Web-Based Decision Support System for School Meal Planning

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ABSTRACT
The prevalence of obesity is on the rise among school children globally and recent reports by several institutions have linked this fact to heightened risk from potential chronic diseases such as hypertension, diabetes, and coronary heart disease. Many elementary school students from lower socio-economic groups are especially at risk. Hence it is important for both parents and school officials to understand the benefits of healthy weight and promote suitable changes to the eating habit of children. Acquiring sufficient and appropriate nutrition during childhood will lessen the risk of nutrition-related health problems and lead to a better quality adulthood. A school meal planner with a recommender option is a helpful tool to allow parents and school to plan a nutritionally balanced meal schedule for children. This paper presents a web-based meal planning decision support system (DSS) for parents and schools to provide suitable dietary meals for elementary school students. A demonstration website for the developed system has been implemented online (http://mealplanner.kyperhub.net).

Keywords: Dietary Guideline, Meal Planner, Nutrition, School Children, Web-Based Decision Support System (DSS)

INTRODUCTION
Malnutrition may be broadly defined as a nutritional state in which there is an imbalance of energy, protein and/or other nutrients. Such deficiency or excess can lead to quantifiable damaging effects on the body form and function, as well as clinical outcome (Stratton, 2007; Meier & Stratton, 2008; Soeters et al., 2008). Over-nutrition, or obesity, implies a positive nutrient balance; whereas under-nutrition results in a negative nutrient balance.

Childhood is an important starting period in life; as a smart and healthy childhood usually brings about high quality adulthood. Therefore, proper meals should be a priority for children both in school and at home. Nowadays, the diet of many children tends to include an inappropriate amount of snack and junk foods. Such diet can lead to obesity (Mauras et al., 2010; Popkin, 2001; Popkin & Larsen, 2004) and may result in an increased risk from many diseases (Mauras et al., 2001; Endocrine Society, 2009). In fact, recent statistics have shown that obesity is on the rise among school children, with those from lower socio-economic groups being at a higher risk (Meier & Stratton, 2008).
There are many potential causes to the improper nutrition problem for children that can be attributed to either home or school. First, many parents are too pre-occupied with work to look after their children constantly and tend to forget about the nutritional value of food. Some of them may cook frozen foods directly from the refrigerator, while others may call the delivery service to save time instead of cooking themselves. Another problem is that parents usually do not know what their children consumed at school; so it is difficult to balance the nutritional requirements. Second, in many schools, especially in developing countries like Thailand, the cafeteria usually prepares the same menu over and over again. The cooks likely are not concerned with offering a variety in the menu and they tend to lack nutritional knowledge in general. So they cannot evaluate the nutritional needs of each meal. An additional factor is that schools have limitation of budget, so they cannot provide high quality food for their students in every meal.

Appropriate consumption of food by following a suitable nutritional guideline is a good way to improve children’s health. Since children have fast body development, insufficient nutrients can be the cause of a slow-down in their growth rate. Such malnutrition could lead to retardation in the development of their bones, muscle and brain.

To address the aforementioned needs, this work presents a web-based school meal planning system that is especially suitable for elementary school students in Thailand. Moreover, a school can realize savings in both money and time by planning meals in advance before the actual cooking. Such practice could benefit raw material procurement as well as cost and inventory control. In addition, the school and parents would know all the ingredients of all food items and the nutritional value of each meal. Furthermore, they can follow the food instructions from the web-based system to prepare each meal as well. This application should help the school and parents to manage the meal plan with balanced nutrition for its students and children, respectively. A summary of the total nutritional value is also made available for convenience and archival purposes.

The organization of the rest of the paper is as follows. We show the relevant previous works. We present the analysis and design for the web-based decision support meal planning system. This is followed by a description of the basic meal planning functions. Then a summary of the developed system is given in the last section.

LITERATURE REVIEWS

Nutrition is described as the change process of nutrients in response to metabolic and physiologic need of the body. Nutrients are chemical compounds obtained from food and can be divided broadly into six groups: protein, carbohydrate, fat, vitamins, minerals, and water. Planning nutritionally balanced meals can be quite complex and challenging. Thus computers have been used for menu planning ever since the development of high-level computer languages in the 1960s (Balintfy, 1964). More recent web-based developments include DietSite, DietPal (Noah, Abdullah, Shahar, Abdul-Hamid, Khairudin et al., 2004), and MenuGene (Gaál, Vassányi, & Kozmann, 2005). However, these tend to be personalized dietary meal planning tools and not easily adaptable to school meal planning.

According to an earlier research (Behrman, 1996), much effort has been undertaken in many developed countries to assist teachers, policymakers, and food caterers to mandate improved nutrition in meals served at school cafeterias, ranging from primary to university level institutions. Also, it has been reported that there is good correlation that health and nutrition lead to overall educational success.

In Thailand, the Royal Mandate of School Lunch Fund Act 1991 was established by the government to address the food and nutrition needs of school children (Chittchang, 2009). The objectives of the National School Lunch
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