INTERNAL MEDICINE

A Customized Online Nutrition Guidance System Is Effective for Treating Patients with Nonalcoholic Fatty Liver Disease by Supporting Continuity of Diet Therapy at Home: A Pilot Study

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Abstract

Continuity is required for diet therapy, but it depends on patients. We examined the utility of a new tool, the customized online nutrition guidance system, in patients with nonalcoholic fatty liver disease (NAFLD). Seven patients plotted their body weight (BW) and marked a customized task card on completion for 90 days on a website. The instructors encouraged them by e-mail. BW, serum transaminase levels, and system usage were evaluated. The results showed that BW and serum alanine aminotransferase levels were significantly lower than at baseline. BW and task visualization as well as encouragement by e-mails were effective in ensuring continuity. Thus, this system is effective in keeping NAFLD patients motivated to continue their diet therapy.

Key words: diet therapy, NAFLD, online system, continuity, cognitive behavior

Introduction

Nonalcoholic fatty liver disease (NAFLD) is defined as fatty liver detected by imaging or histology not associated with alcohol intake, medications, or hereditary disorders but with a metabolic syndrome such as obesity, insulin resistance, dyslipidemia, and hypertension. NAFLD is divided into nonalcoholic fatty liver (NAFL) and nonalcoholic steatohepatitis (NASH). NAFL is hepatic steatosis without inflammation and has little risk of progression, but NASH involves hepatic steatosis, inflammation, and fibrosis and can progress to liver cirrhosis and hepatocellular carcinoma (1). The prevalence of NAFLD is around 20%, and that of NASH ranges from 3% to 5% (2). Several serum makers or clinical scores have been reported to be useful for distinguishing NAFL and NASH (3, 4); however, only a pathological diagnosis (liver biopsy) is generally accepted for differentiation.

The anti-oxidant vitamin E and the insulin sensitizer pioglitazone are reported to be effective against NAFLD, but their long-term safety, especially for pioglitazone, are not well understood (5, 6). Although clinical trials of several new drugs, including farnesoid X receptor agonist and PPARα/δ agonist, are ongoing (7, 8), there is no curative drug treatment for NAFLD at present. Because NAFLD is associated with metabolic syndrome, diet therapy has been shown to be effective (9-11). Indeed, most patients with NAFLD have room for improvement in their lifestyle; however, they often lack the motivation to continue diet therapy at home (12). Furthermore, the continuity of diet therapy depends on each patient, because the instructors cannot support diet therapy when the patients are at home.

To encourage the continuity of diet therapy at home, we launched an industry-academia joint study to examine the utility of a new tool, the "customized online nutrition guidance system," in patients with NAFLD. Briefly, each patient plots their body weight every day and records their food in-

take on a graph for 90 days on their personal webpage in this system. In addition, the patients also check their customized task card when they have completed their tasks. The patients' instructors then analyze the card and encourage the patients by e-mail every 10 days. This system also includes an automatic customized comment generator that offers comments based on the lifestyle data plotted by each patient. The instructors slightly modify these comments and send customized comments to the patients by e-mail.

We investigated the utility of this customized online-nutrition guidance system among patients with NAFLD to determine how helpful it was in encouraging the continuity of diet therapy at home.

Case Report

Study overview

We performed a prospective, single-arm, interventional study to examine the effect of customized online nutrition guidance system on patients with NAFLD. This study was performed at Juntendo University Hospital, Tokyo, Japan, from November 2013 to March 2015. The study protocol was approved by our Institutional Review Board. All of the patients enrolled in this study provided their informed consent.

Patients

Seven patients with clinically diagnosed NAFLD (4 men, 3 women; average age: 57.7±1.5 years) were included this study. NAFLD was diagnosed by ultrasonography or computed tomography. Subjects were excluded if they had alcohol intake of >30 g/day for men and >20 g/day for women or had other liver diseases, including viral hepatitis, autoimmune liver disease, drug-induced liver disease, and hereditary disorders. All patients had been already instructed to start diet therapy at the outpatient clinic and were followed up over 1 year by their attending physicians.

Study design

The customized online nutrition guidance system is a new tool for encouraging diet therapy at home developed by Hitachi (Tokyo, Japan) (Fig. 1A). We held an orientation for each patient regarding how to use this guidance system at Juntendo University Hospital, Tokyo, Japan. Before participating in the study, patients were asked to list and describe the tasks that they planned to perform for weight loss. To select the tasks, we prepared several task cards, called "100-kcal reduction cards" (Fig. 1B). These cards showed that if the patients reduced the specified amount of the food or performed the exercise recommended on each card, they could cut or burn 100 kcal. The patients chose several tasks that they expected to be able to accomplish during the study. Selecting task cards for customization is one of the characteristics of this guidance system (customized task card). As the study proceeded, they marked each listed task when completed. Following registration, each patient was granted access to this system at home (https://www.harasuma.com/hal/). After logging into their personal website on this system, each patient plotted his or her body weight every day and recorded food intake and behavior on a graph for 90 days.

The patients' physicians (primary or non-primary) served as their instructors and checked all information, sending follow-up e-mails every 10 days. The comments in the e-mails were encouraging or praising the patients rather than warning or advising. This guidance system automatically searched for some good points in every 10 days (e.g., decrease in weight, use of task cards several times, etc.) and made customized comments for each patient (customized comment generator) (Fig. 1C). The instructors then modified the comments and sent them by e-mail to the patients, thereby enabling instructors to save time in writing e-mails. A recommended food menu was attached to this e-mail. Patients could contact their instructors at any time by e-mail. To examine the effect of this system on NAFLD, we evaluated body weight and the serum alanine aminotransferase (ALT), and aspartate aminotransferase (AST) levels before and after this study. In addition, we also measured blood glucose, serum insulin, serum LDL-cholesterol, serum triglyceride, and serum γ-GTP levels. The degrees of serum ALT and AST reflect the inflammation in the liver. The goal was 5% weight loss. Three patients were asked about their food and exercise habits before and after this study. To inquire about these habits, we used a questionnaire (Supplementary Table) based on the recommended questionnaires produced by the Ministry of Health, Labour and Welfare in Japan (http://www.mhlw.go.jp/seisakunitsuite/bunya/kenkou_iryou/kenkou/kenkounippon21/en/). After the study, we sent out another questionnaire to the patients about the usage of this guidance system.

Statistical analyses

The data are expressed as the mean ± standard error of the mean. Statistical differences between the means were determined using t-tests followed by the normality test (Wilk-Shapiro test). p values <0.05 were considered statistically significant.

Patients with NAFLD achieved weight loss and a reduction in their serum ALT/AST levels using the customized online nutrition guidance system at home

To evaluate the efficiency of this guidance system in the patients with NAFLD, we measured patients' body weight before and after the study. The patients' mean body weight significantly decreased from 67.1±3.2 kg to 64.2±3.0 kg (Fig. 2A). Four patients reached the 5% weight loss goal. The average rate of weight loss was 4.1±0.4%. Consistent with the reduction in the body weight, the serum ALT levels were also markedly decreased from a mean of 54.5±3.4 IU/L to 39.0±1.8 IU/L. Serum AST levels showed a decreasing trend from 39.2±3.1 IU/L to 32.7±1.7 IU/L (Fig. 2B). In the historical control group, neither the serum ALT nor AST
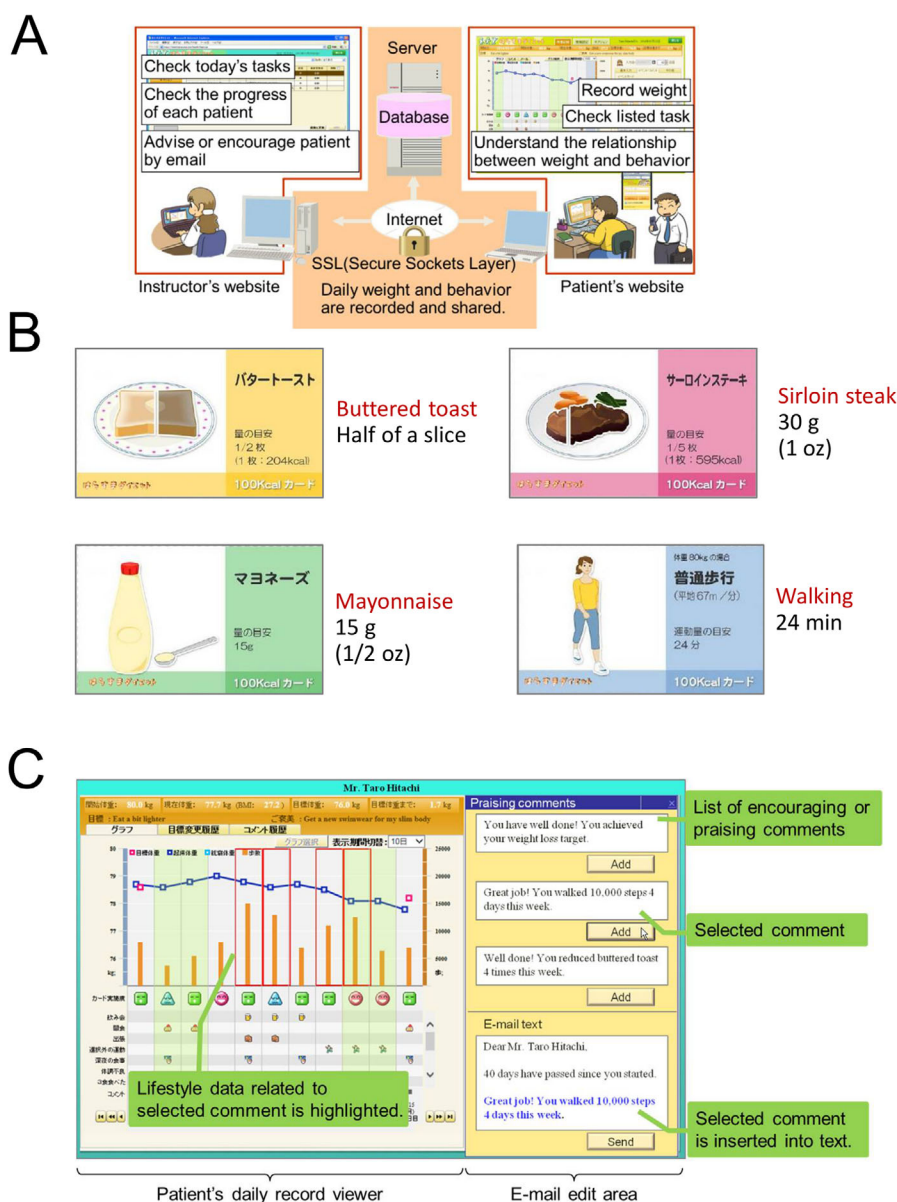
Figure 1. The customized online nutrition guidance system. (A) Overview of the customized online nutrition guidance system. (B) Some examples of 100-kcal reduction cards. (C) Personal webpage on the system and comments automatically generated by this system.

levels were significantly changed (ALT: from 70.1±12.2 IU/L to 64.1±18.3 IU/L, AST: from 48.0±6.1 IU/L to 40.1± 10.0 IU/L). Furthermore, the serum insulin levels were significantly reduced from 14.6±0.9 μU/mL to 9.1±1.3 μU/mL (Supplementary Table 1). These results indicate that customized online nutrition guidance system is effective for treating patients with NAFLD by supporting their diet therapy at home, even if these patients have already been instructed on diet therapy at the outpatient clinic and followed up over one year.

Diet and exercise habits were not altered by the customized online nutrition guidance system

To examine changes in the patients' diet and exercise habits before and after using this guidance system, we asked the patients to answer a questionnaire (Supplementary Ta-

ble 2). Interestingly, the patients had already been taking care of their diet and exercise habits before entry into this study because their scores were above average. In addition, these scores did not change significantly after the study (Fig. 3). These results indicate that before taking part in this study, the patients had already paid attention to what they should do to improve their NAFLD because they had been followed up by physicians for over 1 year; however, it had been difficult for them to continue diet therapy at home even if they knew what they should do.

The customized online nutrition guidance system helped maintain patients' motivation to continue diet therapy at home

To clarify the most effective function of this guidance system, we used a questionnaire asking patients to choose
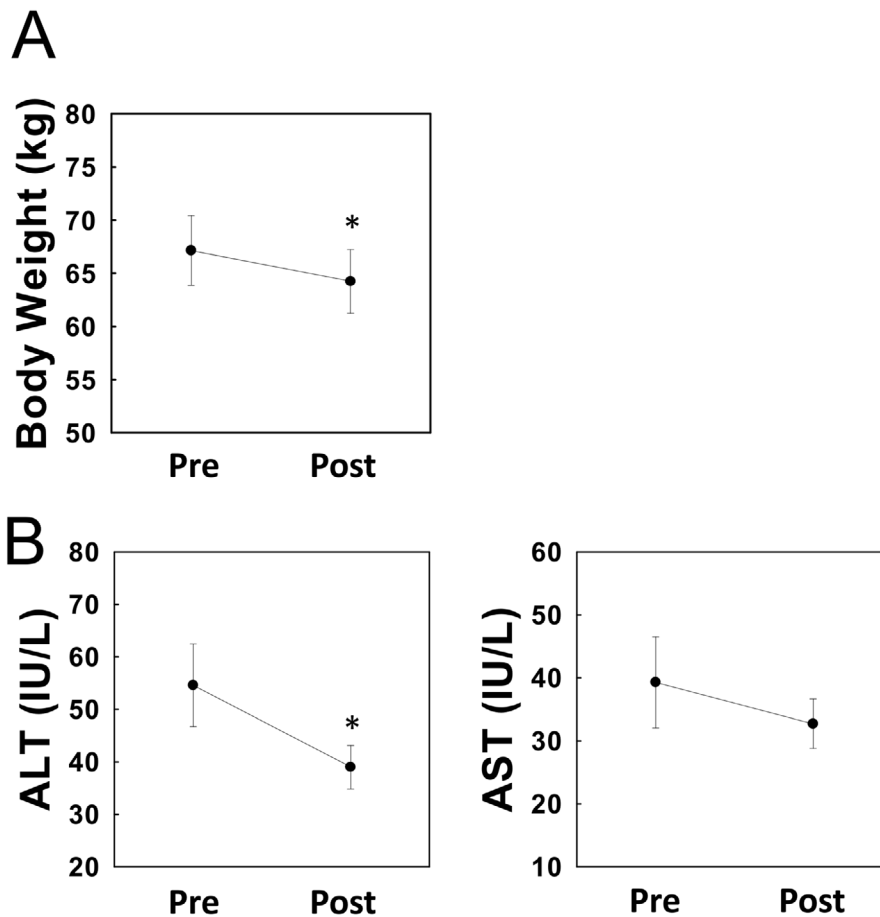
Figure 2. Improvement in non-alcoholic fatty liver disease (NAFLD) by the customized online nutrition guidance system. (A) Body weight and (B) serum alanine aminotransferase (ALT) and aspartate aminotransferase (AST) levels before and after the study. *p<0.05
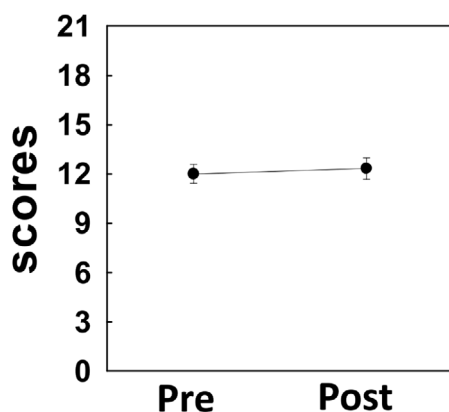

Figure 3. The scores of the diet and habits questionnaire among the participants did not significantly change after using the customized online nutrition guidance system.

one of the following functions: (A) e-mails from instructors every 10 days, (B) body weight visualization on their personal webpages, and (C) customized task cards (100-kcal reduction cards). Furthermore, we also asked the patients to offer any comments about the guidance system in the questionnaire. Two patients said the customized task cards were useful for achieving a concrete indication of diet therapy

(answer choice C). Four answered that plotting their body weight was effective, because they could understand their condition easily and the visualization of their weight encouraged them to continue diet therapy (answer choice B). Although e-mails sent by instructors were not the most popular function of the system, all of the patients stated that the encouragement of the instructors by e-mail motivated them to continue the diet therapy at home. However, no patients sent e-mails to the instructors asking any questions about their diet therapy during this study. In addition, they did not mention the usefulness of the recommended food menu sent by the instructors in their e-mails. These results suggest that the main problem with diet therapy at home in patients with NAFLD is not the methodology but continuity. The functions of this guidance system can simultaneously monitor patients unobtrusively, help them understand their condition, and contribute to their motivation.

Discussion

We examined the utility of a new tool, the customized online nutrition guidance system, in NAFLD patients as part of an industry-academia joint study. We found that the use of this guidance system during diet therapy at home can help

reduce body weight and serum ALT/AST levels in these patients. Notably, even if the patients were already on diet therapy, had been followed up by physicians over 1 year, or had scored above average in the food and exercise habits questionnaire, they achieved a reduction in their weight and serum ALT/AST levels with this guidance system. Furthermore, after analyzing the questionnaires comprehensively, we concluded that "continuity" was more important than the therapeutic methods in achieving success with diet therapy at home in patients with NAFLD. This continuity was strongly supported by cognitive behavior with body weight visualization, encouragement by instructor's e-mails, and explicitly showing tasks for weight loss in this guidance system. Initially, we expected the patients to send many e-mails to the instructors, causing the instructors to become swamped with e-mails. However, no patients sent e-mails to the instructors during this study. Because the patients established their tasks (selecting 100-kcal reduction cards) for the diet therapy by themselves at the beginning of the study and because their diet and exercise habits scored in the upper middle range, we supposed that the patients understood easily what they should do during the study.

The small number of participants is a problem in this study; however, we as instructors should consider why the number of participants was so small. We stepped up efforts to ask patients to join the study, but the patients hesitated to take part because they did not want to be monitored every day and found plotting their bodyweight/behavior annoying. This hesitation may have been caused by a misunderstanding with respect to diet therapy. Because continuity of diet therapy mostly depends on the patient's motivation, if a patient doesn't continue diet therapy, they may feel that they are lazy. This study shows that we as instructors should make ourselves available to patients during diet therapy at home in order to support their continuity, thereby encouraging success with diet therapy. Patients need their instructors' support to continue diet therapy at home. Furthermore, as an eligibility criterion, the patients had to participate in an orientation, and it took over 1 hour to register them in the guidance system, as listing their tasks was a bit time-consuming. We are now modifying this registration system to accelerate the process.

This study showed that instructors should highlight the efficacy of diet therapy for patients with NAFLD and focus not on the methods but on continuity of the weight loss plan. As the patients did not ask questions about the diet therapy, the instructors may rightfully conclude that encouragement and praise are more effective than advice for these patients in the diet therapy. Indeed, the patients selected their tasks by themselves at first, and they reported that visualization of their body weight was effective in encouraging continuity with the diet therapy.

Cognitive behavior therapy is a psychological treatment method based on helping patients understand what is happening with them and supporting their behavior. Some studies have shown that cognitive behavior therapy is effective

against obesity, diabetes, and NAFLD (13-15). This guidance system can help patients understand their behavior and stay motivated by gentle monitoring in the form of e-mails from the instructors. In addition, a bond was developed between the patients and instructors using this guidance system. Focusing on "continuity" and using information technology could change diet therapy at home in patients with NAFLD. This guidance system also has the potential to support diet therapy for patients with other diseases that are related to metabolic syndrome.

In conclusion, the customized online nutrition guidance system led to weight loss and decreased serum ALT/AST levels in patients with NAFLD. To successfully treat patients with NAFLD by diet therapy at home, we should focus not only on dietary habits and methodology but also on continuity of the weight loss plan. This system is a new tool that may be effective for treating patients with NAFLD by encouraging them to stay motivated while undergoing diet therapy at home.

The authors state that they have no Conflict of Interest (COI).

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