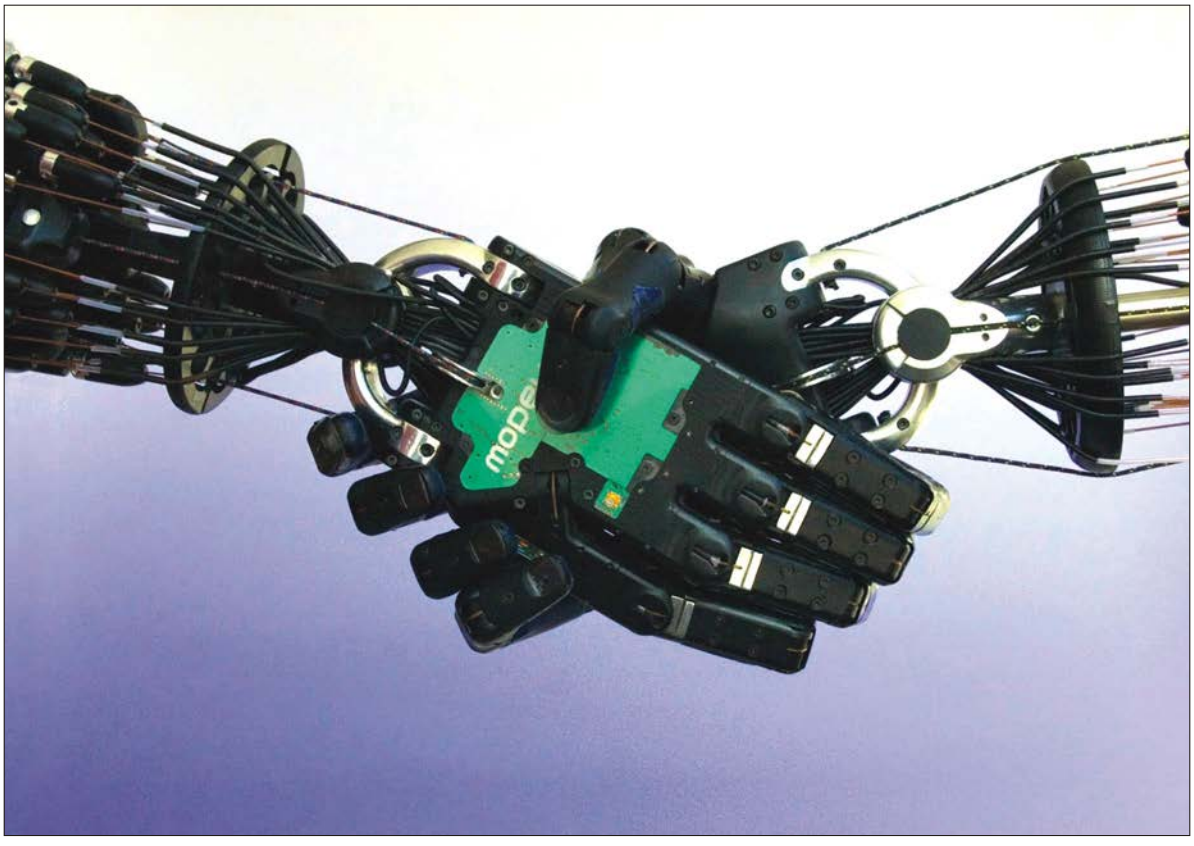

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Research Article
AI-Driven Personalized Nutrition and Health Guidance: Enhancing Health Outcomes for Nigerian Families

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Abstract

Background and Objective: Personalized nutrition, powered by Artificial Intelligence (AI), offers a promising approach to addressing dietary and health challenges in diverse populations. This study explored the effectiveness of AI-driven personalized nutrition interventions tailored to dietary preferences, health needs and locally available foods among Nigerian families. **Materials and Methods:** A total of 200 participants were recruited and stratified into an intervention group (receiving AI-based personalized dietary recommendations) and a control group (following standard dietary guidelines). Evaluated parameters included dietary adherence, blood pressure, blood glucose and BMI. **Results:** Dietary adherence was significantly higher in the intervention group (73%) compared to the control group (44%). Participants in the intervention group also demonstrated notable improvements in health markers, with reductions in systolic blood pressure (average decrease 13 mmHg), fasting blood glucose (average decrease 18 mg/dL), monthly food cost reduced by 15/1% and BMI (average decrease 1.6 points). Qualitative feedback indicated high acceptance of the AI tool, although challenges such as limited access to technology and initial unfamiliarity with AI were reported. **Conclusion:** The AI-driven personalized nutrition can effectively improve dietary adherence and key health outcomes while offering culturally acceptable and affordable guidance for Nigerian families.

Key words: Personalized nutrition, artificial intelligence, dietary adherence, health outcomes, non-communicable diseases

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Nigeria and many other nations faced a complex nutritional landscape. The country experiences the dual challenge of malnutrition and an increasing prevalence of nutrition related Non-Communicable Diseases (NCDs) such as diabetes, obesity and hypertension, driven largely by poor dietary choices and lifestyle[1]. Nigeria current is experiencing a bad trend in nutrition transition, were the traditional diet that in high in cereal and fiber is replaced with a more western pattern diet that is high in refine sugars, fat and animal source food. This coupled with limited dietary diversity has led to rising rates of diet-related health conditions. In light of these challenges, there is growing interest in the potential of personalized nutrition as a tool for improving health outcomes[2].

Personalized nutrition directed dietary recommendations to an individual's unique characteristics, including genetic, metabolic and lifestyle factors. Advances in Artificial Intelligence (AI) have further enhanced this approach, enabling the analysis of vast amounts of health and nutrition data to generate customized nutrition guidance[3]. Using AI in personalized nutrition has revealed promising results in creating diet plans that are more effective in managing and preventing diseases, compared to general dietary recommendations[4]. For instance, AI can help identify genetic triggers to conditions such as obesity and hypertension, giving room for the development of preventive dietary strategies that in line with an individual's unique health profile[5].

In the Nigerian, AI-driven personalized nutrition holds particular promise, as AI systems have the potentials to customize dietary recommendations to locally available foods, resources and cultural practices; thereby providing guidance that is culturally acceptable, economically accessible, sustainable and nutritionally adequate. This localized approach could help create a link between national dietary guidelines and the daily realities of Nigerian families, thereby easing adherence to healthier eating habits[6]. Additionally, AI can be used to formulate affordable meal plans by taking into account regional food availability and costs, making it a viable tool for diverse socioeconomic groups[7].

Despite these promising applications, several barriers impede the widespread adoption of AI-driven personalized nutrition in Nigeria. These include privacy of data, the high cost of genetic testing, limited access to healthcare infrastructure in rural areas and cultural acceptance of dietary changes or taboos. Addressing these challenges will require strategic collaborations among policymakers, technology companies, healthcare providers and local communities.

This paper explored the role of AI-driven personalized nutrition in addressing Nigeria's health challenges, focusing on its potential to improve dietary adherence, reduce the incidence of NCDs and promote sustainable nutritious meal planning. Through the use of local diets and available resources, we examine how AI can transform public health and make nutritionally affordable diets accessible for Nigerian families.

MATERIALS AND METHODS

Study design: The study was conducted over 12 month period, from February 2024 to January 2025. A mixed-methods approach research was adopted in the study, combining quantitative and qualitative methods to assess the effectiveness and feasibility of AI-driven personalized nutrition among Nigerian families. The study involved a controlled trial to determine the effect of AI-based dietary recommendations on dietary adherence and health outcomes.

Study population and sample size: Adults aged 18-65 were selected for the study from diverse socioeconomic backgrounds across different geo-political zones in Nigeria, giving room for regional and cultural variations in diet and lifestyle. Stratification of participants was done according to age, gender, income and geographic location. A total of 200 participants were enlisted for the study and they were divided into two groups, 100 persons were recruited into the intervention group (receiving AI-driven personalized nutrition recommendations) and 100 in the control group (receiving standard dietary guidelines).

Inclusion criteria:

- Adults aged 18-65
- Willingness to participate in the study and follow dietary guidance for six months
- Individuals with no prior diagnosis of severe chronic illnesses other than non-communicable diseases like diabetes or hypertension

Intervention: Participants in the intervention group received AI-driven, personalized nutrition recommendations based on an AI platform designed to analyze individual health profiles, dietary preferences and local food availability.

The control group received general dietary guidelines based on the Nigerian Food Guide and will not receive personalized or AI-based recommendations.

Data collection:

- **Dietary adherence:** Dietary adherence was assessed using a 24 hrs dietary recall and a monthly self-reported food diary. Adherence was measured by comparing actual intake to the AI-recommended or standard dietary guidelines
- **Health outcomes:** Health parameters, including blood glucose, blood pressure, Body Mass Index (BMI) and lipid profile, were measured at baseline, mid-study (2 weeks) and post-intervention (6 months). These metrics helped assess changes related to diabetes and hypertension risk factors
- **Cost-effectiveness and affordability:** The intervention group was trained to prompt the AI system to track food costs in their region and suggest cost-effective meal alternatives. Data on meal costs were collected to evaluate affordability in the intervention group compared to the control group
- **Qualitative data on acceptance and feasibility:** Focus group discussions were held with participants in the intervention group to gather feedback on the usability and acceptance of the AI tool. Structured interviews and a post-study survey further assess participants' perceptions, barriers and willingness to continue using the AI-based recommendations

Data analysis:

- **Quantitative analysis:** Statistical tests, including t-tests and ANOVA, were conducted to assess differences in dietary adherence, health outcomes and cost-effectiveness between the intervention and control groups. Regression analysis was used to examine relationships between socioeconomic factors, adherence levels and health outcomes
- **Qualitative analysis:** Focus group and interview data were analyzed using thematic analysis to identify key themes related to participants' experiences with the AI tool, challenges and suggestions for improvement. A NVivo software was used to code and analyze qualitative data
- **Economic analysis:** Cost-effectiveness analysis was conducted to compare the economic viability of AI-driven personalized nutrition with general dietary guidelines, with a focus on affordability and regional food availability

Ethical considerations: Informed consent was obtained from all participants and they were assured of the confidentiality and anonymity of their data. Participants have the option to withdraw from the study at any point. Data privacy protocols was implemented to ensure the secure handling and storage of personal and health information, particularly for those in the intervention group receiving AI-driven recommendations.

Limitations:

- Self-reported dietary adherence may introduce recall or social desirability bias
- Results may not apply to populations outside Nigeria or with different access to AI technology

RESULTS AND DISCUSSION

Table 1 presents the dietary adherence levels of participants following the intervention. The findings revealed that the intervention group, that received AI-driven personalized nutrition guidance, demonstrated substantially higher adherence to recommended dietary practices when compared to the control group. Specifically, 44% of participants in the intervention group achieved high adherence levels ($\geq$80%), compared to only 18% in the control group. Conversely, low adherence (<60%) was observed among 28% of intervention participants but was markedly higher among the control group (56%). The mean dietary adherence score was 73.0$\pm$12.4% in the intervention group compared with 44.0$\pm$15.7% in the control group. These findings suggest that AI-driven nutrition interventions may significantly ($p \leq 0.05$) improve compliance with dietary recommendations.

The higher level of adherence observed in the intervention group may be attributed to the personalized nature of AI-generated dietary advice, which point recommendations to individual preferences, health conditions and socioeconomic circumstances. Previous studies have shown that personalized nutrition approaches improve dietary behavior and long-term adherence more effectively than generalized dietary guidelines[1,2]. The findings align with evidence suggesting that digital health technologies and AI-based nutrition systems can provide continuous feedback and motivation, thereby increasing compliance with dietary interventions[3].

Table 2 summarizes blood pressure reduction outcomes after the intervention. The results showed that 31% of participants in the intervention group experienced reductions greater than 15 mmHg, compared with only 5% in the control group. Furthermore, 37% of intervention participants achieved reductions between 11 and 15 mmHg, however only 16% of control participants achieved similar reductions. The mean reduction in blood pressure was 13.0$\pm$4.2 mmHg in the intervention group, as against 5.0$\pm$3.1 mmHg in the control group.

Table 1: Dietary adherence among participants

Adherence level (%)	Intervention group (n = 100)	Control group (n = 100)
High adherence (≥80%)	44	18
Moderate adherence (60-79%)	28	28
Low adherence (<60%)	28	56
Mean adherence (%)	73.0±12.4	44.0±15.7

Table 2: Blood pressure reduction after intervention

Blood pressure reduction (mmHg)	Intervention group (n = 100)	Control group (n = 100)
>15 mmHg	31	5
11-15 mmHg	37	16
6-10 mmHg	21	30
≤5 mmHg	11	49
Mean reduction (mmHg)	13.0±4.2	5.0±3.1

Table 3: Blood glucose reduction after intervention

Blood glucose reduction (mmHg)	Intervention group (n = 100)	Control group (n = 100)
>20 mg/dL	34	7
16-20 mg/dL	31	13
11-15 mg/dL	20	19
≤10 mg/dL	15	61
Mean reduction (mg/dL)	18.0±5.8	7.0±4.3

Table 4: BMI reduction after intervention

BMI reduction (Point)	Intervention group (n = 100)	Control group (n = 100)
>2.0	30	8
1.5-2.0	36	19
1.0-1.4	20	24
<1.0	14	49
Mean reduction	1.6±0.7	0.8±0.5

These findings indicated that AI-assisted personalized nutrition significantly ($p \leq 0.05$) contributed to blood pressure management. Dietary modification remain one of the most effective non-pharmacological approaches for the control of hypertension and other nutrition related non-communicable diseases, especially when nutritional recommendations are tailored towards individual needs[4]. AI systems can facilitate adherence to dietary patterns such as the DASH diet by generating customized meal plans and providing real-time feedback. The observed reductions are similar with previous studies which posited that personalized dietary interventions can significantly improve cardiovascular health indicators, including blood pressure[5]. The substantial difference between intervention and control groups suggested that individualized nutrition support may be more effective than standard dietary advice alone.

The results presented in Table 3 revealed significant ($p \leq 0.05$) improvements in blood glucose control among participants who received AI-driven personalized nutrition guidance. A total of 34% of intervention participants achieved blood glucose reductions exceeding 20 mg/dL compared to only 7% of control participants. Similarly, 31% of intervention participants experienced reductions of 16-20 mg/dL, compared to the fact that only 13% of control participants attained comparable improvements. The mean reduction in blood glucose levels was 18.0±5.8 mg/dL in the intervention group as against 7.0±4.3 mg/dL in the control group.

These findings supported the growing body of evidence indicating that personalized nutrition interventions can improve glycemic control. AI-based nutrition systems can analyze individual metabolic responses, dietary habits and health data to generate customized dietary recommendations that optimize blood glucose regulation. Previous research[2] demonstrated that individualized dietary recommendations based on personal metabolic responses resulted in superior glycemic outcomes compared to conventional dietary advice. Similarly, precision nutrition approaches is associated with improved glucose management among individuals at risk of metabolic disorders[3]. Therefore, the superior glucose reductions observed in the intervention group highlighted the potentials of AI-driven nutrition strategies in preventing and managing diabetes-related complications.

Table 4 presented changes in Body Mass Index (BMI) following the intervention. The results indicate that 30% of intervention participants achieved BMI reductions greater than 2.0 points compared to 8% of participants in the control group. Additionally, 36% of intervention participants recorded reductions between 1.5 and 2.0 points, whereas only 19% of

Table 5: Monthly food cost comparison

Variable	Intervention group	Control group
Average monthly food cost		
Before intervention (₦)	85,000±10,500	84,500±11,200
Average monthly food cost		
After intervention (₦)	72,165±9,800	84,120±10,900
Mean cost difference (₦)	-12,835	-380
Percentage change (%)	-15.1%	-0.5%
p-value	<0.01	-

Table 6: Summary of key outcomes

Outcome	Intervention group (AI-based)	Control group (Standard guidelines)	p-value
Dietary adherence	73%	44%	<0.01
Blood pressure reduction	13 mmHg	5 mmHg	<0.01
Blood glucose reduction	18 mg/dL	7 mg/dL	<0.01
BMI reduction	1.6 points	0.8 points	<0.05
Monthly food costs	15.1% lower	-	N/A

control participants achieved similar outcomes. The mean BMI reduction was 1.6±0.7 points in the intervention group compared with 0.8±0.5 points in the control group.

The greater BMI reductions observed among intervention participants suggested that AI-assisted nutrition guidance can effectively be used in weight management. Obesity remains a major risk factor for non-communicable diseases and individualized dietary interventions have been shown to facilitate sustainable weight loss by addressing personal behavioral and physiological factors[6]. AI-driven systems can enhance weight management efforts through personalized meal planning, calorie monitoring and adaptive feedback mechanisms. The observed reduction in BMI is similar with previous studies reporting that personalized dietary interventions result in more favorable weight outcomes than generalized nutritional recommendations[1]. These findings underscored the role of AI in supporting effective obesity prevention and management strategies.

Table 5 compared monthly household food costs before and after the intervention. Prior to the intervention, both groups exhibited similar average monthly food expenditures, with the intervention group spending ₦85,000±10,500 and the control group spending ₦84,500±11,200. Following the intervention, the intervention group's average monthly food cost reduced to ₦72,165±9,800, representing a mean reduction of ₦12,835 and a percentage decrease of 15.1%. Contrarily, the control group experienced only a marginal reduction of ₦380, corresponding to a 0.5% decrease. The reported p-value of <0.01 indicates that the reduction in food costs among intervention participants was statistically significant.

These findings suggested that AI-based personalized nutrition guidance can promote not only better health outcomes but also greater economic efficiency in household food purchasing. By recommending cost-effective and nutritionally appropriate food choices, AI systems may help families optimize food expenditures while maintaining dietary quality. This finding is particularly relevant in Nigeria, where rising food prices continue to affect household food security. Similar observations have been reported by studies examining digital nutrition interventions, which found that personalized dietary planning can reduce food waste and improve budget allocation while maintaining nutritional adequacy[7]. The significant reduction in food costs observed among intervention participants highlights the potential socioeconomic benefits of AI-driven nutrition programs.

Table 6 provides an overall summary of the major outcomes associated with AI-based personalized nutrition guidance. The intervention group achieved substantially better results across all measured indicators compared to participants receiving standard nutritional guidelines. Dietary adherence was markedly higher in the intervention group (73%) than in the control group (44%), while mean blood pressure reduction was more than double that observed in the control group (13 mmHg versus 5 mmHg). Similarly, blood glucose reduction was significantly greater among intervention participants (18 mg/dL compared with 7 mg/dL) and BMI reduction was twice as large (1.6 points versus 0.8 points). Furthermore, the intervention group experienced a significant 15.1% reduction in monthly food costs.

The statistically significant p-values reported for dietary adherence, blood pressure reduction, blood glucose reduction and BMI reduction provide strong evidence supporting the effectiveness of AI-driven personalized nutrition interventions. These findings are consistent with the emerging field of precision nutrition, which emphasizes individualized dietary recommendations based on personal characteristics, health status and lifestyle factors[3]. The results suggest that

integrating AI technologies into nutrition and health guidance may enhance health outcomes, improve chronic disease management and contribute to household economic sustainability among Nigerian families.

CONCLUSION

The present study highlights the significant potential of AI-driven personalized nutrition in improving dietary behavior and health outcomes among Nigerian families facing increasing burdens of nutrition-related non-communicable diseases. By integrating individual health profiles, cultural dietary preferences and locally available food resources, the AI-based intervention demonstrated superior outcomes in comparison to standard dietary guidance. Participants in the intervention group showed improved management of key health indicators, including blood pressure, fasting blood glucose and Body Mass Index (BMI), along with higher dietary adherence and improved cost-effectiveness.

The findings further indicate strong user acceptance and perceived feasibility of AI-based nutritional guidance, particularly when culturally relevant meal plans are incorporated. This suggests that personalized digital nutrition tools can support sustainable dietary behavior change when aligned with local food systems and traditions. However, challenges such as limited digital access, particularly in rural communities and initial skepticism toward AI-based solutions underscore the need for infrastructural support and targeted awareness.

SIGNIFICANCE STATEMENT

This study is significant as it demonstrates that AI-driven personalized nutrition can serve as an effective, culturally adaptable and scalable public health strategy for improving dietary practices and reducing the burden of non-communicable diseases among Nigerian families. It provides evidence to support the integration of digital health tools into community nutrition programs, particularly in resource-limited settings, while emphasizing the importance of improving technological access and public trust for successful implementation.

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