Mashhad University of Medical Sciences (MUMS)

Reviews in Clinical Medicine

Clinical Research Development Center Ghaem Hospital

Food recommender systems for diabetic patients: a narrative review

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ARTICLE INFO

Article type
Review article

Article history
Received: 25 Jun 2015
Revised: 13 Dec 2015
Accepted: 1 Jan 2016

Keywords
Diabetes
Food recommender system
Diet therapy

ABSTRACT

World Health Organization (WHO) estimates that the number of people with diabetes will grow 114% by 2030. It declares that patients themselves have more responsibility for controlling and the treatment of diabetes by being provided with updated knowledge about the disease and different aspects of available treatments, and diet therapy in particular. In this regard, diet recommendation systems would be helpful. They are techniques and tools which suggest the best diets according to patient's health situation and preferences. Accordingly, this narrative review studied food recommendation systems and their features by focusing on nutrition and diabetic issues. Literature searches in Google scholar and Pubmed were conducted in February 2015. Records were limited to papers in English language; however, no limitations were applied for the published date. We recognized three common methods for food recommender system: collaborative filtering recommender system (CFRS), knowledge based recommender system (KBRS) and context-aware recommender system (CARS). Also wellness recommender systems are a subfield of food recommender systems, which help users to find and adapt suitable personalized wellness treatments based on their individual needs. Food recommender systems often used artificial intelligence and semantic web techniques. Some used the combination of both techniques.

Please cite this paper as:
Norouzi S, Nematy M, Zabolinezhad H, Sistani S, Etminani K. Food recommender systems for diabetic patients: a narrative review. Rev Clin Med. 2017;4(3):128-130.

Introduction

Diabetes mellitus (DM) is a group of metabolic disorders in which there are chronic hyperglycemia with disturbances of carbohydrate, protein and fat metabolism due to defects in insulin secretion, insulin action, or both (1).

World Health Organization (WHO) estimates that the number of people with diabetes will grow 114% by 2030 (2). Prevalence of type 2 diabetes quickly raised in native and immigrant Asian people too. Therefore, the morbidity and mortality related to the disease and its complications are also common in Asian population. During recent decades, type 2 diabetes have been rapidly increased in Asia (3).

Prevalence of type 2 diabetes at an early age has affected Asian countries economy. So, national preventive strategies must be taken to increase public awareness about the disease and improve standards of care and health in this respect (4).

Diet therapy is essential for effective management of diabetes, type 2 in particular to reduce the risk of long term damage of tissues. All sug-

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gestions should be offered based on scientific evidences. They have to fit for the individual, taking into account cultural and personal preferences, beliefs and lifestyle (5). Because of significant effects of diet therapy combined with improving diseases, nutritionists and practitioners pay more attentions to developing food recommender systems.

Recommendation systems are sort of information systems helping people to make decisions in intricate area by suggesting evidence-based pieces of advices. Simply, they compare user interest obtained from his/her profile with some reference characteristics come from the item information (content-based approach), knowledge (knowledge based recommender system), the user's profile (collaborative filtering approach) and the combination of all (6). Computerized food recommender applications developed with the objective to assist the patients in daily diet selection, are installed on a variety of portable apparatuses such as cell phones, PDAs (Personal digital assistant), etc (7). and suggest the best diets according patient's health situation and preferences everywhere and every time (8).

The present study reviewed literatures to investigate various types of food recommender systems, their methods and features.

Literature Review

We wrote this narrative review according to guideline of Zurich-Basel Plant Science Center. It reported items preferred for writing a review article, but considering a more narrative approach. We defined the research questions and explored Medical Subject Heading (MeSH) terms to determine our search keys. Then we conducted literature searches in Google scholar in February 2015 with the terms: recommender system, knowledge-based, context-aware, collaborative-filtering food, and snack or nutrition or diabetes. We screened the titles and abstracts of the collected papers. Finally, papers in English in relation to food and diet recommender systems were selected without any limitation for the published year.

We identified three major food recommender types including knowledge –based recommender system (KBRS), context-aware recommender system (CARS) and collaborative-filtering recommender system (CFRS). We also found three related studies, which were not categorized into major types, but their subjects remained in the area of recommender systems including two papers about wellness recommender system and one about the challenges for nutrition recommender systems. The results are shown in Table 1.

A KBRS type recommends items and their features, which meet user's needs and preferences based on specific domain of knowledge. It also determines how the items are useful for the user (6).

Table 1. Types of food recommender systems.

Type	KBRS	CARS	CFRS	other
Number	4	1	1	3

KBRS is divided into two categories: 1.Case-based recommender system and 2. Constraint-based recommender system. Case-based recommenders used similarity metrics to offer recommendations whereas constraint-based recommenders often used predefined explicit rules, which are acquired from a knowledge base.The studies performed by Khan et al, Suksom et al, Lee et al and Chen et al used KBRS technique, and they all are in constraint-based category (7,9-11).

Traditionally, recommender systems, which deal with applications, have two entities: users and items. They do not take into account the context when providing recommendations, while CARS focuses on context, e.g. time and place (6).

Out of the selected papers, Oh et al proposed CARS for well-being care applications, and Lim et al and Farrell et al in two separated studies discussed the development of a wellness recommender system. The wellness recommender system helps users to find and adapt suitable personalized wellness treatments based on their individual needs (12-14).

Runo et al developed a menu recommendation system according to CFRS technique (15). A CFRS is the simplest and original technique of recommender systems, and suggests items to the active user that other users with similar preferences liked in the past (6).

In a study by Mika et al, they focused on challenges for nutrition recommender systems (16).

From another point, food recommender systems can be considered as two following types: The systems that recommend recipes for healthier meals, and the systems that suggest healthier food items. The first type itself is divided into two categories. The first category uses similarity measures to recommend recipes, which are most similar to the meals that user likes. Similarity measures either calculate according to the ingredients or user ratings. For the second category, both user's likes and dislikes are important, this category focuses more on the user's nutritional needs. The second category does not recommend whole meals. Instead, it suggests some foods to be replaced with some other healthier options (16).

According to our results, four papers used food ontology (7,9,10,12), while four papers prefer to

use artificial intelligent techniques (rule-based reasoning and knapsack algorithm) maybe due to the complexity of the ontology construction(11,13-15). Also, all the selected papers considered cultural, religious and lifestyle factors significantly.

Conclusion

This review revealed that CFRS, KBRS and CARS methods are the most common systems. And artificial intelligence such as knapsack algorithm or rule- based reasoning and semantic web such as food ontology and the combination of both were the most popular techniques applied to develop food recommender systems. Also, food recommender systems focused on cultural, religious and lifestyle criteria.

Conflict of Interest

The authors declare no conflict of interest.

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