

# Artificial Intelligence and Digital Technologies in Nutrition Research and Dietetics Practice

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## ABSTRACT

In recent years, digital technologies and artificial intelligence (AI) have begun to transform nutrition research and dietetics practice. This review examines how AI and digital tools are applied in dietary assessment, personalized planning and behaviour monitoring; how mobile apps and digital platforms support nutrition counselling; how machine-learning models predict nutrient intake and health outcomes; the ethical, privacy and equity concerns that arise; and future trends including AI-driven virtual dietitians and fully integrated nutrition-care ecosystems. Although promising, the deployment of these innovations must navigate issues of data quality, algorithmic bias, professional roles, user engagement and regulatory frameworks. Effective integration into dietetics will require interdisciplinary collaboration, transparent methods, and equitable access.

**Keywords:** Artificial intelligence, Digital nutrition, Dietetics, Machine learning, Nutrition technology

## INTRODUCTION

Nutrition care and research have traditionally relied on self-report dietary records, manual dietitian assessments and relatively slow analytic methods. With the explosion of digital sensors, mobile platforms, big data and advanced computational techniques, there is an opportunity to revolutionize how dietary data are collected, processed and used for intervention (Głąbska et al., 2024; Wang et al., 2022). The integration of AI – defined broadly as computational systems performing tasks that typically require human intelligence (such as pattern recognition, decision making, prediction) – offers particular opportunities in nutrition research and dietetics (Rahman et al., 2023). Digital tools (mobile apps, wearables, sensors, chatbots) provide data at scale, enabling more frequent, detailed and real-time monitoring of diet, behaviour and response to intervention (Phalle & Gokhale, 2025). This review will explore the current state of AI and digital technologies in nutrition/dietetics, structured around the key domains of dietary

### Role of AI in Dietary Assessment, Personalized Planning and Behaviour Monitoring

#### Dietary Assessment

Accurate dietary assessment remains a major challenge in nutrition research and clinical dietetics due to recall bias, under-reporting, high burden and limited granularity. Digital tools enhanced by AI are increasingly used to overcome these limitations. Recent reviews indicate that AI-enhanced tools (e.g., image-based recognition of foods, volume estimation, sensor-based detection of eating occasions) are becoming feasible for research and practice (Phalle & Gokhale, 2025; Głąbska et al., 2024). For instance, in a scoping review of AI-assisted dietary assessment tools, 66 studies were identified demonstrating image-based (food image recognition) and motion sensor-based (jaw movement, wrist motion) mechanisms integrated into mobile/wearable platforms (Phalle & Gokhale, 2025). These tools reduce labour and may improve accuracy compared with standard 24 h recall or food frequency questionnaire methods.

#### Personalized Planning and Behaviour Monitoring

Beyond assessment, AI enables personalized diet planning and real-time feedback on behaviour. Systems using machine-learning (ML) or deep-learning (DL) models can integrate individual data (health metrics, biomarkers, preferences, eating behaviour patterns) to tailor recommendations (Rahman et al., 2023). For example, a systematic review found AI-generated dietary interventions led to improved glycaemic control, IBS symptom severity reduction and other health behaviour changes in adults (Wang et al., 2024). Behaviour

monitoring is enhanced via wearables and smartphone sensors that detect eating events or sedentary behaviour, enabling feedback loops and prompting interventions (Głąbska et al., 2024).

### **Implementation in Dietetics Practice**

In clinical settings, dietitians are beginning to adopt AI-supported tools for streamlining nutrition assessment and monitoring workloads. For example, an article on AI in clinical nutrition and dietetics noted applications including malnutrition screening, nutrient intake estimation and workflow support through chatbots, albeit cautioning about accountability and bias (Cheung et al., 2023). AI can enhance the nutrition care process—not replace the human professional—but also shifts the dietitian’s role towards oversight, interpretation and coaching.

## **DIGITAL TOOLS AND MOBILE APPS IN NUTRITION COUNSELLING**

### **Mobile Apps for Diet Tracking and Counselling**

Mobile apps have proliferated for nutrition behaviour change, diet tracking and lifestyle counselling. A review examining digital applications for diet monitoring and precision nutrition found apps targeted citizens, nutritionists and clinicians with functionalities such as diet tracking, goal-setting, feedback and algorithm-driven suggestions (Lupton et al., 2023). These tools show promise for improving adherence and engagement, particularly when combined with behaviour change techniques.

A recent randomized controlled trial of an AI-assisted weight-loss app (eTRIP) among a Southeast Asian cohort documented significant improvements in snacking habits, overeating, physical activity and psychosocial factors within a week, attributed to features like image-recognition food logging, chatbot reminders and user-friendly interface (Chong et al., 2024). This highlights the potential of digital apps to engage users actively and deliver personalized feedback.

### **Tele-Nutrition and Remote Counselling**

The COVID-19 pandemic accelerated telehealth and remote nutrition counselling. Digital platforms now integrate videoconferencing, secure data sharing, app-based food logging, and AI-driven analytics to support remote dietitians and clients. Such platforms improve accessibility (especially for remote/rural clients), facilitate asynchronous monitoring and extend care beyond the clinic. However, technology readiness, digital literacy, and access disparities remain challenges.

### **Behaviour Change and Gamification**

Beyond tracking intake, modern digital nutrition apps embed behaviour-change strategies (goal setting, social support, gamification, nudges) and AI-driven personalization. These features aim to increase engagement and long-term adherence. As digital fatigue and attrition are common, the optimal use of AI-driven personalization and adaptive feedback is a key research area.

### **Machine Learning in Predicting Nutrient Intake and Health Outcomes**

#### **Predictive Modelling for Nutrient Intake and Diet-Related Health Outcomes**

Machine learning and other AI techniques offer powerful analytic capabilities to process large, heterogeneous dietary, behavioural and biomarker datasets, detect patterns and make predictions for health outcomes. A review of AI/ML/DL in nutrition science outlined five clusters of application: food recognition/tracking, dietary assessment, personalized nutrition recommendation, predictive modelling for disease risk and monitoring (Chang et al., 2023). For example, AI models have been used to predict post-prandial glycaemic responses, nutrient deficiencies, chronic-disease risk and to optimize diet recommendations at the individual level (Chang et al., 2023; Rahman et al., 2023).

### **Use Cases**

One study introduced a deep-generative model for nutrition recommendation, showing improved speed and explainability in deliverable dietary advice. Other emerging systems integrate multimodal sensing (e.g., wearable inertial motion data, glucose monitoring and food-image cameras) alongside ML to estimate macronutrient intake automatically and provide real-time dietary feedback (Arefeen et al., 2025). These techniques show promise, especially for metabolic-disease management (e.g., diabetes, obesity), but are mostly still in pilot phases.

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**Limitations and Considerations**

Despite potential, several limitations hinder widespread implementation: data quality and standardization are major issues (Chang et al., 2023). Algorithms are only as good as the data they are trained on; biased datasets can lead to inequitable predictions (Cheung et al., 2023). Interpretability and transparency of ML/DL models remain a concern for clinical use. Moreover, real-world external validation and long-term outcome studies are still scarce (Wang et al., 2022).

**Ethical and Data Privacy Concerns****Algorithmic Bias and Equity**

The promise of AI in nutrition is mirrored by risks, particularly the potential for algorithmic bias, inequity and loss of professional accountability. The literature emphasises that AI-driven nutrition tools may reproduce or amplify biases present in training data, leading to poorer predictions or advice for marginalised groups (Cheung et al., 2023; Głabska et al., 2024). Ensuring representative datasets, algorithmic auditing, and transparency is essential to safeguard equity.

**Privacy, Security and Data Governance**

Digital nutrition tools generate large volumes of sensitive personal and health data (food intake, biometrics, location, behaviour). This creates privacy risks, requiring robust data governance, secure storage, encryption, appropriate consent and clarity about data access/use (Rahman et al., 2023). The nutrition/dietetics field must ensure alignment with medical-data regulations (e.g., HIPAA, GDPR) and ethical standards.

**Professional Roles and Accountability**

As AI tools are integrated into dietetics practice, the role of the human professional evolves. There is concern that over-reliance on AI may depersonalise care or reduce dietitians to “supervisors of algorithms” (Cheung et al., 2023). It is essential to ensure that human judgement, empathy and contextualisation remain central to practice. Ethical frameworks must define responsibility when AI recommendations lead to adverse outcomes.

**Informed Consent and Transparency**

Users must understand how the AI tool works, what data are used, what decisions are being made, and potential risks. Transparent, explainable AI is important both for user trust and regulatory compliance. Additionally, considerations around data ownership, secondary use, commercialization and algorithmic decision-making require ethical deliberation (Głabska et al., 2024).

**FUTURE TRENDS: AI-DRIVEN NUTRITION INTERVENTIONS AND VIRTUAL DIETITIANS****Virtual Dietitians and Chatbots**

One exciting frontier is the development of virtual dietitians: conversational agents (chatbots) powered by natural-language processing and machine-learning, capable of delivering dietary counselling, monitoring, behaviour prompts and reminders. These systems may operate 24/7, scale to many users, integrate sensor and app data, and provide personalised feedback. Early studies show promise but also emphasise the importance of human oversight (Cheung et al., 2023).

**Fully Integrated Nutrition-Care Ecosystems**

The vision is of ecosystems where wearable sensors, mobile devices, electronic health records, food-purchase data, microbiome/biomarker analytics and AI engines converge to provide proactive nutrition care. Such systems would detect nutritional risk, prompt interventions, adapt in real time and support both prevention and management of diet-related conditions. Large-scale precision-nutrition initiatives and digital nutrition platforms are already emerging (Chang et al., 2023).

**Adaptive, Real-Time Diet Coaching**

Real-time sensing and AI may enable truly adaptive diet coaching: for example, alerting a user when their wearable device detects increased glucose, and dynamically adjusting food suggestions or prompts. These “closed-loop” nutrition systems are analogous to closed-loop insulin delivery in diabetes care and represent a major leap for dietetics (Wang et al., 2024).

## Accessibility, Scalability and Global Nutrition

AI and digital nutrition tools hold potential for global nutrition interventions, especially in low- and middle-income countries where dietitian access is limited. Scalable digital platforms can deliver screening, counselling and behaviour change at scale, though they must be culturally adapted, available offline and affordable (Głąbska et al., 2024).

## Research Agenda and Validation

Going forward, rigorous long-term clinical trials, real-world implementation research, cost-effectiveness analyses and equitable deployment strategies will be key. As noted by recent reviews, while AI applications in nutrition are growing, many remain at proof-of-concept stage, and evaluation of health impact is limited (Wang et al., 2022; Cheung et al., 2023).

## CONCLUSION

Artificial intelligence and digital technologies are poised to transform nutrition research and dietetics practice in profound ways. From image-based dietary assessment and real-time behaviour monitoring to AI-driven prediction of nutrient intake and health outcomes, and from mobile diet-counselling apps to virtual dietitians, the possibilities are immense. However, unlocking this potential requires rigorous validation, transparent algorithms, equitable access, and careful integration with human expertise and nutrition care processes. Dietitians and nutrition researchers must work alongside technologists, data scientists and ethicists to ensure that the digital nutrition transformation benefits all, supports high-quality care and advances global nutrition outcomes.

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