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Special Feature Article

Outpatient Use of a Dietary Management Smartphone App for Eating Disorders

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Abstract

A wide range of therapeutic issues need to be addressed in the outpatient treatment of eating disorders. Psychotherapy for psychological problems, advice on social activities such as school and work, psychoeducation about eating disorders, and the management and treatment of comorbid psychiatric and physical problems are necessary. In addition, it is important to provide therapeutic dietary guidance for eating behavior abnormalities. However, it is difficult to understand patients' dietary status, which is important for appropriate dietary guidance. The dietary diary, which is often used in outpatient clinics to monitor patients' symptoms and diet, does not provide the attending physician with a detailed and accurate picture of a patient's actual dietary situation within a short consultation time. Moreover, if the information is incorrect, guidance may even be inappropriate. Patients are expected to make daily efforts to improve their dietary habits even as they are at the mercy of their symptoms. If they do not trust treatment and guidance, are unaware of their recovery, or feel isolated when support is not available, it is more difficult for them to stay motivated. This may lead to dropouts that worsen their prognosis.

To address these clinical issues, the authors developed "TABEKATSU-CHAN", a smart-phone app for managing the eating habits for patients with eating disorders. This app allows patients to record detailed information about their meals and other daily

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activities together with photographic images. The app also has a function to enable patients to engage in activities as planned to maintain regular eating habits, as well as a function to receive periodic psycho-educational materials. By means of this facility, the therapist can share the patient's records instantly through the management tool and can also comment on their records. Since January 2021, patients attending our clinic have been encouraged to use this app. We believe the app is useful for the attending physicians to accurately understand the dietary habits of their patients and to provide dietary guidance. In addition, the communication between the attending physician and the patient through the comment function of this app likely contributes to a good therapeutic relationship. We hope that this smartphone app will further evolve into a tool that not only shares information between doctors and patients, but also encourages a more meaningful mutual connection between them.

Keywords: eating disorders, smartphone app, eating habits, outpatient, dietary diary

Introduction

The therapeutic challenges addressed in the treatment of eating disorders are both wide-ranging and numerous. First, as part of psychiatric treatment, it is important to provide specialized psychoeducation regarding the characteristic pathologies and cognitive patterns of eating disorders, while also improving underlying psychological issues through psychotherapy. This requires adjustments to relationships with family and friends, as well as to school or work commitments. Furthermore, appropriate judgment is required regarding the treatment of patients with comorbid mental disorders such as depression, anxiety disorders, and obsessive-compulsive disorder. Second, various physical issues, such as low body weight and physical complications associated with anorexia, should be managed and treated as appropriate. This involves collaborating with medical departments to conduct tests, and in severe cases, hospitalization must be considered. Third, therapeutic interventions targeting overall daily activities are also crucial. Patients often struggle to determine how to modify not only the amount and manner of their eating but also their sleep patterns and other activities. Therapists must accurately identify the issues in the patient's daily activities and repeatedly provide specific advice and guidance to help them resume regular eating habits.

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Treatment for patients with eating disorders is a challenging process. They must commit to treatment with patience for several months to years to normalize their eating habits and recover physically and mentally; however, fear of weight gain and feelings of frustration stemming from an inability to control eating behaviors, such as binge eating, can lead to discontinuation of outpatient treatment. To ensure the continuation of this challenging treatment, it is essential for the therapist to accurately understand the patient's issues and provide appropriate treatment and guidance, and for the patient to maintain trust in the therapist and a willingness to cooperate with treatment.

The authors have developed "TABEKATSU-CHAN," a dietary management smartphone app designed to assist with managing and recording dietary habits, and recommended its use to patients with eating disorders undergoing outpatient treatment. Although use of the app was discontinued in December 2023, this article introduces our efforts to monitor patients' dietary habits and provide dietary guidance through it.

I. Assessment and Management of Dietary Habits

Regarding psychotherapy for adults with anorexia nervosa, the UK NICE guidelines (2017) recommend cognitive behavioral therapy, the Maudsley model of anorexia nervosa treatment for adults (MANTRA), and specialist supportive clinical management (SSCM) as evidence-based treatments.[1)3)] Each of these psychotherapies has its own theoretical framework and therapeutic techniques, and there are differences in the content and flow of each session, as well as in the duration and frequency of sessions. However, what they have in common is that they address psychological issues influencing eating behavior by focusing on the thought patterns, interpersonal relationships, and emotions specific to patients with eating disorders. Furthermore, all of these psychotherapies share the view that regaining regular eating habits and improving the nutritional status are essential for recovery. In cognitive behavioral therapy (CBT), self-monitoring, such as keeping a food diary, is recommended as part of efforts to gain control over eating behaviors.[2)]

However, guided self-help is encouraged as the first stage of treatment for patients with bulimia nervosa.[3)] This is a method in which the therapist guides the patient's own efforts to manage their symptoms. The therapist does not need to be a specialist in eating disorders, and this approach is recommended prior to more intensive treatments, such as CBT. Guided self-

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help has been instrumental in patient recovery, with Japanese translations of British textbooks and simple workbooks now available.[4)6)] Through this approach, patients gain a thorough understanding of their illness and learn about the nature of their symptoms through symptom monitoring, enabling them to explore and attempt strategies to address their eating behavior issues. Furthermore, they are encouraged to maintain a regular daily routine and pay attention to managing their daily activities.

In Japan, while the number of medical institutions implementing these specialized treatments for eating disorders is limited, many general psychiatric clinics have long provided advice and guidance for symptom improvement based on the therapist's understanding of the patient's dietary habits. The Department of Neuropsychiatry, Osaka Metropolitan University Hospital (hereinafter referred to as "our department") has long utilized dietary diaries to assess patients' eating habits. These are forms in which patients record their usual meal contents and times, along with sleep and other daily activities. In addition to serving as a tool for patient self-monitoring, we also use these diaries to help clinicians understand each patient's daily life. The effectiveness of record details depends on the patient's level of motivation for treatment, as well as their meticulousness and diligence. However, even if a patient provides detailed entries, there are limits to what a clinician can grasp about dietary habits based solely on written records during a brief outpatient visit; misinterpretation could lead to inappropriate guidance.

II. Dietary Recording via Smartphone Apps

In recent years, smartphone apps designed to track dietary habits have been released successively. Many of these are intended for weight management, such as dieting. Some apps assist with self-management by tracking weight, meal content, calorie intake, and exercise, while others offer services where dietitians provide advice based on the recorded data. Some outpatients attempt to communicate their dietary intake by showing their attending physician photos of meals recorded in these apps; however, it is difficult to fully convey daily dietary habits in this manner. Furthermore, there is concern that the detailed tracking of weight and calorie intake offered by these apps could lead patients to adopt pathologically strict numerical goals. While meal management apps for patients with eating disorders exist overseas, their efficacy and safety have not yet been sufficiently demonstrated,

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and they do not meet the specifications generally available in Japan.[5)]

In light of these challenges, the authors developed "TABEKATSU-CHAN," a smartphone app designed to support the recording and management of meals and daily activities for patients with eating disorders. From January 2021, among eating disorder patients attending our department, this app was used in place of traditional food diaries as an attempt to monitor patients' dietary habits. Patient consent for app use was obtained via the app itself. The app was used in an observational study conducted by the Department of Neuropsychiatry, Osaka Metropolitan University Hospital, following approval from the Osaka Metropolitan University Ethics Committee for Medical Research. Please note that service for this app ended in December 2023.

III. Features of the Dietary Record and Management App "TABEKATSU-CHAN"

Patient users of this app enter data on various items, including various records and self-assessments regarding their dietary habits; they can also communicate with their attending physicians and other support staff, review educational materials about their condition, and have questions answered (Table 1). The main features of this app, developed for the purpose of recovery from eating disorders, are shown below (Figure 1).

1. Detailed recording of meals and activities

Detailed recording of daily activities is the central function of this app. For patients with eating disorders to comprehend their own problematic eating behaviors and consider strategies for improvement, it is important to first understand their dietary habits objectively. One of the app's strengths is the ability to record meals with photos. Before eating, users rate the time, meal context (location and who they are eating with), and their pre-meal mood and physical condition, and then take and upload a photo of the meal they are about to eat. After eating, they indicate what percentage of the meal they consumed, provide a self-assessment of the amount eaten, and evaluate their post-meal mood and physical condition. If the user overeats or vomits, they can check the corresponding box, and in the free text field, they can record their thoughts and feelings regarding each meal entry. This logging feature is not limited to meals; it allows users to categorize and record various daily activities, such as sleep, work, school, studying, hobbies, housework, exercise, outings, bathing, and other activities. Each activity log

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can be displayed on the app screen in either a list or timetable format, making it easy to review later.

Additionally, the app includes a feature that prompts users to reflect on the day and provide an overall evaluation at the end of each day. In addition to a comprehensive evaluation of the day, daily rhythms, and a numerical rating of meals, users can self-assess and enter how they felt about their total food intake for the day. Furthermore, users can record the number of episodes of binge eating or vomiting, number of laxative tablets taken, and frequency of bowel movements.

2. Evaluation and comments on records

In the treatment of eating disorders, patient dropout is often a significant issue. For patients to overcome the psychological conflicts that arise during the recovery process and persistently strive to change their eating habits, it is considered crucial that they feel they are being watched over and supported by their therapists, family, or other supporters, and that they do not feel psychologically isolated.

Therefore, this app includes a feature that allows patients to communicate with users who support their dietary management (support users). Support users can send comments on each of the patient's dietary records or a "Like" icon to show approval, and patients can reply to these. The system is designed so that support users can view the patient's records only if the patient grants permission; sharing records or communicating with others is restricted. Currently, this app limits support users to medical professionals such as the patient's attending physician, nurses, and psychologists, but we are considering expanding this to include family members and other supporters in the future. Interaction with supporters is expected to provide patients with a sense of security and encouragement.

3. Activity schedule

To restore a balanced diet and prevent or reduce overeating, it is important to maintain a regular daily rhythm. A lifestyle with reversed day-night cycles inevitably leads to irregular eating habits, and meals at unusually early or late times, as well as irregular intervals between meals, are also undesirable. It is advisable to establish a schedule based on three meals a day, set fixed times for sleep and wakefulness, and plan daily tasks and hobbies. This app allows users to enter detailed schedules for daily activities. By consciously following the pre-determined plan as much as possible, patients strive to establish appropriate daily rhythms and eating habits. Schedules and completed activities are displayed as

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lists or a timeline on the app's main screen, allowing for constant monitoring. The app is designed to support patients in maintaining a regular lifestyle, such as by allowing them to record whether they were able to follow their plan by overwriting each schedule entry.

4. Educational materials on eating disorders

A thorough understanding of the illness is essential for recovery from an eating disorder. To help patients clarify the challenges they need to address, there is much to understand, including the background and maintaining factors, pathological cognitions regarding weight and body shape, physical effects of the illness, and things to try for improvement. With this app, patients can receive all 16 educational materials on eating disorders listed in Table 2 on a regular basis over approximately six weeks. The goal is for patients to deepen their understanding of the illness by reading these materials and writing down the content that applies to them and their thoughts.

IV. Management Tools for Supporters

The records in this app contain a vast amount of information, including patients' daily meals and eating habits. To enable therapists and other support users to efficiently and accurately grasp this information through the app, a dedicated management tool for support users is necessary. Recorded data entered into the app are immediately stored on a server. The management tool for support users retrieves these encrypted data, allowing them to constantly monitor the patient users' records, and they are viewed on Internet-connected computers or tablet devices. The large screen facilitates the display of a wide range of recorded information in a single view. For example, a week's worth of recorded meals can be displayed side-by-side on a single screen with accompanying images, or activity logs can be presented as a timetable to confirm daily rhythms (Figure 2). Additionally, recorded data can be visualized as graphs, which aids in the patient's self-assessment and tracking changes in symptoms over time. Furthermore, a smartphone version of the management functions is available for support users, providing them with immediate notifications of the patient's records. This is considered useful for reducing the burden on healthcare providers when communicating with patients.

V. Utilization of the App in Outpatient Care

In our department's eating disorder outpatient clinic, we have been working on an attempt in which attending physicians share patients' dietary

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records via this app. Patients record their daily dietary habits in the app, and their attending physicians review them as needed. However, treatment itself is conducted face-to-face during outpatient visits and cannot be performed via the app. During outpatient visits, we review and evaluate dietary records displayed on a monitor while discussing treatment goals and providing guidance for improvement. Since we began using this app, we have been able to assess patients' conditions outside of scheduled appointments. For attending physicians, the benefits include the ability to gain a detailed understanding of patients' symptoms and daily life challenges, as well as the reduction of time spent on lifestyle assessment within the time-constrained outpatient setting. Furthermore, communication with patients via this app is considered to have contributed to maintaining a positive therapeutic relationship and ensuring treatment continuity. However, managing patients outside of clinic hours can place a burden on the attending physician, so certain rules regarding record review are considered necessary.

VI. Examples of Guidance and Communication Based on App Records

Various aspects of outpatients' dietary habits were identified through records in this app. For example, the timetable view of activity logs clearly revealed dietary patterns in a patient with bulimia nervosa: binge eating frequently occurred on the evening before a day off following consecutive workdays; if the patient did not binge on that evening, they would binge the following morning; and on days when they went out, they did not binge but ate less during the day, leading to binge eating at night. Furthermore, by graphically visualizing the trends in binge-eating frequency, we confirmed that this habit increased during periods when the patient's workplace relationships deteriorated. Additionally, in another patient with anorexia nervosa, it became clear that on days when food intake was low, sleep duration was shorter, and if lunch was delayed beyond the scheduled time, the patient would skip dinner entirely. While some patients were already aware of their own eating patterns, others only realized them after they were pointed out. In this way, visualizing dietary information often helped the attending physician identify problems in the patient's eating habits and discuss measures during consultations to reduce risks leading to eating behavior abnormalities.

Furthermore, the attending physician's comments on the patient's dietary records sometimes encouraged

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the patient to eat. One patient wrote about feeling anxious while visiting a café with a friend in the app, but after reading the attending physician's comment, she found the courage to eat cake for the first time in a long while. She explained that her intention to enjoy the conversation with her friend helped alleviate her fear of food. This was an example of how immediate communication between the attending physician and patient led to appropriate behavior.

VII. Survey on App Usage

In August 2021, we conducted an anonymous online survey of patients using the app. The survey participants were female patients with eating disorders currently receiving treatment at our department, and we received responses from 30 individuals. Ninety percent of respondents had experience using paper-based dietary diaries before using this app. Regarding the app's use, 40% of respondents answered "I agree" and 46.7% answered "I somewhat agree" when asked if they could "accurately record their meals," indicating that the majority evaluated it positively. Additionally, 66.7% of respondents gave a positive evaluation when asked if the app had made it "easier to recognize problems with their eating habits." Furthermore, 80% of all respondents stated that they "would like to continue using the app in the future." While the app received generally favorable evaluations from patient users, 46.7% reported that "recording meals is a hassle," indicating that the app has not yet fully addressed the fundamental inconvenience associated with dietary logging. It is therefore considered necessary to pursue improvements in usability, such as enhancing input methods and other operational features of this app.

Conclusion

Having patients with eating disorders record their daily meals and daily activities in this app not only helped them self-monitor their symptoms but also assisted their attending physicians in gaining a more accurate understanding of the patients' symptoms and living conditions. This, in turn, is considered to have led to more appropriate dietary guidance during outpatient visits. Furthermore, the daily meal images recorded in this app by patients with eating disorders were refreshing even to the authors, who have long treated patients with eating disorders, and provided many new insights. As one might expect, we realized that even among patients with similar eating disorders, the appearance of the dining table and content of meals vary widely, reflecting each household's eating habits,

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environment, and family preferences. One patient's "usual meal" differs from the "usual" of other patients or households, and consequently, their path to recovery and goals are also different. Furthermore, from photos showing just a small portion of rice or a dining table cluttered after a binge, we felt we could sense the patients' daily efforts and struggles. As attending physicians, we gained a deeper understanding of the patients' situations and reaffirmed that what patients need is practical, concrete guidance tailored to their specific circumstances. Furthermore, the authors' desire to support the patient was reflected in the comments sent in response to the patient's records. These may have had a modest positive impact on the therapeutic relationship between the patient and their attending physician.

Smartphone apps are expected to see an ever-widening range of applications in medical and healthcare fields in the future. However, we must also be mindful of how such technology is utilized within the context of mental health care. Particularly in psychotherapy, which deals with psychological issues, communication should be conducted using words imbued with human warmth. While this app has evolved into a tool that provides psychological support to patients while exploring more efficient and effective approaches to recovery through information-sharing using digital technology, we believe that it remains crucial to establish a stable system for providing such apps in the future.

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図１　食生活記録・管理アプリ「たべ活ちゃん」の画面表示例（一部加工）

Figure 1: Example screen display of the dietary management app “TABEKATSU-CHAN” (partially edited)

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図 2　管理ツールの画面表示例（一部加工）
睡眠，食事，家事，仕事，趣味，外出，運動，入浴でそれぞれ活動は色分けされ表示されている．

Figure 2: Example screen display of the management tool (partially edited)
Activities are color-coded and displayed for sleep, meals, housework, work, hobbies, outings, exercise, and bathing.

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表１　食生活記録・管理アプリ「たべ活ちゃん」への入力情報

●患者ユーザーの入力項目	
食事の記録	摂取する食事画像（朝/昼/夕食，間食など） 食事開始/終了時刻，食事環境・状況，食前・後の気分や体調，食事摂取量などの自己評価点，嘔吐の有無など
食事以外の活動記録	生活活動（睡眠，運動，趣味，就労，就学など）の開始/終了時刻
食行動異常の記録	過食回数，自己誘発性嘔吐の回数，下剤服用錠数
毎日の自己評価	自己評価点（食事，生活リズム），自由記載（1 日の感想など）
活動スケジュール	翌日の（食事，睡眠，その他）活動予定
教育資料への回答入力	定期配信される教育資料に関する質問への回答や感想など
治療・支援者との連絡	支援ユーザからの各活動に対する評価やコメントに返信

Table 1: Information entered into the dietary management app “TABEKATSU-CHAN”

● Input Items for Patient Users

Meal records

Images of meals consumed (breakfast, lunch, dinner, snacks, etc.)

Start/end times of meals, meal environment and circumstances, mood and physical condition before and after meals, self-assessment scores for food intake, presence or absence of vomiting, etc.

Records of activities other than meals

Start/end times of daily activities (sleep, exercise, hobbies, work, school, etc.)

Records of eating behavior abnormalities

Number of binge-eating episodes, number of self-induced vomiting episodes, number of laxative tablets taken

Daily self-assessment

Self-assessment scores (meals, daily rhythm), free text (daily reflections, etc.)

Activity schedule

Planned activities for the following day (meals, sleep, other)

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Input of responses to educational materials

Answers to questions and reflections regarding regularly distributed educational materials

Communication with therapists and support staff

Replies to evaluations and comments from support staff regarding various activities

表 2 「摂食障害患者のための教育資料」目次

1．摂食障害とは？
2．社会・文化からの影響
3．肥満とやせのイメージ
4．体重のふしぎ
5．薬で体重はコントロールできる？
6．よい運動と間違った運動
7．ダイエットの落とし穴
8．身体をむしばむ摂食障害
9．飢餓は人を変える―飢餓実験より―
10．摂食障害はあなたのこころを変えた？
11．食べ物のことで頭がいっぱい
12．身体計測があなたに教えてくれること
13．過食・嘔吐サイクルに陥らないために
14．摂食障害をやっつけよう
15．栄養バランスと正しい食事
16．骨を健康に

Table 2: Table of contents for “Educational Materials for Patients with Eating Disorders”

1. What Are Eating Disorders?
2. Social and Cultural Influences
3. Perceptions of Obesity and Thinness
4. The Mystery of Weight
5. Can Medication Control Weight?
6. Good vs. Bad Exercise
7. The Pitfalls of Dieting
8. Eating Disorders That Erode the Body

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9. Hunger Changes People—Lessons from Hunger Experiments
10. Has an Eating Disorder Changed Your Mind?
11. Obsessed with Food
12. What Body Measurements Tell You
13. How to Avoid Falling into the Binge-purge Cycle
14. Let's Beat Eating Disorders
15. Nutritional Balance and Proper Diet
16. Keeping Your Bones Healthy

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