Mobile Engagement Behaviors Associated with Sustained 15% Weight Loss

Ann Lih¹, Rojin Safavi², Zariyah Isaq¹, Shery Haller¹ and Mohammed Bailony²

¹Enara Health, 1650 S. Amphlett Blvd, Suite 115, San Mateo, CA 94402, USA
²University of California, Santa Cruz, California, USA

Abstract

Background: This study aimed to report weight loss outcomes and evaluate behaviors of high performing participants who achieved ≥ 15% weight loss at 6 and 18 months in a precision medicine weight loss program, which incorporates clinical visits, a mobile application (mHealth) and tailored nutritional programming.

Methods: A retrospective analysis was performed on participants, aged ≥ 18 years with BMI ≥ 25 kg/m², who enrolled in Enara Health’s weight loss program from March 1, 2015 to October 1, 2018. Participants were matched into 6 and 18-month cohorts. An analysis characterized high-performing participants who lost ≥ 15% of their starting weight. Behaviors evaluated included: monthly appointments, monthly coaching text conversations, weekly food pictures, percent of educational content completed, weekly weight monitoring, and number of days wearing an activity tracker.

Results: Average weight loss for the 6-month (n = 479) and 18-month (n = 145) cohorts was -12.40% and -13.99%, respectively. 32.57% of participants achieved 15% weight loss at 6 months and 41.38% of participants achieved 15% weight loss at 18 months. High achievers at 6 months had increased monthly appointments (3.05 ± 0.82 vs 2.72 ± 0.92, P < 0.001), weekly food pictures (40.64 ± 27.85 vs 33.61 ± 26.51, P = 0.011), educational activity compliance (60.98 ± 34.48% vs 47.10 ± 34.91%, P < 0.001) and weekly weights (3.11 ± 2.28 vs 2.55 ± 1.97, P = 0.011). High achievers at 18 months attended more monthly appointments (2.12 ± 0.58 vs 1.78 ± 0.70, P = 0.002), engaged in more monthly coaching text conversations (6.92 ± 5.61 vs 4.41 ± 3.65, P = 0.002), and weighed themselves more frequently beyond 12 months (1.92 ± 1.98 vs 1.26 ± 1.64, P = 0.47).

Conclusion: Participants in the Enara Health precision weight loss program lost an average of -13.99% at 18 months. Self-tracking behaviors characterized high achievers at 6 months and increased number of provider-patient touchpoints characterized high achievers at 18 months. Mobile health applications may be better suited to achieve sustained weight loss by designing features that facilitate provider-patient interactions on top of self-tracking technology.

Keywords
mHealth, Mobile health, Obesity treatment, Weight loss, Behavioural modifications

Introduction
Recent studies have predicted that by 2030 nearly 1 in 2 Americans will struggle with obesity [1]. The exponential growth in incidence rates is correlated to...
an increasing chronic disease burden and decreasing mortality after the age of 40 in this population [2]. Problematically what is often underestimated with respect to this growing epidemic is the difficulty of treatment.

Standalone approaches to obesity, whether economical, behavioral, lifestyle or pharmacological have not been able to demonstrate sustained outcomes. A recurring trend throughout these weight-loss interventions was poor attrition past 6-months [3, 4]. Several studies have shown that both self-tracking technology and programs with multicomponent approaches help reduce attrition in weight loss programs [5, 6]. The opportunity for mobile technology to help deliver and tailor multimodal obesity treatments has been widely explored over the last decade [7-9]. Almost 30% of all mobile health development has focused exclusively or partially on weight loss. We now have approximately 30,000 mobile applications to help with weight loss [10].

Research evaluating the effectiveness of mobile health interventions have demonstrated conflicting findings on whether technology improves weight loss outcomes [11-13]. Some meta-analysis of randomized control trials has found that web-based interventions did not improve weight loss over off-line counterparts [14] while others have found that they do exhibit a modest improvement in results [15-17]. The reason for this conflicting data is largely because mobile interventions are lumped monolithically when in fact they are widely divergent in the type of intervention they each deliver. Each application has varying degrees of self-monitoring, feedback, gamification, social support, and educational features. Current mobile health studies on weight loss have not taken this into consideration and as a result we do not have a good understanding on which features are most effective and in which settings [18, 19] Without a more nuanced examination, decision makers and developers lack information on how to improve mobile weight loss interventions. One study that did examine the impact of varying intervention features within a mobile application found text message based coaching conversation was associated with increased weight loss in females but not in males. This study is the first mobile health (mHealth) study that postulates that a mobile health intervention may need to be personalized by gender [20].

Enara Health is a comprehensive program, delivering behavioral, pharmacologic, and nutritional therapy via mobile and web-based application. The purpose of this study was to evaluate mobile engagement behaviors of high performing participants who achieved ≥ 15% weight loss at 6 and 18 months in a precision medicine weight loss program. The mobile application under study allows for examination and comparison of self-monitoring, feedback, support, and educational features within the same mHealth program. This may shed insight on which features and usage are better for sustained weight loss.

Methods

Study design

This is a retrospective cohort study analysing the mobile engagement behaviors of adults participating in a comprehensive precision weight loss program (Enara Health). Data were collected from the electronic health records of patients who enrolled and started a weight loss journey during the period from 1 March 2015 to 1 October 2018 (with follow-up through 1 April 2019). Enara Health provided the study investigators with all relevant data following de-identification of the entire dataset. The Hummingbird Institutional Review Board (Needham, MA, USA) approved the study protocol and deemed that the study met the requirements for exemption from the US Department of Health and Human Services regulations for the protection of human subjects (45 CFR 46.101[b][4]).

Weight loss program interventions

Enara Health is a medical company based in San Mateo, California, that offers a unique hybrid digital and in-person weight loss program. The Enara Health weight loss program has been operating since March 2015. By combining mobile technology with healthcare visits, the program provides patients with personalized physician-driven medical weight loss plans. Upon enrolment, patients are initially evaluated by a physician or physician assistant who determines the severity of obesity and the patient's readiness to change and performs a full metabolic workup and examination. Patients engage in one-on-one meetings with a registered dietitian on a weekly basis during the first 3 months, once every other week during the next 3 months and then once monthly for 6 months. Patients also see their physician or physician assistant on average once a month for the first 3 months, and then every 3 months thereafter. Patients may conduct their visits either in-person or via face-to-face video communication. There is a monthly fee of $50 for patients with insurance (most insurances accepted) or $300 without insurance.

Between visits, patients utilize a mHealth application, which delivers tailored educational content, messages of encouragement and support, nutritional and behavioral feedback, a review of meals and feedback by a registered dietitian, as well as exercise suggestions, planning and encouragement by a fitness trainer. Messages can be initiated by either patient or providers (physicians, dietitians, fitness trainers). Providers will typically respond within a 12-24-hour window; while it is not a 24-hour on-call messaging service, it allows for sufficient accountability, guidance, and support to patients throughout their week. Providers can also initiate conversations in response key alerts they receive on patients' appointment, exercise, food log, and weight trends. Patients may choose between an intense, rapid weight loss program (daily caloric intake: 800-1,000 kcal) or a non-intensive weight loss program that emphasizes non-processed foods but does not encourage calorie counting. Both options encourage whole, unprocessed, low glycemic foods. Although all participants are assigned a target exercise goal of 150 min week-1, a personal exercise coach determines the duration of exercise based on the patient's physical ability. Many patients utilize activity trackers such as Fitbit® or Apple Watch® to monitor weekly exercise.

Where appropriate, patients are prescribed medications
to assist with weight loss. Prescriptions are driven by the patient’s request after attending an educational visit on anti-obesity medications (AOMs). AOMs are prescribed in accordance with the US Food and Drug Administration-labeled recommendations; however, in the event of non-coverage, generic equivalents are prescribed, and any off-label usage is discussed with the patient. The choice of medication is ultimately made by the patients and their physicians.

Prescribed weight loss medications include lorcaserin, phendimetrazine, diethylpropion, phentermine/topiramate, liraglutide and bupropion/naltrexone. Some patients may be prescribed more than one AOM. Routine follow-up visits with the provider are conducted to ensure that the patient is responding positively to the medication and is not experiencing adverse effects. All patients are started on the lowest dosage of medications, while dose adjustments are made on an individual basis as needed to achieve the desired outcomes.

Study cohort selection

Patients enrolled in the Enara Health weight loss program during the study period, who were aged ≥ 18 years with a BMI ≥ 25 kg/m² at enrollment, were eligible for inclusion. Patients who became pregnant during the study period were excluded from the analyses.

Assignment of mobile engagement cohort

Overall, participants were matched into a 6 and 18 month cohorts so long as their start date indicated that they could have participated in the study duration regardless of their engagement status at that time point. Completers were defined as any participant who logged a home weight ± 30 days from the cohort end date. High achievers were defined as participants who achieved greater than 15% weight loss.

Study data collection

Enara Health collected demographic and clinical data for all study patients at the initial clinic visit. Height, body weight, blood pressure, pulse, and body composition were measured at the first appointment to establish baseline values and then rechecked in the clinic at every in-person appointment thereafter. Body weight was collected daily via the patient’s home scale, which connected directly to Enara Health’s provider dashboard. Mobile engagement data were collected from Enara’s mobile app and included monthly appointments, monthly coaching text conversations, weekly food pictures, percent of educational content completed, weekly weight monitoring, and number of days wearing an activity tracker.

Study endpoints

The primary outcome measurements were total percent of weight lost and percentage of participants who were high achievers defined as those who lost ≥ 15% of their starting weight.

For each mobile engagement behavior in a subgroup, the average (± standard deviation) of the engagement values were calculated. The significance of the average engagement between the subgroups were measured using a t-test. All statistical analyses were performed using Python 3.6. Statistical significance was defined as P < 0.05.

For the 18-month cohort, sustained mobile engagement behavior was defined as behavior averages from months 12-18 within each subgroup. This allowed for exploration and comparison of behavioral markers of success at different time periods throughout a participant’s journey.

Results

Selection of study cohort

Figure 1 shows the distribution and selection of the final study cohorts and high achiever subgroups. Data were obtained for 569 patients enrolled in the Enara Health weight loss program who met the study criteria during the study period. 84% (n = 479) of the 6-month cohort (n = 569) had weight data at the 6-month mark while 56% (n = 145) of the 18-month cohort (n = 261) had weight data at the 18-month mark. 32.57% (n = 156) of participants in the 6-month cohort were high achievers (≥ 15% weight loss) and 41.38% (n = 60) of participants in the 18-month cohort were high achievers (≥ 15% weight loss at 18 months).

Baseline patient characteristics

Table 1 and 2 present the baseline characteristics between the subgroups of the 6-month cohort and 18-month cohort respectively. The mean age was 46 ± 13 years for both cohorts. In the 6-month cohort, high achievers had significantly higher starting BMI (35.90 ± 6.17 vs 34.24 ± 6.30, p = 0.007) and high triglycerides (143.50 ± 79.51 vs 121.34 ± 94.06, p = 0.018). There was no statistical difference between subgroups in the 18-month cohort for any baseline characteristics including anti-obesity medication use which was available for comparison in that cohort.

Comparison of changes in baseline weight in the 6-month cohort and 18-month cohort

Figure 2 and 3 demonstrate average weight loss for the 6-month (n = 479) and 18-month (n = 145) cohorts of -12.40% and -13.99% respectively. Figure 4 shows the percentages of the 6-month cohort and 18-month cohort that achieved 10%, 15% and 20% weight loss. 64.7% and 32.6% of participants
achieved a 10% and 15% weight loss at 6 months. 72% and 41.40% of participants achieved a 10% and 15% weight loss at 18 months.

Engagement characteristics of high achievers at 6-months

High achievers at 6-months attended 11% more appointments (3.05 ± 0.82 vs 2.72 ± 0.92, P = 0.001), took 21% more food pictures (40.64 ± 27.85 vs 33.61 ± 26.51, p = 0.011), completed 29% more educational activities (60.98 ± 34.48 vs 47.10 ± 34.91, P < 0.001) and stepped on the scale 25% more times per week (3.11 ± 2.28 vs 2.55 ± 1.97, p = 0.011) compared to non-high achievers (Table 3). There were no differences in monthly provider text message conversations or the frequency of activity tracking between the two groups.
and participated in 54% more text-based conversations with their providers (6.81 ± 5.90 vs 4.43 ± 3.8, p = 0.009) than non-high achievers (Table 5). When comparing activity from month 12-18 to months 1-12, weekly weigh-ins, educational activity, exercise tracking, monthly appointments, and food logging all dropped substantially while provider-patient text conversations persisted.

### Discussion

The results of our study provide direction in the future of obesity treatment. Our findings are consistent with prior research that show the importance of self-monitoring (in both weight and food intake) and frequent touchpoints with providers on the app for weight loss [21-24]. However, the most significant part of our study is the sustained weight loss we observed at 18-months and the behaviors associated with this long-term weight loss.

Beyond 6-months, we see certain behaviors that were crucial to initial weight loss start to drop off. While educational content and documenting food intake through photos made a significant difference between high achievers and low achievers at 6-months, these behaviors do not make an observable difference between high and low achievers at 18-months. It can be extrapolated that after 6-months, app users have reached a threshold of educational information and are capable of making good nutritional decisions on their own. They are not dependent on the educational modules nor on dietitian feedback on their food photos. These functions on the app become automated in the user’s regular lifestyle and decision making, leading to a lower frequency of these behaviors in the app, while maintaining a similar level of weight loss.

As these behaviors that were essential to driving weight loss at the start of the program become statistically insignificant at the 6-month point, new behaviors emerge as better predictors of long-term weight loss [25, 26]. The difference in behaviors

### Table 4: 18-month cohort-engagement behaviors of subgroups.

| Behaviors                      | ≥ 15% weight loss (n = 60) | < 15% weight loss (n = 85) | P value |
|--------------------------------|---------------------------|----------------------------|---------|
| Number of monthly appointments | 2.12 ± 0.58 (n = 59)      | 1.78 ± 0.70 (n = 85)       | 0.002*  |
| Number of monthly provider text conversations | 6.92 ± 5.61 (n = 60) | 4.41 ± 3.65 (n = 82) | 0.003* |
| Number of weekly food pictures | 25.56 ± 18.57 (n = 59) | 21.12 ± 14.79 (n = 79) | 0.136   |
| Educational content completed (%) | 53.21 ± 34.08 (n = 59) | 50.87 ± 32.25 (n = 78) | 0.687   |
| Number of weekly weigh-ins     | 1.77 ± 1.79 (n = 60)      | 1.22 ± 1.61 (n = 77)       | 0.064   |
| Number of days wearing an activity tracker | 156.89 ± 147.58 (n = 75) | 199.23 ± 174.15 (n = 43) | 0.188   |

Values shown are n (%) or means ± standard deviation for the intention-to-treat population (N = 145). * categories differ significantly from each other at P < 0.05.

### Table 5: 18-month cohort-sustained engagement characteristics.

| Behaviors                      | ≥ 15% weight loss (n = 60) | < 15% weight loss (n = 85) | P value |
|--------------------------------|---------------------------|----------------------------|---------|
| Monthly appointments           | 0.58 ± 0.29 (n = 60)      | 0.51 ± 0.29 (n = 77)       | 0.114   |
| Monthly provider text conversations | 6.81 ± 5.90 (n = 60) | 4.43 ± 3.83 (n = 74) | 0.009* |
| Weekly food pictures           | 15.62 ± 18.37 (n = 59) | 11.48 ± 14.23 (n = 71) | 0.164   |
| Percent of educational content completed | 38.47 ± 37.22 (n = 59) | 35.88 ± 38.74 (n = 70) | 0.702   |
| Weekly weight monitoring       | 1.92 ± 1.98 (n = 60)      | 1.26 ± 1.64 (n = 69)       | 0.047   |
| Number of days wearing an activity tracker | 65.56 ± 114.93 (n = 52) | 91.13 ± 121.84 (n = 47) | 0.292   |

Values shown are n (%) or means ± standard deviation for the intention-to-treat population (N = 145). * categories differ significantly from each other at P < 0.05.

### Sustained engagement characteristics high achievers at 18 months

A sub-analysis of engagement behaviors specifically between months 12 and months 18 showed the high achievers in the 18-month cohort were associated with 52% more weekly self-weigh-ins (1.92 ± 1.98 vs 1.26 ± 1.64, p = 0.047) and participated in 54% more text-based conversations with their providers (6.81 ± 5.90 vs 4.43 ± 3.8, p = 0.009) than non-high achievers (Table 5). When comparing activity from month 12-18 to months 1-12, weekly weigh-ins, educational activity, exercise tracking, monthly appointments, and food logging all dropped substantially while provider-patient text conversations persisted.

### Table 3: 6-month cohort-engagement behaviors of subgroups.

| Behaviors                      | ≥ 15% weight loss (n = 156) | < 15% weight loss (n = 323) | P value |
|--------------------------------|---------------------------|----------------------------|---------|
| Number of monthly appointments | 3.05 ± 0.82 (n = 156)      | 2.72 ± 0.92 (n = 323)       | 0.001*  |
| Number of monthly provider text conversations | 10.37 ± 8.85 (n = 153) | 9.76 ± 8.44 (n = 310) | 0.486   |
| Number of weekly foods pictures | 40.64 ± 27.85 (n = 150) | 33.61 ± 26.51 (n = 306) | 0.011* |
| Percent (%) of educational content completed | 60.98 ± 34.48 (n = 146) | 47.10 ± 34.91 (n = 299) | < 0.001* |
| Number of weekly weigh-ins     | 3.11 ± 2.28 (n = 150)      | 2.55 ± 1.97 (n = 305)       | 0.011* |
| Number of days wearing an activity tracker | 85.93 ± 56.36 (n = 124) | 97.93 ± 56.89 (n = 128) | 0.095   |

Values shown are n (%) or means ± standard deviation for the intention-to-treat population (N = 479). * categories differ significantly from each other at P < 0.05.
between high achievers and low achievers during months 12 through months 18 provide a hint towards what is missing in the current treatment of obesity. We found that successful long-term weight loss was characterized by regular weight-ins as well as initiating more text-based conversations. These two behaviors can be linked to long-term success because of their direct correlation with combating attrition and lack of motivation. Regular weight monitoring provides users with realistic data on their progress and helps patients avoid dramatic weight recidivism [27]. The high volume of in-app conversations emphasizes the important role that a provider-patient relationship plays in promoting behavioral changes [28-30]. Text-based conversations are a convenient way for patients to maintain touchpoints with their providers to receive personalized feedback and encouragement if they start to experience weight regain or loss of motivation.

It is also worth noting that our study utilized anti-obesity medications when deemed appropriate based on a decision made together by a medical provider and patient. While medication use did not differ significantly between high and low achievers in the 18-month cohort, it is included in our discussion to highlight the importance of multimodal treatments in a disease as complex as obesity [31, 32]. This study has the benefit of reflecting real-life situations and true clinical experiences, a perspective that randomized controlled studies do not.

Our study is unique from comparable studies on mobile engagement for obesity intervention in that it measures four different types of mobile engagement interventions: self-monitoring, feedback, support, and educational content. These distinctions help guide the future of mobile health apps by providing intervention-specific data. It also corroborates with other findings that meaningful and lasting weight loss requires a comprehensive set of interventions instead of a singular approach. Our findings suggest that mobile health applications may be better suited to achieve sustained weight loss by designing features that facilitate provider-patient interactions on top of self-tracking technology.

This study is also one of few that examines what happens to mobile engagement, and associated weight loss, over a duration of 18-months. While some studies have found short-term weight loss success through mobile app engagement, few have been able to show sustained weight loss beyond 6-months.

One limitation of our study design is the retrospective nature which does not allow us to control certain variables. In particular, the coaching in the mobile App was provided by obesity trained registered dietitians, physician assistants, and doctors. Hence, this may not be comparable to mHealth interventions where coaches are not specialty trained. Clinical expertise may be confounding the impact attributed solely through mobile coaching.

This study has demonstrated how delivering a comprehensive behavioral, pharmacologic, and nutritional weight loss program via a mobile health can help improve sustained weight loss. This is achieved by designing features within a mobile application that facilitate and elevate provider-patient relationships in order to limit and prevent weight recidivism. This study has demonstrated that technology enabled multicomponent approaches can play a significant role in the obesity treatment.

References
1. Ward ZJ, Bleich SN, Cradock AL, Barrett JL, Giles CM, et al. 2019. Projected U.S. state-level prevalence of adult obesity and severe obesity. N Engl J Med 381(25): 2440-2450. https://doi.org/10.1056/nejmsa1909301
2. Preston SH, Vierboom YC, Stokes A. 2018. The role of obesity in exceptionally slow US mortality improvement. Proc Natl Acad Sci U S A 115(3): 957-961. https://doi.org/10.1073/pnas.1716802115
3. Dalle Grave R, Claudi S, Molinari E, Petroni ML, Bondi M, et al. 2005. Weight loss expectations in obese patients and treatment attrition: an observational multicenter study. Obes Res 13(11): 1961-1969. https://doi.org/10.1038/oby.2005.241
4. Moroshko I, Brennan L, O’Brien P. 2011. Predictors of dropout in weight loss interventions: systematic review of the literature. Obes Rev 12(11): 912-934. https://doi.org/10.1111/j.1467-789x.2011.00915.x
5. Pirrota S, Joham A, Hochberg L, Moran L, Lim S, et al. 2019. Strategies to reduce attrition in weight loss interventions: systematic review and meta-analysis. Obes Rev 20(10): 1400-1412. https://doi.org/10.1111/obr.12914
6. Allen JK, Stephens J, Dennison Himmelfarb CR, Stewart KJ, Hauck S. 2013. Randomized controlled pilot study testing use of smartphone technology for obesity treatment. J Obes 2013: 151597. https://doi.org/10.1155/2013/151597
7. Tate DF, Wing RR, Winett RA. 2001. Using internet technology to deliver a behavioral weight loss program. JAMA 285(9): 1172-1177. https://doi.org/10.1001/jama.285.9.1172
8. Wharton CM, Johnston CS, Cunningham BK, Sterner D. 2014. Dietary self-monitoring, but not dietary quality, improves with use of smartphone app technology in an 8-week weight loss trial. J Nutr Educ Behav 46(5): 440-444. https://doi.org/10.1016/j.jneb.2014.04.291
9. Patel ML, Hopkins CM, Brooks TL, Bennett GG. 2019. Comparing self-monitoring strategies for weight loss in a smartphone app: randomized controlled trial. JMIR Mhealth Uhealth 7(2): e12209. https://doi.org/10.2196/12209
10. Nikolau CK, Lean ME. 2017. Mobile applications for obesity and weight management: current market characteristics. Int J Obes (Lond) 41(1): 200-202. https://doi.org/10.1038/jibo.2016.186
11. Park SH, Hwang J, Choi YK. 2019. Effect of mobile health on obese adults: asymptomatic review and meta-analysis. Health Inform Res 25(1): 12-26. https://doi.org/10.4258/hir.2019.25.1.12
12. Bacigalupo R, Cudd P, Littlewood C, Bissell P, Hawley MS, et al. 2013. Interventions employing mobile technology for overweight and obesity: an early systematic review of randomized controlled trials. Obes Rev 14(4): 279-291. https://doi.org/10.1111/obr.12006
13. Laing BY, Mangione CM, Tieng CH, Leng M, Vaisberg E, et al. 2014. Effectiveness of a smartphone application for weight loss compared with usual care in overweight primary care patients: randomized, controlled trial. Ann Intern Med 161(10 Suppl): S5-S12. https://doi.org/10.7326/m13-3005
14. Beleigoli AM, Andrade AQ, Cançado AG, Paulo MN, Diniz MFH. 2019. Web-based digital health interventions for weight loss and lifestyle habit changes in overweight and obese adults: systematic review and meta-analysis. J Med Internet Res 21(1): e298. https://doi.org/10.2196/jmir.9609
15. Khokhar B, Jones J, Ronksley PE, Armstrong MJ, Caird J, et al. 2014. Effectiveness of mobile electronic devices in weight loss among overweight and obese populations: asymptomatic review and meta-analysis. BMC Obes 1: 22. https://doi.org/10.1186/s40608-014-0022-4
16. Chin SO, Keum C, Woo J, Park J, Choi HJ, et al. 2016. Successful
weight reduction and maintenance by using a smartphone application in those with overweight and obesity. Sci Rep 6: 34563. https://doi.org/10.1038/srep34563

17. Ferrara G, Kim J, Lin S, Hua J, Seto E. 2019. A focused review of smartphone diet-tracking apps: usability, functionality, coherence with behavior change theory, and comparative validity of nutrient intake and energy estimates. JMIR Mhealth Uhealth 7(5): e9232. https://doi.org/10.2196/nh.9232

18. Kankanhalli A, Shin J, Oh H. 2019. Mobile-based interventions for dietary behavior change and health outcomes: scoping review. JMIR Mhealth Uhealth 7(1): e11312. https://doi.org/10.2196/11312

19. Bardus M, van Beurden SB, Smith JR, Abraham C. 2016. A review and content analysis of engagement, functionality, aesthetics, information quality, and change techniques in the most popular commercial apps for weight management. Int J Behav Nutr Phys Act 13: 35. https://doi.org/10.1186/s12966-016-0359-9

20. Painter S, Ditsch G, Ahmed R, Hanson NB, Kachin K, et al. 2016. Retrofit weight-loss outcomes at 6, 12, and 24 months and characteristics of 12-month high performers: a retrospective analysis. JMIR Mhealth Uhealth 4(3): e101. https://doi.org/10.2196/mhealth.5873

21. Harvey J, Krukowski R, Priest J, West D. 2019. Log often, lose more: electronic dietary self-monitoring for weight loss. Obesity (Silver Spring) 27(3): 380-384. https://doi.org/10.1002/oby.22382

22. Peterson ND, Middleton KR, Nackers LM, Medina KE, Milsom VA, et al. 2014. Dietary self-monitoring and long-term success with weight management. Obesity (Silver Spring) 22(9): 1962-1967. https://doi.org/10.1002/oby.20807

23. Rose SA, Poynert PS, Anderson JW, Noar SM, Conigliaro J. 2013. Physician weight loss advice and patient weight loss behavior change: a literature review and meta-analysis of survey data. Int J Obes (Lond) 37(1): 118-128. https://doi.org/10.1038/ijo.2012.24

24. McVay M, Steinberg D, Askew S, Bennett GG. 2019. Provider counseling and weight loss outcomes in a primary care-based digital obesity treatment. J Gen Intern Med 34(6): 992-998. https://doi.org/10.1007/s11606-019-04944-5

25. Sciamanna CN, Kiernan M, Rolls BJ, Boan J, Stuckey H et al. 2011. Practices associated with weight loss versus weight-loss maintenance: results of anational survey. Am J Prev Med 41(2): 159-166. https://doi.org/10.1016/j.amepre.2011.04.009

26. Nakade M, Aiba N, Morita A, Miyachi M, Sasaki S, et al. 2012. What behaviors are important for successful weight maintenance? J Obes 2012: 202037. https://doi.org/10.1155/2012/202037

27. Byrne S, Cooper Z, Fairburn C. 2003. Weight maintenance and relapse in obesity: aqualitative study. Int J Obes Relat Metab Disord 27(8): 955-962. https://doi.org/10.1038/sj.iobr.7801205

28. Mayor S. 2016. GP referral to weight loss programme is quick and effective, finds study. BMJ 355: i5727. https://doi.org/10.1136/bmj.i5727

29. Jordan K. 2019. A provider-patient relationship: the critical first step of smoking cessation. J Gen Intern Med 35(1): 10-11. https://doi.org/10.1007/s11606-019-05276-0

30. Kahan SI. 2018. Practical strategies for engaging individuals with obesity in primary care. Mayo Clin Proc 93(3): 351-359. https://doi.org/10.1016/j.mayocp.2018.01.006

31. Taylor J. 2020. Looking beyond lifestyle: acomprehensive approach to the treatment of obesity in the primary care setting. JNP-J Nurse Pract 16(1): 74-78. https://doi.org/10.1016/j.npr.2019.09.021

32. Lavie CJ, Laddu D, Arena R, Ortega FB, Alpert MA, et al. 2018. Healthy weight and obesity prevention: JACC health promotion series. J Am Coll Cardiol 72(13): 1506-1531. https://doi.org/10.1016/j.jacc.2018.08.1037