Chapter 22
Leveraging Data Science for Personalized Nutrition

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ABSTRACT

The field of nutrition is experiencing a remarkable shift towards personalization. The traditional "one-size-fits-all" approach to dietary recommendations is increasingly being challenged by the recognition that individuals have unique genetic, metabolic, and environmental factors that influence their nutritional needs. The objective of the chapter is to delve into the utilization of data science for personalized nutrition. It aims to explore the latest advancements in research concerning the integration of machine learning models to personalize every step of the nutrition care process. This review underscores the prospective role of AI in the realm of clinical nutrition and how such applications could advance care quality while streamlining healthcare provision. By shedding light on this area, the goal is to stimulate discussion, potentially allay concerns, and foster collaborative efforts to optimize the application of AI in clinical nutrition and beyond. It is crucial to acknowledge the extensive and intricate ethical and legal considerations surrounding AI in healthcare.

INTRODUCTION

In recent years, the field of nutrition has experienced a remarkable shift towards personalization (Singh et al., 2023; Ghosh et al., 2023). The traditional "one-size-fits-all" approach to dietary recommendations is increasingly being challenged by

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the recognition that individuals have unique genetic, metabolic, and environmental factors that influence their nutritional needs (Ghosh et al., 2023; Ghosh et al., 2022; Ghosh et al., 2021; Choudhury et al., 2024). This realization has paved the way for the integration of data science and advanced analytics into the realm of nutrition, enabling the development of personalized nutrition strategies tailored to an individual's specific requirements (Ghosh et al., 2024). Artificial intelligence (AI) encompasses a broad range of initiatives aimed at employing computers to perform tasks traditionally undertaken by humans (Pettit et al., 2021, p. 729). Tasked with specific objectives, computers receive, analyze, and manipulate data to determine the most appropriate course of action for achieving desired outcomes (Brooks-Warburton et al., 2022). AI has become integrated into numerous aspects of daily life, from smart home devices to music streaming services, social media platforms, and even the vehicles we operate. In healthcare delivery, AI is progressively gaining traction, particularly in areas such as disease detection, diagnosis, monitoring, prognostication, and risk assessment. Notably, AI applications are prominent in diagnostics, where computers are trained to recognize abnormalities from extensive image datasets. This includes tasks like lesion recognition in endoscopy (Antonelli et al., 2023), radiological interpretation (Berbís et al., 2023), and histological assessment (Baxi et al., 2022), all falling under the umbrella of computer vision tasks (Ghosh et al., 2024). At present, AI serves as a supportive tool to enhance clinical decision-making and streamline care delivery (Martinez-Martin et al., 2021). For example, it can expedite mammogram reviews in breast cancer screening programs, allowing for the interpretation of a greater volume of scans in a shorter timeframe, or reduce instances of missed pathologies during endoscopic examinations. Across various medical specialties, AI applications have demonstrated promising outcomes, contributing positively to healthcare practices (Antonelli et al., 2023, p.114, Berbís et al., 2023, p.1427, Martinez-Martin et al., 2021, p.115).

Personalized nutrition is gaining significant traction in clinical settings, with healthcare professionals increasingly employing genetic testing and other personalized approaches to manage chronic diseases and enhance patient outcomes (Ghosh et al.,2021,Ghosh et al.,2023). With advancements in science and technology, coupled with heightened awareness, there is widespread recognition that unhealthy eating habits, including overnutrition, contribute to various diseases (Mathur et al., 2019,p.695, Murakami et al.,2015,p.15, Ohkuma et al.,2013,p.46). Correcting these habits and adopting healthier lifestyle practices can help prevent these diseases (Moscatelli et al.,2023,p-15). A recent compelling report highlighted that personalized and tailored nutrition interventions for patients lead to improved survival rates compared to conventional nutrition approaches aimed at the entire population (Bargetzi et al.,2021,p.1025, Perez-Torres et al.,2021,p.13). Against the backdrop of a social environment that values individuality and a heightened interest