my patients. | 3.69 | 1.991 | 0.025 |
| 4. | I believe that recommending nutraceuticals and functional foods is an essential aspect of holistic patient care. | 3.70 | 2.099 | 0.019 |
| 5. | I consider patient preferences and dietary habits when suggesting nutraceuticals and functional foods as part of their treatment plan. | 3.66 | 1.707 | 0.045 |
| **Identifying Perceived Barriers and Facilitators to Integrating Nutraceuticals and Functional Foods in Clinical Practice** | | | | |
| 6. | I perceive lack of standardized guidelines as a barrier to confidently integrating nutraceuticals and functional foods into clinical practice. | 3.73 | 2.412 | 0.009 |
| 7. | I see limited patient awareness and acceptance as a hindrance to recommending nutraceuticals and functional foods. | 3.79 | 3.070 | 0.001 |
| 8. | I believe time constraints in patient consultations hinder the incorporation of nutraceuticals and functional foods into treatment plans. | 3.81 | 3.296 | 0.001 |
| 9. | I believe patient education initiatives on the benefits of nutraceuticals and functional foods would ease their integration into clinical practice. | 3.77 | 2.836 | 0.003 |
| **Examine Health Practitioners' Attitudes Towards Collaborative Efforts with Nutritionists and Dietitians for Optimizing Patient Outcomes** | | | | |

| | | | | |
|---|---|---|---|---|
| 10 | I strongly believe collaborative efforts with nutritionists and dietitians positively impact patient outcomes in managing metabolic disorders through nutraceuticals and functional foods. | 3.69 | 1.991 | 0.025 |
| 11 | I perceive communication and coordination challenges as barriers to effective collaboration with nutritionists and dietitians in recommending nutraceuticals and functional foods. | 3.71 | 2.214 | 0.014 |
| 12 | I value the expertise of nutritionists and dietitians in tailoring dietary recommendations and incorporating nutraceuticals for managing metabolic disorders. | 3.77 | 2.836 | 0.003 |
| 13 | I see interdisciplinary teamwork as essential for comprehensive care when suggesting nutraceuticals and functional foods for metabolic disorders. | 3.66 | 1.707 | 0.045 |
| 14 | I believe joint training programs and workshops for health practitioners, nutritionists, and dietitians would enhance collaborative efforts in optimizing patient outcomes. | 3.79 | 3.070 | 0.001 |

Table above is showing Role of Nutraceuticals and functional foods as preventive and remedial medicine.

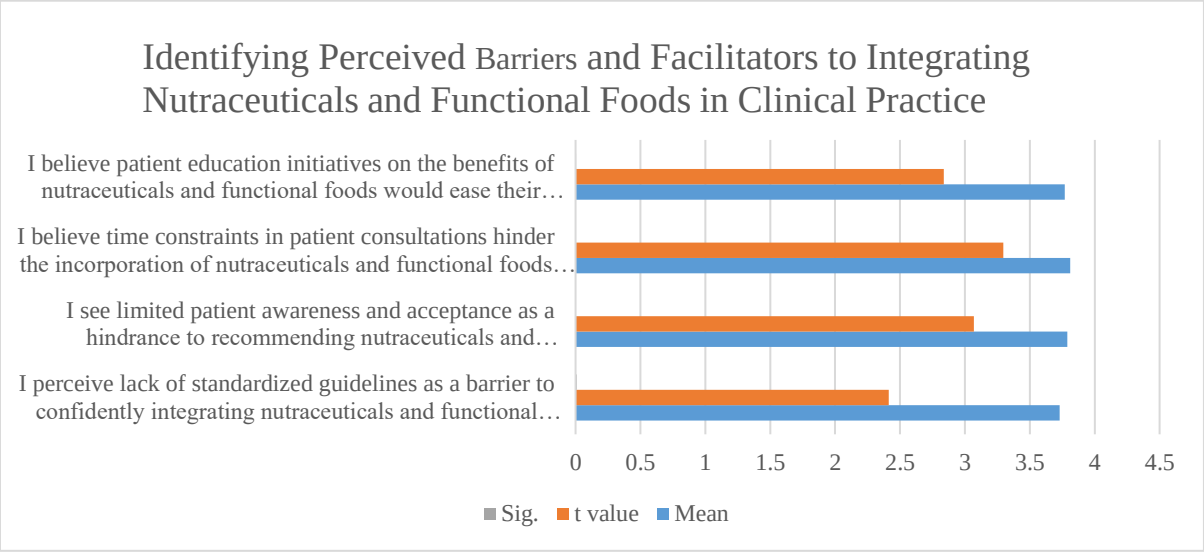
Objective 1: Evaluating Health Practitioners' Confidence in Recommending Nutraceuticals and Functional Foods

**Interpretation:**
The majority of health practitioners showcase a strong sense of confidence in their understanding of the effectiveness of nutraceuticals and functional foods for enhancing patient health. Their agreement about the significant benefits of incorporating these supplements into treatment plans indicates a belief in their potential to positively impact patient well-being. Health practitioners also express readiness and openness to expanding their knowledge base through continuous learning, demonstrating a commitment to staying updated with the latest research and advancements in this field. Their recognition of the essential nature of recommending these supplements within holistic care emphasizes a patient-centered approach, considering individual preferences and dietary habits in treatment planning.



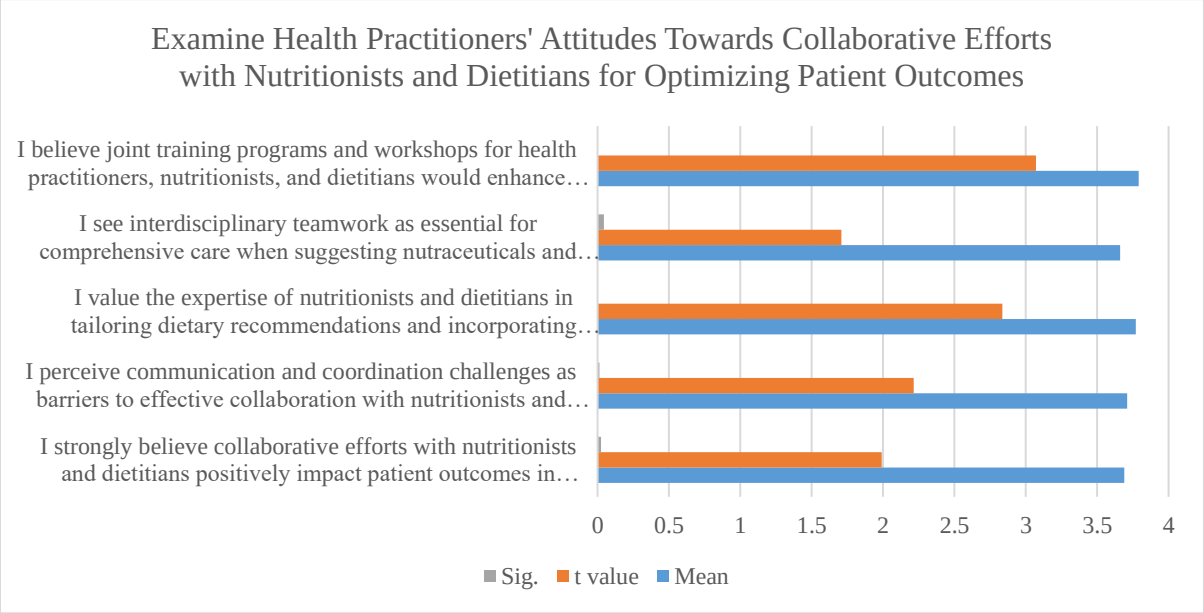

Objective 2: Identifying Perceived Barriers and Facilitators to Integrating Nutraceuticals and Functional Foods in Clinical Practice

**Interpretation:**
While acknowledging certain obstacles, such as time constraints, limited patient awareness, and challenges with insurance coverage, health practitioners demonstrate a nuanced understanding of the potential facilitators for integrating nutraceuticals and functional foods into clinical practice. They recognize the importance of standardized guidelines as a foundation for confident decision-making. Health practitioners also underscore the significance of patient education and the availability of quality supplements, emphasizing the role of education and accessibility in successful integration.




Objective 3: Examine Health Practitioners' Attitudes Towards Collaborative Efforts with Nutritionists and Dietitians for Optimizing Patient Outcomes

**Interpretation:**
Health practitioners exhibit strong positive attitudes toward collaborative efforts with nutritionists and dietitians, recognizing the potential impact on managing metabolic disorders through nutraceuticals and functional foods. Their confidence in effective collaboration and acknowledgment of the value of inputs from other specialists highlight the importance of complementary expertise in patient care. While identifying communication challenges, practitioners emphasize the significance of interdisciplinary teamwork, showing a willingness to navigate and overcome these obstacles. The endorsement of joint training programs underscores their commitment to continuous professional development and improved collaborative efforts for achieving better patient outcomes




In summary, the responses from health practitioners indicate a collective understanding of challenges and opportunities related to nutraceuticals and functional foods in clinical practice. Their emphasis on education, collaboration, and patient-centric approaches signifies a holistic viewpoint aimed at optimizing patient outcomes and delivering comprehensive healthcare without using any previously generated content. Further t-test shows that all the statements are significant (with the value below 0.05) .

**Discussion**

It is quite evident from the findings that the market of Nutraceuticals has great potential and requirement looking at the current scenario. There has been major shift in the eating and living style of people which has lead to vulnerability to lifestyle diseases and disorders. The modernization of agriculture has played a pivotal role in bringing about change and the last two centuries have seen a fundamental transformation of diets in all affluent countries. However therapeutic life changes with the help of dietary modifications could help in management and prevention of the lifestyle diseases. This is the most ideal situation but looking at the fast pace life it really becomes difficult to follow the dietary guidelines as it must incorporate careful dietary planning, use of medication and due to which lot of people choose pharmacotherapy as the first line of treatment. Apparently the question arises regarding the side effects of these drugs on health of liver, Gastro intestinal Tract and kidney. Since ages the potential benefits of plants and their medicinal properties have been appreciated by the allied health professionals. However the major gap lies in the experimental research to back up the evidence. There is a strong need and even belief of the health professionals as per proved in this study that Nutraceuticals and Functional foods should be considered as the choice of management and preventive therapy. in order to provide the evidence in the improvement and efficacy of these compounds. Based on this study, we devise recommendations to different stakeholders in the spirit of better patient care. In particular, we provide recommendations for allied healthcare professionals, individuals, and government institutions to come together and promote the usage of Functional Foods as the best remedial therapy for the metabolic disorders.

**Conclusion**

“Prevention is better than cure” is an age old saying that keeps echoing everywhere and it takes on a different tier of significance when it comes to dietary health choices. With the rising amount of diabetic and other metabolic disorder patients, we cannot expect the health care system to singlehandedly control and take care of the situation. The present era proposes the use of alternative medicines with bio active compounds extracted from several plant parts. These herbal medicines otherwise called new era of preventive medicine are now the source of many imperative drugs in this contemporary world. Furthermore with ever rising health problems due to luxurious lifestyle and changes in this modern society, there is a soaring need for use of potent medicinal.(Monalisa Mohanty,Samita Mohanty 2021). Plants against various oral ailments. Complete reliance on health care system would mean living off medicines lifelong which also contributes to innumerable side effects. It is thus the best means to incorporate dietary health supplements like functional foods and nutraceuticals into everyday life and prevent the occurrence of lifestyle diseases and metabolic disorders. And as a part of efficient implementation of the newer innovations in the fields, better regulations and awareness are also needed to maximize the benefits and reach maximum masses.

In summary, the survey's findings underscore a prevalent confidence among health practitioners in the efficacy and integration of nutraceuticals and functional foods within patient care, emphasizing their pivotal role

in holistic approaches. While acknowledging barriers such as time constraints and limited awareness, practitioners strongly endorse facilitators like standardized guidelines and interdisciplinary collaboration, signaling an openness to overcome challenges. Moreover, their positive attitudes towards collaborative efforts with nutritionists and dietitians reveal a collective enthusiasm for optimizing patient outcomes related to metabolic disorders through joint expertise and tailored interventions. Overall, the survey highlights a balanced recognition of the benefits, barriers, and collaborative potential among health practitioners regarding the integration of nutraceuticals and functional foods for enhanced patient care.

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**Authors' contributions:** Prof. Ruchu Kuthiala designed the research and collected the data from various Health Professionals in the various fields. Dr. Sanyogita Deshmukh conducted editing and helped in statistical analysis of the research.

**Conflict of interest**: The authors declare that there is no conflict of interest.

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