

Ecological momentary assessment for smoking cessation: abridged secondary publication

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KEY MESSAGE

Among smokers with no intention to use smoking cessation aids, ecological momentary assessment (EMA), followed by nurse-led phone counselling and text messaging, was effective in increasing tobacco abstinence and smokers' readiness and preparation for quitting, relative to no intervention after EMA completion.

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Introduction

Smoking is the leading modifiable risk factor for premature death.¹ Behavioural and pharmacological interventions can double the chance of successful smoking cessation.² However, unassisted quitting remains widely used.³ In 2017, among Hong Kong smokers, 81.2% were aware of free smoking cessation services; however, only 2.6% and 4.0% had ever used and intended to use these services, respectively.⁴

Ecological momentary assessment (EMA) is self-administered documentation of behaviours, cognitions, and events. It can reduce bias in reporting negative behaviours, while facilitating analysis of temporal and causal relationships between event exposures and smoking-related outcomes.⁵ EMA can be used to monitor smoking characteristics and customise cessation treatment. Smokers who are not ready to quit might not proactively seek smoking cessation aids. They may be more interested in monitoring their smoking behaviours and receiving personalised quitting support. This study aimed to evaluate the efficacy of an EMA-based smoking cessation intervention.

Methods

This two-arm, open-labelled, randomised controlled trial was conducted between March 2022 and January 2023. Individuals were eligible if they were aged ≥ 18 years, had smoked daily in the preceding 7 days—verified by exhaled carbon monoxide (≥ 4 parts per million) or salivary cotinine (≥ 30 ng/mL), had no intention to use smoking cessation services or medications in the coming month, and had not used any such services or medications in the preceding 7 days. Individuals who were pregnant or diagnosed with mental illness were excluded.

Participants were instructed to document their

smoking triggers (withdrawal, emotional, social, and habitual), smoking behaviours (smoking, nicotine craving, and tobacco product purchasing), and daily cigarette consumption five times (at 3-hour intervals) per day during waking hours for 1 week using the Smoking Radar App. Subsequently, participants were randomly assigned to receive no intervention or personalised smoking cessation intervention (including nurse-led phone counselling and 10-week customised messages via instant messaging applications) guided by the EMA information. In total, 31 text messages were sent on a tapering schedule, from eight in the first week to one in the tenth week. Core messages included a summary of the 1-week EMA, the harmful effects of smoking, the benefits of quitting, methods to cope with nicotine withdrawal symptoms, and the quit plan. Additional messages addressing coping strategies for personal smoking triggers were also provided.

At the 3-month follow-up, participants were assessed for behavioural progression toward smoking cessation using the Incremental Behaviour Change Toward Smoking Cessation (IBC-S) [scores range from 0 to 24; higher scores indicate more readiness and preparation in quitting], tobacco abstinence in the past 7 days according to exhaled carbon monoxide (< 4 parts per million) or salivary cotinine (< 30 ng/mL), and self-reported use of smoking cessation services or medications. EMA compliance and satisfaction with the intervention were also assessed. Satisfaction was rated on a scale ranging from 0 (very dissatisfied) to 4 (very satisfied).

An intention-to-treat analysis was performed by assuming that non-respondents at the 3-month follow-up were smokers. Logistic and linear regression analyses were conducted to assess the effect of the personalised intervention on IBC-S scores.

Results

Of 1461 individuals screened, 1179 were eligible; 459 of them (mean age, 36.7±10.7 years; 33.8% women) were randomly assigned to the intervention (n=231) or control (n=228) group. The retention rate was 89.8% at the 3-month follow-up and did not significantly differ between groups. The two groups were comparable, except that the intervention group had higher scores for perceived importance of quitting and perceived confidence in quitting (Table 1).

At the 3-month follow-up, the intervention group had a higher tobacco abstinence rate (odds ratio [OR]=2.46, P=0.04), higher IBC-S scores (unstandardised B=0.84, P<0.01), greater use of smoking cessation services (OR=7.72, P<0.001), and greater use of smoking cessation medications (OR=5.83, P<0.001) [Table 2].

EMA compliance rates were 73.9% in the intervention group and 76.7% in the control group. Only 10 participants did not complete the 1-week EMA. Satisfaction scores were 2.9 for phone counselling and 2.8 for the 10-week text messaging programme (Table 3).

Discussion

At the 3-month follow-up, the EMA-based personalised intervention doubled the tobacco abstinence rate and increased smokers' readiness and preparation for quitting. The intervention also increased the use of smoking cessation services and medications, with a larger effect size. EMA was used to profile smoking characteristics, including tobacco consumption level, readiness to quit, withdrawal symptoms, tobacco purchasing, and smoking triggers. Guided by the EMA information, the intervention provided a more personalised quit plan to address specific smoking triggers; it also increased smokers' preparation to quit and acceptance of smoking cessation aids, while promoting subsequent initiation of abstinence.

This study has some limitations. Smokers with no intention to use smoking cessation services or medications were targeted; implementation of

TABLE 1. Characteristics of participants.

| Characteristic | Intervention (n=231)* | Control (n=228)* |
|-------------------------------------------------------------|-----------------------|------------------|
| Age, y | 36.0±10.5 | 37.4±10.9 |
| Sex | | |
| Male | 147 (63.6) | 157 (68.9) |
| Female | 84 (36.4) | 71 (31.1) |
| Education level | | |
| Primary or below | 3 (1.3) | 1 (0.5) |
| Secondary | 108 (46.7) | 107 (46.9) |
| Post-secondary | 120 (52.0) | 120 (52.6) |
| Monthly household income, HK\$ | n=229 | n=227 |
| <30 000 | 113 (49.3) | 119 (52.4) |
| 30 000-59 999 | 85 (37.1) | 79 (34.8) |
| ≥60 000 | 31 (13.5) | 29 (12.8) |
| No. of cigarettes per day | n=214 | n=206 |
| 1-10 | 104 (48.6) | 91 (44.2) |
| 11-20 | 82 (38.3) | 86 (41.7) |
| 21-30 | 19 (8.9) | 16 (7.8) |
| ≥31 | 9 (4.2) | 13 (6.3) |
| Nicotine dependence level, Heaviness of Smoking Index | | |
| Low, 0-2 | 100 (43.3) | 106 (46.5) |
| Moderate, 3-4 | 107 (46.3) | 107 (46.9) |
| High, 5-6 | 24 (10.4) | 15 (6.6) |
| Readiness to quit | n=230 | |
| Within 30 days | 35 (15.2) | 28 (12.3) |
| Within 6 months | 29 (12.6) | 29 (12.7) |
| Over 6 months, not decided yet, or no | 166 (72.2) | 171 (75.0) |
| Incremental Behaviour Change Toward Smoking Cessation score | 6.1±3.2 | 6.0±3.1 |
| Previous quit attempts | n=230 | |
| No | 78 (33.9) | 89 (39.0) |
| Yes | 152 (66.1) | 139 (61.0) |
| Self-efficacy | | |
| Perceived importance of quitting | 6.0±3.0 | 5.4±3.1 |
| Perceived difficulty of quitting | 7.2±2.7 | 7.1±2.8 |
| Perceived confidence in quitting | 4.9±2.4 | 4.4±2.7 |

* Data are presented as mean±standard deviation or No. (%) of participants.

TABLE 2. Outcomes at the 3-month follow-up.

| Outcome | Intervention (n=231)* | Control (n=228)* | Crude odds ratio / unstandardised B (95% confidence interval) | P value |
|-------------------------------------------------------------|-----------------------|------------------|---------------------------------------------------------------|---------|
| Biochemically validated tobacco abstinence | 19 (8.2) | 8 (3.5) | 2.46 (1.06-5.75) | 0.04 |
| Incremental Behaviour Change Toward Smoking Cessation score | 8.4±3.2 | 7.6±2.7 | 0.84 (0.30-1.38) | <0.01 |
| Use of smoking cessation services | 28 (12.1) | 4 (1.8) | 7.72 (2.62-22.40) | <0.001 |
| Use of smoking cessation medication | 36 (15.6) | 7 (3.1) | 5.83 (2.54-13.40) | <0.001 |

* Data are presented as mean±standard deviation or No. (%) of participants.

TABLE 3. Compliance and satisfaction with ecological momentary assessment–based smoking cessation intervention.

| Outcome | Intervention | Control | P value |
|---------------------------------|--------------|-----------|---------|
| Compliance rate, % | 73.9±23.8 | 76.7±21.8 | 0.19 |
| Satisfaction | | | |
| Brief phone counselling (n=156) | 2.9±0.6 | - | - |
| 10-week text messaging (n=190) | 2.8±0.6 | - | - |

an EMA-based intervention for smokers who are already using smoking cessation services may not yield the same effect size. Additionally, the individual effects of EMA, brief phone counselling, and text messaging could not be disentangled. Future trials assessing the additive and interactive effects of the individual components are warranted. Only 3.1% of participants were aged ≥ 60 years, which is lower than the 8.1% among Hong Kong smokers, probably due to lower rates of smartphone use among older smokers.

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Disclosure

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- Zhang MJ, He WJA, Luk TT, Wang MP, Chan SSC, Cheung YTD. Effectiveness of personalized smoking cessation intervention based on ecological momentary assessment for smokers who prefer unaided quitting: protocol for a randomized controlled trial. *Front Public Health* 2023;11:1147096.

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