Swiss Francs Seem to Make Insured Move: Comparing Daily and Monthly Financial Incentives of a Scalable Digital Health Intervention

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Abstract: Despite the widely known necessity to counteract the increase in physical inactivity, only small strides have been achieved so far. Digital health interventions (DHIs) are proposed to reach both healthy and at-risk populations on a large scale. However, designing scalable DHIs that are engaging in the long term remains a challenge. Small financial incentives may help to achieve such long-lasting behaviour changes. This work thusly investigates the effects of daily or monthly paid small financial incentives on step counts and goal achievements in physical activity. Six-month observational field data of a physical activity DHI (PADHI), offered by a Swiss health insurer, was used for this investigation. From 1623 contacted customers, 742 (45.7%) joined the PADHI. Step counts and times the challenging goal was reached were significantly higher in the condition of daily paid incentives. The findings from objectively measure daily step counts and goal achievements indicate better outcomes when incentives are paid daily. Further findings indicate the importance of recording various physical activities and not only step counts.

1 INTRODUCTION

Despite various attempts and approaches, physical inactivity remains an immense problem as a health risk factor. At least 20% of the world's population is insufficiently active and doesn't meet the recommended 150 minutes of moderate-intensity or 75 minutes of vigorous-intensity aerobic physical activity (PA) per week (Sallis et al., 2016). Findings from further studies underline the necessity to promote PA. These findings show that PA decreases the risk of mortality (Lear et al., 2017), the risk of noncommunicable diseases such as diabetes, cancer or coronary heart diseases (Kyu et al., 2016; Lee et al., 2012,), and the cox hazard ratio of cardiovascular events and fractures (Harris et al., 2019). Western societies are increasingly becoming older. One problem of this demographic change is that older people tend to suffer longer and more frequently from sicknesses and chronic diseases. Therefore, a cost increase in healthcare is imminent making affordable and scalable changes in healthcare inevitable.

One frequently discussed solution is the use of digital health interventions (DHI) delivered via smartphones, wearable devices, or websites (Kowatsch, Otto, Harperink, Cotti, & Schlieter, 2019). They inform individuals about their current health condition and are capable of delivering personalized interventions to the masses at low costs (Steinhubl, Muse, & Topol, 2015; Troiano et al., 2008).

However, reaching vulnerable individuals that would most benefit from DHIs remains a key challenge. This selection bias is even higher when participation is voluntary and not "prescribed" by a doctor (Chinn, White, Howel, Harland, & Drinkwater, 2006). Furthermore, the maintenance of these behaviour adjustments for a substantial amount of time poses a difficult challenge (Finkelstein et al., 2016).

A promising approach to attract and maintain participation in DHIs is the use of financial

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incentives. Studies using relatively large incentive values of an average maximum amount of $ 20.75 per week seem to effectively change the amount of PA (Strohacker, Galarraga, & Williams, 2014). These relatively high incentives improved different objective measures of PA (Barte & Wendel-Vos, 2017), the number of times PA exercises attended (Barte & Wendel-Vos, 2017; Mitchell et al., 2013; Strohacker et al., 2014), and exercise behaviour (Mitchell et al., 2013).

Unfortunately, different studies show that after withdrawing incentives, the PA changes typically do not sustain and therefore need to be paid over a long time (Finkelstein et al., 2016; Harkins, Kullgren, Bellamy, Karlawish, & Glanz, 2017; Patel, Asch, Rosin, Small, Bellamy, Eberbach, et al., 2016; Patel, Asch, Rosin, Small, Bellamy, Heuer, et al., 2016; Patel et al., 2018). To provide these necessary financial incentives on a large scale and for a long time, a crucial feature would be to keep them relatively small (Kramer, Tinschert, Scholz, Fleisch, & Kowatsch, 2019). Relatively small financial incentives having a significant impact on PA were around $1 per day (Patel, Asch, Rosin, Small, Bellamy, Heuer, et al., 2016; Shin et al., 2017; Strohacker et al., 2015). In a cluster-randomized trial study, small personal or charity financial incentives (monthly payment between CHF 5.00 to 10.00) led to an increase of PA (Kramer et al., 2019). Surprisingly, participation and reached step goals declined even while the study was running and incentives not yet withdrawn. The authors argue that incentives may need to be modified to counter this decline in participation and achieve lasting changes in behaviour. Accordingly, prior studies (Barte & Wendel-Vos, 2017; Strohacker et al., 2014) showed relatively stable effects as long as the participants received financial incentives.

Against this background, this study aims to propose and discuss different incentives schemes for physical activity digital health interventions (PADHIs). The research question of this study is whether a small daily paid incentive or a small monthly paid incentive leads to an improvement in daily steps, daily step goal achievements, and a attrition rate reduction.

The next section describes the characteristics of the study population and the evaluated PADHI. We then describe the methods of data analysis to answer the research question. Afterwards, results of the six-month observational field study are presented and discussed. A summary concludes this paper.

2 METHOD

We cooperated with a large Swiss health insurer to answer the research question. The insurer started to offer a PADHI to their customers in 2015 (Kramer et al., 2019). In the last quarter of 2018, an average of 10.530 (SD = 5547) daily steps were achieved by 13799 customers. Compared to all other self-service health promotion interventions of the insurance this PADHI has the most continuous users. Data for the 6-month study of the current paper was collected from a subset of these customers between April 1st and September 30th 2016.

Participants, that already participated in a previous study by Kramer et al. (2019) were invited by e-mail. Participants were required to be at least 18 years old, enrolled in the complimentary insurance program (see Section 2.2 below), and had to accept the terms of participation and privacy policy. Furthermore, they had to confirm that they were not under any medical treatment that forbid PA. Although no eligibility criteria were defined on the canton (federal state of Switzerland) state-level, all participants that provided demographic information resided in a German-speaking canton. In the invitation text, a brief description of the initiative and a link to the insurer's platform with more detailed information was provided. On the linked platform the participants signed up and were asked to complete a survey to collect demographic data such as gender, age, and level of activity. In total 1632 individuals that already participated in a previous study by Kramer et al. (2019) were contacted for recruitment.

The institutional review board of the University of St. Gallen, Switzerland, approved the study (HSG-EC-2016-06-13-A).

2.1 Incentive Schemes

Participants received financial incentives if they reached specific daily step goals. For the first three months, participants received a monthly payment if they reached the daily step goal averaged over the entire month. They received CHF 10.00 if the average daily step of the month was above 10000 steps or received CHF 5.00 if they achieved at least 7500 steps per day but didn't reach the goal of 10000 steps per day. Participants with an average daily step count below 7500 didn't receive any financial incentive.

After three months the incentive scheme was changed. The participants received daily payments for three months if they reached the same goals as defined above. Participants reaching at least 10000 steps per day received a payment of CHF 0.40 on that day. Participants reaching 7500 steps per day but not 10000 steps per day received CHF 0.20 on that day. Table 1 shows the paid financial incentives by the goal that was achieved and the incentive scheme. Due to these different financial schemes for the first and last three months, all participants could earn a total amount between CHF 33.00 and CHF 66.00 depending on their performance within each of the parts.

Table 1: Incentive mechanisms of the evaluated PADHI.

Averaged Daily Steps	Monthly Payment (Apr-Jun)	Daily Payment (Jul-Sep)
< 7500	CHF 0.00	CHF 0.00
7500 – 10000	CHF 5.00	CHF 0.20
> 10000	CHF 10.00	CHF 0.40

For two weeks after the first three months, no financial incentive was paid. This break arose due to a technical problem by switching from monthly to daily payments, leading to no steps being recorded within those two weeks. Unfortunately, this break resulted in different amounts of data points for further analysis. To address this, only the first 76 days within every three months of the study were used for further analysis.

2.2 Study Sample

Due to legal reasons, the PADHI could not be part of the statutory health insurance program. It could only be offered to insureds with a complimentary insurance plan. It is important to take into consideration, that 75% of the Swiss population is enrolled in such an insurance plan (Eisler & Lüber, 2016).

2.3 Measures and Statistical Analysis

Participants recorded their daily steps via commercial pedometers offered by Garmin, Jawbone, or Fitbit, or a specific smartphone app by Fitbit. The app option was offered because buying a compatible pedometer, although at a reimbursed price, was the most cited reason for non-participation (41%) of participants that did not want to participate in a prior study by Kramer et al. (2019). Demographic data were in addition to the data from the pedometer measured via a self-report questionnaire.

From the provided data the average daily step count, the number of days the app was used, the last day the app was used, and the dropout rate were calculated. Depended two-tailed t-tests with and α-level of 0.05 to compare the average daily step count, and the number of days the 10000 or 7500 goal was reached within each of the different financial incentive scheme were used for statistical analysis.

For the initial description and some analyses, all participants, that used the app at least once and had an average step count that did not exceed four standard deviations from the mean, were included. Average step counts exceeding four standard deviations from the mean were considered a technical fault or personal manipulation. For further analyses, participants not providing data for at least 150 days of the study were excluded. This is corresponding to non-participation of more than one month. Participants were marked as a dropout if they provided no data for at least one week and did not provide any further data afterwards at any point until the end of the study. These dropouts were still included in the analysis as they provided at least 150 days of data, which can be considered to be sufficient in the remaining window of time (Guertler, Vandelanotte, Kirwan, & Duncan, 2015).

The effect of the two different incentive schemes on the number of goals achieved was calculated by a four-field Chi-Square Test, with an α-level of 0.05.

3 RESULTS

From initially 1632 contacted insurance members 742 (45.5%) signed up and provided at least one day of data. Of these only one participant exceeded the mean number of steps by four standard deviations, leaving 741 (45.4%) participants that met this criterion. Data for at least 150 days was provided by 392 (24.0%) participants. Table 2 compares the number of participants and the dropout rate for all participants and those providing at least 150 days of data. Except the initial attrition considering the number of people that were contacted, the dropout rate within the study was 174 (23.5%) for the participants that used the app at least once and 10 (2.6%) for the participants that provided at least 150 days of data. Figure 1 shows the attrition rate for all participants of the study and the attrition rate for all participants of the study by gender and age groups.

The following descriptions are for the 392 participants included in the analysis. Demographic data was provided by 371 (94.6%) participants, 207 (55.8%) being males. The mean age was 46.4 (SD = 13.8) ranging from 21 to 92 years. An overview of the analysed measures and their distribution are reported in Figures 2 for averaged daily steps and Figure 3 for reached goals within each financial incentive scheme.

Table 2: Number (#) and attrition of participants.

	Used DHI at least once	Used DHI at least 150 days
# participants at start	741 (54.5%)	392 (76%)
# participants after three months	631 (14.8%)	392 (0%)
# participants after incentive change	623 (15.9%)	392 (0%)
# participants after six months (end of study)	567 (23.5%)	382 (2.6%)

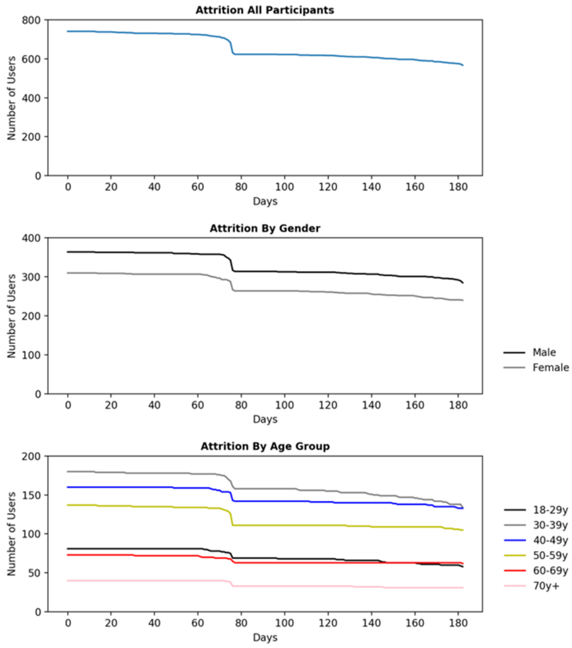

Figure 1: Attrition for all participants that used the PADHI and attrition for all participants that used the DHI by gender or age.

There was a highly significant increase of average daily step data from the monthly incentive payments (M = 11552.8, SD = 2962.6) to the daily incentive payments (M = 11971.9, SD = 3047.1), $t(391) = 4.85$, $p < .001$. A significant increase from the average days per week the 10000-step goals reached from the monthly incentive payment (M = 4.1, SD = 1.8) to the daily incentive payments (M = 4.6, SD = 1.8) was observed, $t(391) = 7.48$, $p < .001$. The average number of days per week the 7500-step goal was reached significantly decreased from the monthly incentive payments (M = 1.2, SD = 0.8) to the daily incentive payments (M = 1.0, SD = 0.8), $t(391) = 5.27$, $p < .001$.

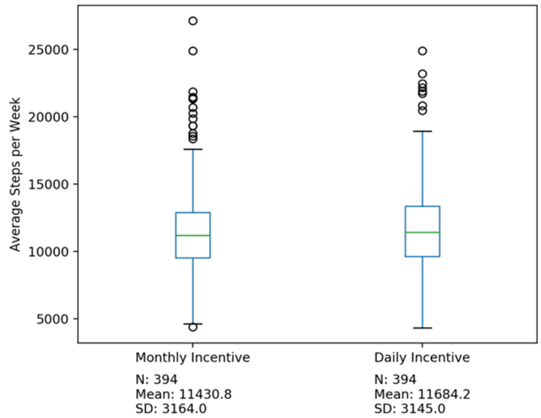

Figure 2: Distribution of weekly averaged steps counts by financial incentive scheme.

The number of days the 10000 daily step goal was reached significantly differed by which incentive scheme was used, X^2 (1, N = 50270) = 167.9, $p < .01$. The daily incentive scheme displays more days the more challenging goal was reached (19739 number of days for daily incentives vs 17973 for monthly incentives). The number of days the 7500 daily step goal was reached did not significantly differ by which incentive scheme was used, X^2 (1, N = 21863) = 0.8, $p = .39$. Figure 4 illustrates the number of days the different goals were reached and the days the goals were not reached.

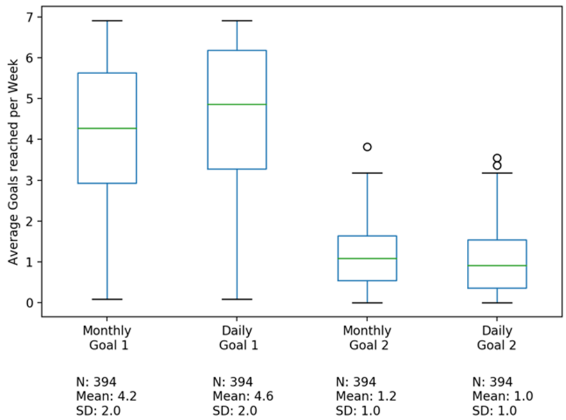

Figure 3: Distribution of Weekly Averaged Reached Goals by the financial incentive scheme (Goal 1 = 10000 daily steps reached, Goal 2 = 7500 daily steps reached).

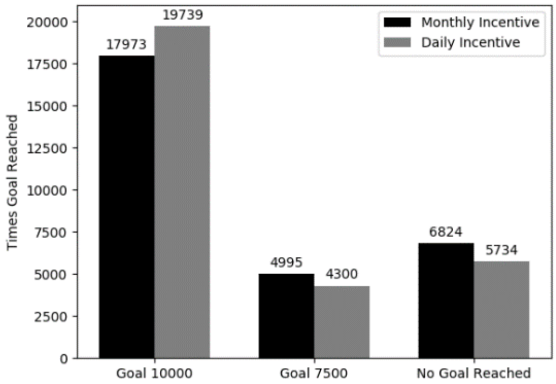

Figure 4: Times the 10000 daily step goal, the 7500 daily step goal, or no goal was reached by the incentive scheme.

4 DISCUSSION

This study investigates the effect of different financial incentive schemes (monthly vs. daily payments) on attrition, PA (measured by the number of steps), and goal achievements of a large scale PADHI.

The percentage of people responding to the initial recruitment was fairly good (45.5%). It is important to take into consideration that participants were recruited from a previous study investigating the effect of DHIs. The number of participants that provided sufficient data (at least 150 days of data) to be analysed is in contrast low. Only 14% of the initially contacted 1623 participants met this criterion.

In contrast, within the 6-months of the study, the attrition rate was very low compared to the prior work by Kramer et al. (2019). Interestingly the two weeks of no financial activity had almost no drop-out effect. The attrition rate of the group that provided at least 150 days of data was only 2.6%. This finding could be important for future work as it shows that frequent users once engaged seem to consistently interact with the DHI regardless of a break in the payment of the financial incentive.

The results from analysing the average daily steps made, the average number of times the more challenging 10000 steps goal was reached per week, and the total number of days the more challenging 10000 steps goal was reached seem to favour the daily paid incentive. Only the average number of days per week the less challenging 7500 steps goal was reached seems to favour the monthly paid incentives. The analysis revealed no significant difference for the total amount of days the less challenging 7500 steps goal was achieved. Due to the fact, that the number of days the 10000 daily step goal was reached, was higher over both financial incentive schemes it seems that participants either aim high and in turn achieve the higher goal or do not try to reach a goal and in turn do not achieve any goal at all. For further research, it could be interesting to investigate whether providing only one goal has a positive effect due to the reduction of the complexity or if more but very challenging goals have a positive influence on PA and continuous participation. Both approaches could be supported by the theory of implementation intentions (Gollwitzer, 1999) stating that goals should be specific and challenging. Taken this tendency to reach the higher goal and the average steps made per week into account the results suggest that a daily financial incentive seems to have a positive effect on the number of steps for every day.

The findings of the current work are limited in several ways. First, it can be assumed that the contacted individuals are already relatively active due to the fact, that they participated in an earlier study that investigated the use of DHI as well and that voluntary PA initiatives, in general, tend to attract people that are already sufficiently active and show health-supportive behaviour.

Second, the findings of the current work may be country or at least region-specific. It is, therefore, possible that other countries are less or more open to the use of tracking devices and digital coaching applications.

Finally, causal inferences cannot be drawn from the current study due to the nature of the observational study design. Therefore, the results are limited in their generalizability. They rather give interesting insights into possible future studies investigating the differences between monthly and daily financial incentive schemes that have the goal to increase physical.

5 SUMMARY

Relatively small daily paid financial incentives (CH 0.20 – 0.40) seem to lead to higher daily steps counts compared to relatively small monthly paid financial incentives (CH 5.00 – 10.00). Participants seemed to aim for the higher goal or not bother to reach any goal at all on that specific day. Future work should investigate the importance of setting clear but ambitious goals and financial incentives to further promote PA.

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REFERENCES

Barte, J. C. M., & Wendel-Vos, G. C. W. (2017). A Systematic Review of Financial Incentives for Physical Activity: The Effects on Physical Activity and Related Outcomes. *Behavioral Medicine, 43*(2), 79-90. doi:10.1080/08964289.2015.1074880

Chinn, D. J., White, M., Howel, D., Harland, J. O. E., & Drinkwater, C. K. (2006). Factors associated with non-participation in a physical activity promotion trial. *Public Health, 120*(4), 309-319. doi:10.1016/j.puhe. 2005.11.003

Eisler, R., & Lüber, A. (2016). Wie wichtig ist den schweizern eine spitalzusatz- versicherung? . Retrieved from www.comparis.ch/»/media/files/medien-corner/ studies/2006/krankenkassen/spitalzusatzversicherungen_studie.pdf.

Finkelstein, E. A., Haaland, B. A., Bilger, M., Sahasranaman, A., Sloan, R. A., Nang, E. E. K., & Evenson, K. R. (2016). Effectiveness of activity trackers with and without incentives to increase physical activity (TRIPPA): a randomised controlled trial. *The Lancet Diabetes & Endocrinology, 4*(12), 983-995. doi:10.1016/S2213-8587(16)30284-4

Gollwitzer, P. M. (1999). Implementation intentions: strong effects of simple plans. *American psychologist, 54*(7), 493.

Guertler, D., Vandelanotte, C., Kirwan, M., & Duncan, M. J. (2015). Engagement and Nonusage Attrition With a Free Physical Activity Promotion Program: The Case of 10,000 Steps Australia. *Journal of Medical Internet Research, 17*(7), e176. doi:10.2196/jmir.4339

Harkins, K. A., Kullgren, J. T., Bellamy, S. L., Karlawish, J., & Glanz, K. (2017). A Trial of Financial and Social Incentives to Increase Older Adults' Walking. *American Journal of Preventive Medicine, 52*(5), e123-e130. doi:10.1016/j.amepre.2016.11.011

Harris, T., Limb, E. S., Hosking, F., Carey, I., Dewilde, S., Furness, C., Cook, D. G. (2019). Effect of pedometer-based walking interventions on long-term health outcomes: Prospective 4-year follow-up of two randomised controlled trials using routine primary care data. *PLOS Medicine, 16*(6), e1002836. doi:10.1371/journal.pmed.1002836

Kowatsch, T., Otto, L., Harperink, S., Cotti, A., & Schlieter, H. (2019). A design and evaluation framework for digital health interventions. *it - Information Technology, 61*(5-6), 253-263. doi:10.1515/itit-2019-0019

Kramer, J. N., Tinschert, P., Scholz, U., Fleisch, E., & Kowatsch, T. (2019). A Cluster-Randomized Trial on Small Incentives to Promote Physical Activity. *Am J Prev Med, 56*(2), e45-e54. doi:10.1016/j.amepre. 2018.09.018

Kyu, H. H., Bachman, V. F., Alexander, L. T., Mumford, J. E., Afshin, A., Estep, K., Forouzanfar, M. H. (2016). Physical activity and risk of breast cancer, colon cancer, diabetes, ischemic heart disease, and ischemic stroke events: systematic review and dose-response meta-analysis for the Global Burden of Disease Study 2013. *BMJ*, i3857. doi:10.1136/bmj.i3857

Lear, S. A., Hu, W., Rangarajan, S., Gasevic, D., Leong, D., Iqbal, R., Yusuf, S. (2017). The effect of physical activity on mortality and cardiovascular disease in 130 000 people from 17 high-income, middle-income, and low-income countries: the PURE study. *The Lancet, 390*(10113), 2643-2654. doi:10.1016/s0140-6736(17)31634-3

Lee, I. M., Shiroma, E. J., Lobelo, F., Puska, P., Blair, S. N., & Katzmarzyk, P. T. (2012). Effect of physical inactivity on major non-communicable diseases worldwide: an analysis of burden of disease and life expectancy. *The Lancet, 380*(9838), 219-229. doi:10.1016/s0140-6736(12)61031-9

Mitchell, M. S., Goodman, J. M., Alter, D. A., John, L. K., Oh, P. I., Pakosh, M. T., & Faulkner, G. E. (2013). Financial Incentives for Exercise Adherence in Adults. *American Journal of Preventive Medicine, 45*(5), 658-667. doi:10.1016/j.amepre.2013.06.017

Patel, M. S., Asch, D. A., Rosin, R., Small, D. S., Bellamy, S. L., Eberbach, K., Volpp, K. G. (2016). Individual Versus Team-Based Financial Incentives to Increase Physical Activity: A Randomized, Controlled Trial. *Journal of General Internal Medicine, 31*(7), 746-754. doi:10.1007/s11606-016-3627-0

Patel, M. S., Asch, D. A., Rosin, R., Small, D. S., Bellamy, S. L., Heuer, J., Volpp, K. G. (2016). Framing Financial Incentives to Increase Physical Activity Among Overweight and Obese Adults: A Randomized, Controlled Trial. *Annals of Internal Medicine, 164*(6), 385-394. doi:10.7326/m15-1635

Patel, M. S., Volpp, K. G., Rosin, R., Bellamy, S. L., Small, D. S., Heuer, J., Asch, D. A. (2018). A Randomized, Controlled Trial of Lottery-Based Financial Incentives to Increase Physical Activity Among Overweight and Obese Adults. *American Journal of Health Promotion, 32*(7), 1568-1575. doi:10.1177/0890117118758932

Sallis, J. F., Bull, F., Guthold, R., Heath, G. W., Inoue, S., Kelly, P., Hallal, P. C. (2016). Progress in physical activity over the Olympic quadrennium. *The Lancet, 388*(10051), 1325-1336. doi:10.1016/s0140-6736(16) 30581-5

Shin, D. W., Yun, J. M., Shin, J.-H., Kwon, H., Min, H. Y., Joh, H.-K., Cho, B. (2017). Enhancing physical activity and reducing obesity through smartcare and financial incentives: A pilot randomized trial. *Obesity, 25*(2), 302-310. doi:10.1002/oby.21731

Steinhubl, S. R., Muse, E. D., & Topol, E. J. (2015). The emerging field of mobile health. *Science Translational Medicine, 7*(283), 283rv283-283rv283. doi:10.1126/ scitranslmed.aaa3487

Strohacker, K., Galárraga, O., Emerson, J., Fricchione, S., Lohse, M., & Williams, D. (2015). Impact of Small Monetary Incentives on Exercise in University Students. *American Journal of Health Behavior, 39*. doi:10.5993/AJHB.39.6.5

Strohacker, K., Galarraga, O., & Williams, D. M. (2014). The Impact of Incentives on Exercise Behavior: A Systematic Review of Randomized Controlled Trials. *Annals of Behavioral Medicine, 48*(1), 92-99. doi:10.1007/s12160-013-9577-4

Troiano, R. P., Berrigan, D., Dodd, K. W., Masse, L. C., Tilert, T., & McDowell, M. (2008). Physical activity in the United States measured by accelerometer. *Med Sci Sports Exerc, 40*(1), 181-188. doi:10.1249/mss.0b013e31815a51b3